A STUDY OF INCLUSIVE EDUCATION AND ITS EFFECTS ON THE TEACHING OF BIOLOGY TO VISUALLY IMPAIRED LEARNERS

By

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DECLARATION

I declare that the thesis, which I hereby submit for the degree Philosophiae Doctor at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at any other institution.

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M.O. Maguvhe

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ABSTRACT

A study of inclusive education and its effects on the teaching of biology to visually impaired learners

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AIM AND OBJECTIVES

The investigation aimed to determine how the learning of the life sciences is facilitated (mediated) in special schools for blind learners and to establish how the lessons learnt from this experience could be implemented to the advantage of blind learners in the Senior Phase and Further Education and Training Band in inclusive Outcomes-based education settings.

METHODOLOGY

Educators and blind learners were interviewed through the use of the Qualitative Inquiry methodology as well as its techniques and strategies for data gathering. Analysis of the transcripts resulted in the development of themes/codes discussed in the research investigation.

RESULTS

Educators spent a good amount of time and effort with blind learners in the biology and life sciences classrooms. It appeared as if the pastoral role of the educator predominantly exceeded the teaching of biology and life sciences to these learners. Further, it became evident that the emphasis did not fall strongly

enough on the achievement of the outcomes envisaged with the biology curriculum but more on the establishment of a caring and supportive classroom environment.

CONCLUSIONS

Biology and other life sciences subjects have much potential for the blind learners in South Africa but they are not offered at some of the schools or efficiently mediated due to educators' reluctance, lack of knowledge and resources. Learning mediation strategies to make biology and life sciences more accessible to blind learners could be explored.

KEY WORDS

Teaching and learning mediation of science
Blind and visually impaired learners
Inclusive education
Outcomes-based education
Strategies for learning
The importance of life science to blind learners and the society in general
Science process skills
The development of subject system
Competences for discovery
Interaction / social / emotional environment
Guidelines for biology educators

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CHAPTER 1

OUTLINE OF THE RESEARCH INVESTIGATION

1.1 INTRODUCTION

Blind children are excluded from biology because the subject is so visual by nature, but they need it for their understanding of the natural reality in the world in which they live and for their own academic development. The focus of the present research is on learners at special schools because that is the school setting where they currently receive their education. However, in the light of the Department of Education's policy of inclusion, Outcomes-based Education, resource centres and full-service schools, (White Paper 6) a model through which blind learners can access biology is absolutely necessary, and it is for this reason that the study aims at developing and suggesting mechanisms which will be relevant to all education settings.

To be able to achieve this goal, one had to comprehensively study the mediation of life sciences to blind learners in special schools with special reference to biology for visually impaired learners. During that exigent but gratifying process, the researcher learnt valuable lessons from visiting a number of schools for the blind, which could be of tremendous worth towards developing an inclusive education policy for outcomes-based education in South Africa. The visually impaired learners referred to in this research, are individuals who cannot perceive light, or who could not distinguish between light and darkness, or who could not distinguish or recognise any object but have perception of light, or are able to perceive objects as vague images or outlines only, either in motion or stationary.

Great strides have to be made in the improvement of special education as well as the mediation of live sciences to blind and visually impaired learners, since some of the special education facilities would be transformed into resource centres and special school personnel would become members of district-based support teams (who have the task of giving expert advice and support to inclusive schools). Gee, Alwell, Graham and Goetz (1994:13) wrote that the primary focus, therefore, of the support team planning the instruction of the student must be to determine the means by which the student will receive information, how instructional techniques will be adapted to suit the needs of the learner, and how the learner will be allowed to demonstrate knowledge and participate in the instructional and social activities which take place at school and in the classroom. According to the researcher's understanding, the team referred to in the previous quotation consists of educators and support staff.

1.2 PROBLEM STATEMENT

In this work, the researcher comprehensively scrutinised the following problems that were inter-related to and inter-dependent:

1. Most special schools for blind learners lack basic adaptive equipment and resources necessary for the mediation of life sciences. Therefore, blind learners are given much theory but experience

minimal life sciences' exploration, experimentation and expressive practices. Approximately 20 % of blind learners are accommodated at special schools, according to White Paper 6 (2001:8), that is 280 000 such learners. Since blind learners at existing special schools do not have adequate resources, this implies that a large number of blind learners who are at inclusive schools or out of school also do not have resources. Unfortunately, the National Department of Education (Inclusive Education Sub-Directorate) revealed that the Department does not possess statistics regarding blind learners at inclusive schools (Telephone discussion 31 March 2004). If this were the case, blind learners doing life sciences would not receive relevant support in terms of both human and material resources. The implication is that many learners would not be catered for at inclusive schools unless a record could be kept of learners needing learning mediation resources.

2. The learning mediation of life sciences tends to pose both major challenges and difficulties to blind learners in an Outcomes-based classroom as this lays much emphasis on the visual ability of learners. Gettys and Jacobsen (2000:1104) supported this sentiment by noting that: "(i)n the chemistry lab however, most of your observations are visual, such as reading a scale or noting a colour change."

3. Lack of visual ability in the learning mediation of life sciences in an outcomes-based classroom places additional pressures on blind learners. These pressures are in the form of expectations created by peers, parents, educators, the government, and the public in general. According to Webson (1997:40) such expectations constitute a good example of pressure on blind people. There are, as well, negative pressures and expectations that blind learners are unable to perform up to standard on life sciences, "… because they are blind". Such expectations definitely put tremendous pressure upon blind learners learning life sciences.

Furthermore, because the inclusive education system is a relatively new system in South Africa to be offered at specific schools, the researcher is of the view that:

4. Educators in special schools for visually impaired learners as well as those at inclusive schools lack the competency to mediate life sciences to blind learners. Therefore, the lack of competences and the lack of visual ability would make it tremendously harder for the blind learner to both effectively and fruitfully learn, access, understand and acquire an equal life sciences' knowledge that is not distorted or reduced, as compared to that acquired by his/her non-blind class or schoolmates.

The researcher further believes that the facilitation of life sciences needs to be adapted or modified in a suitable and special way in order to permit all learners, regardless of their blindness, both to receive and access quality education in an outcomes-based education classroom on terms which are both reasonable and accommodating. In other words, the study seeks to investigate and fully understand the provision of special education to blind learners in terms of the mediation of life sciences and lessons that could be drawn regarding an inclusive education policy for the Outcomes-based classroom.

As there are differing types and degrees of visual impairments, the work, in particular, gave attention to the totally blind as the researcher considers them to be the most vulnerable individuals in terms of the learning mediation of life sciences in an Outcomes-based classroom. Because of their unique needs and the ever-challenging life sciences, adaptations have to be made so that they could access, experience through all practicable means, learn, understand and be totally accommodated in various learning mediation and learning life sciences environments, including and not limited to the classroom environment, laboratory environment, field trips environment, and other natural environments; for example, viewing the rainbow, sun and moon eclipses, climate change, cloud formations with their various types and structures, germination of seeds in their very early stages, et cetera.

The research afforded the researcher ample opportunities to discover, develop and promote new approaches, strategies, tools, techniques, et cetera, that are essential for the improvement and encouragement of the full and active participation, as well as the active contribution, of the blind learners in special schools and in the learning mediation of life sciences in an Outcomes-based classroom or the community in particular. Mahatma Gandhi in Webson (1997) argued that each of us should be the change we want to see in the world.

1.3 AIM AND OBJECTIVES OF THE STUDY

1.3.1 AIM OF THE STUDY

The main aim of the investigation is to determine how the learning of the life sciences is facilitated (mediated) in special schools for visually impaired learners and to establish how the lessons learnt from this experience could be implemented to the advantage of visually impaired learners in the Senior Phase and Further Education and Training Band in inclusive Outcomes-based education settings.

1.3.2 OBJECTIVES OF THE STUDY

To achieve this aim the following objectives are envisaged in the study:

1. To determine how the lack of visual ability, during the learning mediation of biology and other life sciences, impacts on blind learners, life science educators, special schools and Outcomes-based education.
2. To assess whether the present teaching of blind learners in special schools is in line with the Outcomes-based policy and to determine whether educators are achieving the learning outcomes specified for the teaching of the life sciences.
3. To determine (assess) the outcomes specified for the teaching of the life sciences/biology in secondary schools in terms of the revised national curriculum statements.
4. To expose the characteristics (substance and syntax) of the life sciences/biology as a subject and to use these characteristics as criteria for the selection of appropriate learning mediation strategies.

5. To evaluate existing learning mediation strategies and methods for the life sciences against the outlined national curriculum statements and to determine to what extent these strategies and methods are being met by educators in special schools.
6. To determine whether and how visually impaired learners achieve the learning outcomes specified for the life sciences/biology and to establish which variables restrict effective teaching and learning in the life sciences/biology classroom.
7. To apply and assess the findings regarding the mediation of the life sciences/biology in special schools to the practices and strategies proposed for the mediation of learning in the life science/biology in inclusive educational settings.
8. To identify possible adaptations that could be made to our traditional classroom practices in support of blind and visually impaired learners in inclusive Outcomes-based classrooms.

As an adjunct to the above-discussed objectives, the researcher endeavours to make both society and the government aware of the plight of blind learners in special schools and to apply the experiences of blind learners at open schools under an inclusive education policy. It is also imperative for the researcher to mobilise and urge all sectors of society in South Africa to educationally support these learners and those community structures that worked and still work assiduously to proffer blind learners considerable assistance. Abantwana-Phambili (2001:2) has asserted, "(t)his is an urgent need for action from all of us."

What further triggered the researcher's thinking and reaction is that, as far back as 1967, Haring and Schiefelbusch (1967:282-297) reported on various issues related to the education of visually impaired learners. They focused primarily on the importance of vision and the mode of reading, and attempted (in classical positivist style) to illustrate how intelligence manifests itself in blind and visually impaired learners as compared to the deaf. Their work emphasised the significance of blindness and information processing (1967:267) and also illustrated the maximum utilisation of available sensory data during learning mediation as well as the translation of visual stimuli. Attitudes towards blindness as well as the social adjustment of the blind were also highlighted in this early publication.

Freeman (1986:106) emphasised the importance of visual impairment as a handicap to gifted learners as follows: "(i)n them visually impaired learners, conceptual development and abstract thinking seem to be delayed by the absence of visual stimulation or images; cognitive development occurs more slowly, and norms for chronological age groups are invalid."

The significant role of visual stimuli as prerequisites for conceptual development in the facilitation/mediation of the subject content in general and the life sciences more specifically, has been recorded by many authors such as Falk (1980:156), Perkins (1974:529), Erwin, Perkins, Ayala, Fine and Rubbin (2001:338-351) and Fraser, Loubser and Van Rooy (1996:68-72).

Wittich and Schuller (1973:51) explained more than three decades ago that perception remains the foundation of learning. They stressed the fact that without a sufficient conceptual foundation, learning would be severely impaired and thinking would be severely limited (1973:53). What also has to be taken into consideration, though, is that various developments in technology have significantly contributed, and will still do so, towards improving the plight of the visually impaired in the facilitation/mediation of learning.

Learning mediation aids such as computers with speech (JAWS), interfaced speech synthesisers, closed-circuit television (CCTV), taped materials, reading machines, talking machines, hand-held magnifiers, Braille, paperless Braille machines, talking calculators, sound sonification, auditory analogues of visualization, instruments with auditory (and not visual) readings, touch and voice-based interfaces, touch and large print components have become standard equipment for the teaching of the blind and visually impaired Kumagai (1995:82); Trief and Feeney (2003:138-143); Collette and Chiappetta (1986:282); Wareham (1995:16); Siekierska, Labelle, Brunet, McCurdy and Pulsifer (2003:491).

It is generally accepted that with the loss or absence of vision, the amount of sensory data available to the learner would be reduced Haring and Schiefelbusch (1967:268). It is for this reason that the teaching and learning of the blind and visually impaired have to be firmly grounded in a multi-sensory approach Erwin *et al.,* (2001:339). Various socio-educational factors might also impact on the performance of blind and visually impaired learners in the classroom. Van Wagner (1994) and Trief and Feeney (2003:138) highlighted the importance of social integration and assertiveness training and explained why pre-registration for classes, communication with professors, the planning of schedules, the early ordering of books, effective orientation and mobility instruction remain essential for meaningful learning of blind and visually impaired learners.

On the other hand, Kumagai (1995:82) has the following to say about blind and visually impaired learners and the acquisition of the science process skills: "(a)t its heart, science is about observation: looking at things, measuring them, analysing their properties, figuring out how they work. How then does one proceed when nature's most basic and powerful tool for observing – that of sight – is missing?"

Carin and Sund (1989:215) listed a number of cases where the teaching of science to blind and visually impaired learners in the school curriculum has become a reality through the accommodation of specialised equipment. The authors referred to materials that are hands-on, multisensory and which contain discovery oriented activities (1985:216). Collette listed similar comments and Chiappetta (1986:282) emphasised the importance of raised and textured diagrams in the teaching of blind and visually impaired learners.

Erwin *et al.,* (2001:339) and Van Wagner (1994:82-84) reinforced these arguments by emphasising the fact that visually impaired science students should be given ample opportunity to manipulate and explore equipment and materials related to tactile and auditory interactions. These suggestions are supported by Gage and Berliner (1998:178), who emphasised the importance of interactions with the physical environment as a teaching strategy. The multidimensionality and feasibility of sensory stimulation (concrete-empirical props) find support in the argument that multiple educational media have to be used to enhance the quality of learning.

However, one could search for a solution to the problem in Ausubel's view that concrete-empirical props serve to enhance the transition from concrete to abstract cognitive functioning (Ausubel 1968:201; 219).

Although this theory would normally not hold for adolescents, functioning at the formal operational level (1968:203), Ausubel (1968:220) argues that the use of concrete-empirical props and discovery methods should only be used during the early stages of instruction. This is one reason why Haring and Schiefelbusch (1967:271) as far back as 1937 highlighted the importance of maximising "…(t)he blind learner's ability to use those sensory data which do come in through his intact sensory modalities."

This study further focuses on maximising the learning opportunities and experiences of blind and visually impaired learners by making relevant stakeholders aware that their drastic and sustained intervention is urgently needed in the mediation of life sciences as well as the inclusion of blind learners. Furthermore, the government in general, and the Department of Education in particular, should play a constructive role which fosters changes in attitude and behaviour as far as education for blind and visually impaired learners is concerned. The Government and the Department of Education should both share the compulsion to guarantee that the educational rights of all children, including the blind and visually impaired child in inclusive education, are protected in an enabling learning mediation environment that facilitates their overall growth and holistic development into educated, productive and self-reliant citizens of our country. Webson (1997:39) supported the previous statement by maintaining that blind people are people with the same rights, interests, needs, fears, and abilities as any other cross-section of the general public.

However, according to the researcher, the blind learners' lack of visual ability complicates and multiplies their difficulties and inabilities in the learning mediation of biology and other life sciences subjects. If those complicated and multiplied difficulties and inabilities are not addressed during learning mediation of life sciences, it would be still more intricate for blind learners to learn and benefit from the life sciences in general and biology in particular.

Arentz and Van Genderen (2002:1) remarked that seeing is not only the perception of light or patterns by the eye but also the transmission of these patterns to the cerebral nervous system (a physiological process). In the brain the stimuli have to be translated into images, movements, colours et cetera.

The authors further remarked that understanding visual information is a complex process that takes many steps, like:

- Separating foreground from background;
- Seeing colours and forms;
- Recognising forms;
- Perceiving different parts as one entity;
- Recognising images and faces; and
- Understanding the meaning of images.

As indicated above, lack of vision complicates and multiplies problems. Arentz and Van Genderen (2002:2) argued that lack of vision causes visual-cognitive problems, such as "where" is something and "what" is it. The "where" gives information about the location of an object in space, if it is moving or not, and the orientation of an object.

The "what", as they put it, becomes active when people have to recognise objects and faces, and is closely related to people's memory.

The Constitution of the Republic of South Africa (1996:7; 14) states that all citizens must have equality and enjoy all rights and freedoms. This is to say that the blind learner in a special or open school must enjoy, without impediments, basic education including adult basic education and training. The blind learner is entitled to enjoy and benefit from Further Education, "… which the state, through reasonable measures, must make progressively available and accessible."

This assertion includes even the learning mediation of life sciences and biology. The Constitution of the Republic of South Africa (1996:14) further states that in order to ensure the effective access to, and implementation of the right to education, the state has to take into account equity, practicability and the need to redress the results of past racially discriminatory laws and practices.

Owing to this stipulation, the researcher is of the view that there is therefore a call for a comprehensive and continuing programme of action that would galvanise the entire nation to deal with the exigent reality facing blind learners in both special schools and inclusive education settings, as well as regarding the learning mediation of life sciences (biology) in an Outcomes-based classroom. According to the researcher, the learning mediation of life sciences in an Outcomes-based classroom shows intimidating trends that need to be stopped and reversed.

Furthermore, through this work, the researcher attempts to bring to light the effects of special education on the learning mediation of life sciences to blind learners in an Outcomes-based education classroom. The researcher hopes to accomplish a great and noble task, but his "… chief duty is to accomplish small tasks as if they were great and noble" (Ntsika Enterprise Promotion Agency 2001:25).

1.4 RESEARCH QUESTIONS

This investigation interrogated the following questions, which are informed by the fact that education is moving away from the three Rs (reading, writing and arithmetic) to three Xs (exploration, experimentation and expression).

It is undoubtedly true that a prerequisite for the learning mediation of biology and other life sciences is one's visual ability.

Therefore:

1. How does the lack of visual ability during the learning mediation of biology and other life sciences impact on blind learners, life sciences educators, special schools and Outcomes-based education?
2. Is the present teaching of blind learners in special schools in line with the Outcomes-based education policy and are educators achieving the learning outcomes specified for the teaching of life sciences?

3. What are the learning outcomes specified for the teaching of the life sciences/biology in secondary schools in terms of the revised national curriculum statements?
4. What are the characteristics (measured in terms of substance and syntax) of the life sciences/biology as subject and what would be the most appropriate learning mediation strategies in terms of these criteria?
5. What would be the most appropriate learning mediation strategies and methods for the teaching of the life sciences measured against the outlined national curriculum statements and to what extent do educators use and apply these strategies and methods in special schools?
6. To what extent do visually impaired learners achieve the learning outcomes specified for the life sciences/biology and which variables restrict effective teaching and learning in the life sciences/biology classroom?
7. How compatible is the mediation of the life sciences/biology in special schools with the practices and strategies proposed for the mediation of learning in the life sciences/biology in inclusive educational settings?
8. What adaptations to our traditional classroom practices will therefore be required in support of blind and visually impaired learners in inclusive Outcomes-based classrooms?

1.5 RESEARCH HYPOTHESIS

According to the researcher's point of view, it is not common practice for the researcher employing qualitative research methodology with its techniques and strategies to formulate hypotheses as they are applicable to quantitative research methodology.

Some of the reasons why the researcher nevertheless formulated hypotheses for this research investigation include, but are not limited to, the following:

a) Hypotheses are good and valuable tools for both the verification or the falsification of one’s beliefs or suspicions.
b) Hypotheses also provide a platform for researchers to work from.
c) Through formulating hypotheses, researchers are able to establish the true value of the study, its applicability, its consistency as well as its neutrality. Other reasons why hypotheses were specifically formulated for this research investigation are furnished in chapter five-paragraph 5.3.2 subsection (a).

The following hypotheses were formulated:

1. The mediators of the life sciences/biology to visually impaired learners in secondary special schools are well-acquainted with the envisaged learning outcomes to be achieved in science classrooms but rely heavily on the transmission of information as delivery mode, as opposed to investigative and inquiry teaching strategies, mainly because of the lack of visual ability of learners and inadequate resources.
2. Visually impaired life sciences/biology learners rely heavily on instructional support mechanisms as principles for effective teaching and learning in the science classroom but these conditions are not

met because of the lack of resources and of the necessary financial and logistical support in special and inclusive schools.

3. Life science and biology educators apply creative and innovative learning mediation strategies in special schools for the blind and visually impaired learners.
4. Educators responsible for the mediation of biology and life sciences in special schools for the blind are fully equipped to optimise the potential of their learners in terms of the requirements put forward by the outcomes for biology and the life sciences in an Outcomes-based learning environment.

As explained in the introductory part of this subsection, the researcher would hold the view that the above-discussed hypotheses are true and correct unless the data gathered and analysed proves the contrary.

As a supplement to the above-highlighted hypotheses, the researcher would further hold the following views that:

- ❑ Drawings are problematic to blind learners because they are not taught how to draw but are given ready-made drawings. Owing to this, the researcher is convinced that there are no other activities to supplement a loss in their drawing ability.
- ❑ Many educators have a tendency to engage their blind learners very seldom in practical work, field trips or related activities.
- ❑ Practical activities that blind learners are involved in are limited, very simple and elementary in nature, therefore calling for very minimal intellectual challenges or advanced problem solving skills.

Therefore, the researcher will be guided by the following things:

i) statement of hypothesis
ii) research questions and
iii) questionnaire and inventories in his quest to acquire relevant information necessary for these study.

1.6 TARGET POPULATION

The intended population of this research is primarily the targeted schools referred to in chapter five, educators at special schools for the education of learners with special education needs, blind learners, education authorities at local, provincial and national level, associations of and for the blind, parents/guardians of learners who are blind, members of the community who are interested in blind people's issues, and academicians. The study is aimed at conscientising the above indicated groups regarding the challenges and difficulties which Outcomes-based Education policy and the learning mediation strategies of biology to blind learners in an Outcomes-based Education and Training classroom pose for blind learners.

1.7 METHODOLOGY

This researcher investigated the mediation of life sciences to blind learners at special schools in South Africa and its effects on the mediation of biology to blind learners in an Outcomes-based classroom. The researcher employed the Qualitative Inquiry methodology as well as its techniques and strategies for data gathering. This is discussed in detail under 5.2.1. In addition, hypotheses were interpreted and discussed even though they are quantitative in nature. Reasons for doing so are provided in paragraphs 1.5 and 5.3.2 (a).

1.8 DEFINITIONS OF TERMS/CONCEPTS

Terms/concepts found in the title of this thesis or related to the title, are defined.
Before the researcher defines terms and concepts used in this work, the researcher needs to elucidate the notion of inclusive education and training.

According to White Paper 6 (2001:16), inclusive education and training is about:

- Acknowledging that all children and youth can learn and that all children and youth need support.
- Accepting and respecting the fact that all learners are different in some way and have different learning needs which are equally valued as an ordinary part of our human experience.
- Enabling education structures, systems and learning methodologies to meet the needs of all learners.
- Acknowledging and respecting differences in learners, whether due to age, gender, ethnicity, language, class, disability or HIV status.
- Acknowledging that learning also occurs in the home and community, and within formal and informal modes, and structures.
- Changing attitudes, behaviour, teaching methodologies, curricula and the environment to meet the needs of all learners.
- Maximising the participation of all learners in the culture and the curricula of educational institutions and uncovering and minimising barriers to learning.
- Finally, empowering learners by developing their individual strengths and enabling them to participate critically in the process of learning. According to the government, some of the results highlighted above could be achieved through Outcomes-based Education.

(a) OUTCOMES-BASED EDUCATION AND TRAINING

Some literature refers to Outcomes-based Education as “OBE/OBET”. The acronym/s could be used interchangeably.

Though Malcolm (2000:4-5) advised that Outcomes-based Education defies simple definition because it is essentially a management system which could be fitted to different philosophies of education, and specifies learning as including and not limited to prescribed outcomes and assessment criteria, phase organisers, learning programmes, expected levels of performance and illustrative learning materials, the researcher nevertheless chose the following definitions because of their meaning and implications. Spady is the architect of the philosophy of Outcomes-based Education. What is heartening, according to Malcolm (2000:4-5), is that both Spady (1994:1) and South Africa's definitions talk about transformational Outcomes-based Education. This does not mean that the two definitions are not different; for example, unlike Spady's definition, South Africa's definition focuses more on the social, economic and cultural transformation of the nation while Spady's definition is limited in scope and value, as emphasis is laid on transformation of the structure and content of schooling.

Van Der Horst and McDonald (1997:7) defined Outcomes-based Education as: "...(a)n approach which requires teachers and learners to focus their attention on two things. Firstly, the focus is on the desired end results of each learning process. These desired end results are called the outcomes of learning and learners need to demonstrate that they have attained them. They will therefore continuously be assessed to ascertain whether they are making any progress. Secondly, the focus is on the instructive and learning processes that will guide the learners to these end results. Teachers are required to use the learning outcomes as a focus when they make instructional decisions and plan their lessons."

On the other hand, Spady (1994:1) regards Outcomes-based Education as clearly focusing and organising everything in an educational system around what is essential for all students to be able to do successfully at the end of their learning experiences.

The Outcomes-based Education and Training definitions/explanations furnished above caused the researcher to understand and regard it as a system with a clear picture of outcomes to be attained and demonstrated by all learners at their own pace and rate, through the guidance of instructive and learning processes. As a point of departure, the system should both ensure and determine what all learners are able to do, then organise the curriculum according to learners' ability and unique needs, then carefully plan instruction and assessment in order to make sure that learning mediation ultimately happens and is also effective. Furthermore, Outcomes-based Education should be regarded as an approach, which makes use of clear statements about the knowledge, and skills that learners should acquire as a result of their learning. Clear statements are also made about the values and attitudes that are being promoted as learners engage in Mediated Learning Experiences or processes.

(b) CURRICULUM

"(C)urriculum is everything planned by educators which will help develop the learner. This can be an extra-mural sporting activity, a debate, or even a visit to a library" (Curriculum 2005 Lifelong learning for the 21st century 1997:10).

According to Bertram, Fotheringham and Harley (2000:3), a curriculum could further be understood in the following two ways: "(f)irstly, ... as a plan (which may be written in a document). This plan reflects the knowledge, skills and attitudes that any society chooses to pass on their children." In their view curriculum should secondly be seen as the learning and teaching experiences that happen in any site of education. Therefore, a curriculum is a carefully planned and well written document that explicitly reflects the knowledge, skills, values and attitudes of societies that are intended to be passed to or mediated to the future generation, comprising both the old and the young. This document gives educators room to manoeuvre as well as to take their ideas, which are embodied in the curriculum document, and enact them in their respective institutions of learning and classrooms.

In addition, the way in which educators would interpret a curriculum depends on and is highly influenced by the knowledge, skills and beliefs of that particular educator as well as by the context, milieu, and conditions in which the educator finds himself/herself during the learning mediation. Curriculum comprises the following components: academic programme, practical programme (trait oriented) and skills training programme.

(c) TEACHING AND LEARNING MEDIATION STRATEGIES

Van Der Horst and McDonald (1997:123) regard teaching and learning mediation strategies as a real plan of attack. According to them, this plan of attack "…(o)utlines the approach you intend to take in order to achieve outcomes." Furthermore, they aptly stated in their work (1997:124) that teaching strategies are "...(a) broad plan of action for teaching activities with a view to achieving an aim."

In simple terms, instructional or teaching and learning mediation strategies can best be understood as methods, tools, techniques or approaches with which the educator communicates ideas, expectations, intentions and new knowledge to the learners. (The researcher's own definition.) However, it is of paramount importance that before educators decide on a teaching and learning mediation strategy to be used during an activity, they have, as a matter of fact, to be clear about their specific outcomes, learning outcomes and the main content of their envisaged lesson.

Landman (1988:548) understands and regards teaching to be "...(a) medium of education but not all teaching is educative. Teaching concentrates on intellectual actualisation, including in its scope bodies of knowledge (such as knowledge of values and norms) and skills useful for communal existence."

Teaching should not be confined to school or formal teaching. It does take place out of school in informal or non-formal circumstances and schools do not exist mainly for teaching but also for education provided by means of other forms of mediation. Therefore, teaching encompasses both formal and informal processes where the educator at school or out of school employs methods, techniques, tools, approaches, et cetera, to communicate ideas, intentions, expectations and new knowledge to the learners or students. (The researcher's own definition.)

Teaching and learning mediation are indispensable to one another. They share many common features of which the most important are imparting or acquiring knowledge, acquiring essential skills and gathering experience.

Pauw (1990b:31) maintained that learning mediation is "...(t)he process through which an individual develops or acquires knowledge, skills or attitudes. It is influenced by the interaction of many individual or environmental variables, is highly related to language development, and its development or acquisition may be originated or modified through planned educational intervention."

On the other hand, Landman (1988:432) considers learning mediation to be implying the acquisition of significant content, the realisation of meaningful conduct, experiences and acts of volition, and the revelation of meaningful ability (to do activities) and skills.

Kruger, Smit, Du Pr`e and Le Roux (1996:129) maintained that learning mediation is a process that underlies or gives rise to perceivable (observable or noticeable) changes in behaviour in situations involving practice, teaching and life experiences. An individual, who is engaged in learning mediation, should be able to know, understand and perform things accordingly, with a feeling of competence and skill. It does not matter whether an individual has learnt through associative, cognitive, social and/or moral learning mediation; what matters most is that an individual should, at the end of the day, be able to recall, remember and reconcile things learnt, heard, seen or read. Finally, learning mediation involves goal setting, distribution of learning time, proper utilisation of learning resources, constant feedback, determining the value and meaningfulness of learning material, self-motivation and explaining and distinguishing sense from non-sense.

(d) BLINDNESS AND VISUAL IMPAIRMENTS

The world health Organisation defines blindness as 3/60 (finger counting at three meters) (Vaughan, Asbury and Riordan-Eva 1999:384)

However in S.A., a person is registered blind if he/she has a visual acuity of less than 6/60 with correction. It must be emphasised that in the context of the measurement of visual acuity, the figure 6/60 does not represent a fraction. It means that the person with a visual acuity of 6/60 would be able to see at 6 metres what someone with normal vision would be able to see at 60 metres (Best 1992:2)

Although the term visually impaired is used in many countries to describe both those who are blind and those with low visions the terms [1]blind and partially sighted are widely used in S.A., being endorsed by the S.A.N.C.B.

For the purpose of this study, the term blind will be used to refer to those persons who are either totally blind, that is, having no light perception, or those who have limited light perception, but are unable to either read print, even with optical or magnification devices, or to identify objects.

Pauw (1990b:10) indicated that someone who is blind "...(l)acks the normal ability to see, possibly because of developmental defects in the eye itself or because of a neural defect disrupting communication between eye and brain." Words such as "visually challenged, visually impaired, visually handicapped, visually disabled, experiencing visual barriers, et cetera" might often be used to refer to an individual who is blind. Blind individuals could also suffer from other causes of visual impairments. Visual impairments could be used interchangeably with the term visual disability and are defined by Corn and Koenig (1996:9) as a term that encompasses both those who are blind and those with low vision.

[1] In his study the researcher used blind and visually impaired to be meaning blind and partially sighted.

Arter, Mason, McCall, McLinden and Stone (1999:8-9) have distinguished different types of visual impairments, such as myopia (short sightedness), albinism, retinitis pigmentosa (a disease that affects the retina, causing tunnel vision and night blindness). Other impairments might include strabismus, retinal detachment, photophobia, macular degeneration, nystagmus, hyperopia, astigmatism, glaucoma, cataracts, et cetera.

In addition to these issues, Wang, Reynolds and Walberg (1989:155) also maintained that "...(t)he seemingly simple term visual handicap covers a wide range of children.... Included are those who have never had any visual function, those who had normal vision for some years before becoming gradually or suddenly partially or totally blind, those with handicaps in addition to the visual loss, those with selective impairments of parts of the visual field, and those with a general degradation of acuity across the visual field. Thus it is misleading to think of visually handicapped children are being all alike, with the implication that they may all be treated alike with uniform success in educational or other settings. In fact, this is an extremely heterogeneous population, and one which places correspondingly mixed demands on the people and agencies which deal with it."

Individuals who are partially sighted or who have low vision, fall into this category. Corn and Koenig (1996:4) defined a person with low vision as one experiencing "…(d)ifficulty accomplishing visual tasks, even with prescribed corrective lenses, but who can enhance his or her ability to accomplish these tasks with the use of compensatory visual strategies, low vision and other devices and environmental modifications." According to them, low vision further implies a vision loss that is severe enough to interfere with the ability to perform everyday tasks or activities and that could not be corrected to normal by conventional eyeglasses or contact lenses.

According to Corn and Koenig (1996:7) partial sight refers to "…(p)ersons with best-corrected visual acuity in the best eye of 20/70 to 20/200." Both persons who are either partially sighted or have severe low vision are able to function with a substantial or a negligible amount of usable vision without relying entirely on the tactile and auditory senses.

According to the researcher, the disparity between low vision, partial sightedness and blindness occurs in that low vision and partially sighted persons have usable vision while blind persons do not. Low vision and partially sighted persons could employ compensatory visual strategies, low vision and other assistive devices, environmental modifications and vision to accomplish learning mediation activities. It is argued by Wang *et al.* (1989:157) that blind individuals depend on tactile and auditory senses in acquiring information and the accomplishment of learning mediation activities. Lack of visual ability impacts in a negative way on their learning mediation, as vision is crucial for seeing relevant data.

(e) BIOLOGY

Hornby (1987:82) defines biology as the "(s)cience of physical life of animals (Zoology) and plants (Botany)."

Biology is defined by Van Aswegen, Fraser, Nortje, Slabbert and Kaske (1993:1) as "...(h)uman activity which is directed towards seeking knowledge about living matter." Biology is a field of study that deals with the collection, investigation, observation, analysis, identification, interpretation, explanation, and evaluation of the facts and concepts regarding living matter in order to seek answers and solutions by observing, attaching new meaning to an observation, discovering, investigating, et cetera.

The learning mediation of biology at schools involves exposing learners to learning environments such as the laboratory, natural environments, field trips, practical environments involving observation, exploration, experimentation, expression, inquiry, analysis, interpretation, acquisition of experience, knowledge and skills. The teaching and learning mediation of biology at school presently encourages biology learners to be initiative, innovative and creative.

(f) INCLUSION AND INCLUSIVE EDUCATION

According to UNESCO, inclusive education is a developmental approach seeking to address the learning needs op all children, youth and adults, with specific focus on those who are vulnerable to marginalisation and exclusion. Ref: http//www.unesco.com.

The principle of inclusive education was adopted at the World Conference on Special Needs Education: Access and Quality (Salamanca, Spain, 1994) and was restarted at the world Education forum (Dakar, Senegal, 2000). The idea of inclusion is further supported by the UNESCO standard rules on the Equalization of Opportunities for persons with disabilities proclaiming participation and equality for all.

Asmal (2004:5) regards inclusion as referring to an education system that:

- Recognises and respects the differences among all learners, and builds on the similarities;
- Supports all learners, educators and the system as a whole so that the full range of learning needs can be met. The focus is on teaching and learning actors, with the emphasis on developing good teaching strategies that will benefit all learners;
- Focuses on overcoming barriers in the system that prevent the system from meeting the full range of learning needs. That focus is on adapting the curriculum, and strengthening support systems in the classroom.

He (2004:10) further considers inclusive education as involving three important factors:

- Changing mainstream education so that learners experiencing barriers to learning can be identified early and receive appropriate support;
- Changing special schools and specialised settings so that learners who experience mild to moderate disabilities can be adequately accommodated within mainstream education through appropriate support from district-based support teams, including special schools as resource centres and specialised settings; and

- Upgrading the quality of special schools and specialised settings so that they, together with district-based support teams, can provide high-quality service for learners in full-service and "ordinary" schools.

According to White Paper 6 (2001:8-9) inclusion entails moving away from the category system which allowed only those learners with organic, medical disabilities access to support programmes, and

- Basing the provision of education for learners with disabilities on the intensity of support needed to overcome the debilitating impact of those disabilities;
- Placing an emphasis on supporting learners through full-service schools that will have a bias towards particular disabilities depending on need and support;
- Directing how the initial facilities will be set up and how the additional resources required would be accessed;
- Indicating how learners with a disability will be identified, assessed and incorporated into special, full-service and ordinary schools in an incremental manner;
- Introducing strategies and interventions that will assist educators to cope with a diversity of learning and teaching needs to ensure that transitory learning difficulties are ameliorated;
- Giving direction for the education support system needed; and
- Providing clear signals about how current special schools will serve identified disabled learners on site and also serves as a resource to educators and schools in the area.

As stated in Asmal (2004:5) inclusive education is based on the following principles:

- Acceptance of the principles and values contained in the South African Constitution and White Papers on education and training;
- Human rights and social justice for all learners;
- Participation and social integration;
- Equal access to a single, inclusive education system;
- Access to the curriculum, equity and redress;
- Community responsiveness; and
- Cost-effectiveness.

According to Van Steen Landt (1995:4), UNESCO regards inclusion as a more general school reform, aimed at accommodating pupil diversity, including disability, and offering quality education to all pupils.

On the other hand Burden (1995a:47-48) suggested that inclusion should be understood as a practice that "...(e)xpects the society to facilitate the acceptance of those who do not fit in by accepting them just as they are. Inclusion in its pure form should rather be defined as a warm and embracing attitude, accepting and accommodating the other unconditionally (without preconditions)." Furthermore, inclusion implies that because of the existence of a different attitude in a society, the needs of people with disability are also addressed differently, that is following the bottom-up approach where society responds to the diversity with an attitude that embraces learning, interpreting, widening perspectives and reflective enquiry.

The guiding principle of inclusion according to Engelbrecht, Green, Naicker and Engelbrecht (1999:32) is that schools should accommodate all learners regardless of their physical, intellectual, social, emotional, linguistic or other conditions. This should include disabled and gifted learners, street and working learners, learners from remote and nomadic populations, learners from linguistic, ethnic or cultural minorities and learners from other disadvantaged or marginalised areas or groups. Inclusion is simply a means of extending educational opportunities to a wide range of marginalised groups who may historically have had little or no access to schooling.

By “low institutions” the researcher refers to early intervention programmes for blind learners offered at kindergartens stretching up to Junior Phase. “Middle institutions” are institutions offering Intermediate education, Senior Phase and Further Training Band. “High institutions” are tertiary institutions such as universities.

According to the researcher, inclusion should be understood as an educational integration of both disabled and able-bodied learners at any educational institution, either for academic or vocational training (low, middle and high), in order for both groups to equally access, acquire and effectively participate in all mediated learning experiences, processes and activities, where all learners are granted ample opportunities and pleasant situations to get used to each other, and, also, to accommodate, appreciate and fully know and understand each other’s conditions.

Asmal (2004:6) recognises the following as key differences between special education and inclusion:

- Special schools focus on the individual while inclusion focuses on society; that is, if society cannot cater for people who experience barriers to learning, then it is society that must change.
- Special schools focus on disability in terms of a medical and welfare framework that represents a perception of the disabled as "ill" and "needing care", while inclusion focuses on human rights of learners, parents/guardians et cetera and on development, and is thus an agenda of redressing past inequalities, and transforming education to serve a new social order, to meet pressing national needs, and to respond to new realities and opportunities.
- Special schools focus on barriers to learning presented by the disabled learner, and getting learners to fit into the existing educational system, while inclusion focuses on identifying barriers to learning, existing in the system itself, that prevent access to learning.
- Special education segregates learners in terms of both race and category of disability, while inclusion focuses on an inclusive, redress approach, and on provision of education based on the levels and intensity of support which learners require.
- Special schools render support at low, moderate and high intensity levels, while inclusion does not render support services at high intensity levels.

(g) MAINSTREAMING

In Meisel's (1996:155) view, mainstreaming refers to the temporal, instructional and social integration of eligible exceptional children with normal peers. It is based on an ongoing, individually determined educational needs assessment, requiring classification of responsibility for coordinated planning and programming by regular and special education administrative, instructional, and support personnel. The intentions of mainstreaming are similar to those of inclusion. Mainstreaming is a system that enhances mutual acceptance and appreciation of one another by able-bodied learners and disabled learners at regular schools.

The difference between inclusion and mainstream education is that mainstream education is a temporary, instructional, social and educational integration between the disabled and the able-bodied, while inclusion is meant to be a permanent arrangement. Furthermore, classification of learners, programming and planning for mainstream policy is decided upon by a group of experts including regular and special educators, instructional and support personnel. This means that inclusion strives to promote permanent acceptance and accommodation of the disabled unreservedly, while mainstream education concentrates on the temporary instructional and social integration of eligible exceptional children with normal peers which, according to the researcher, could be terminated at any time. According to the researcher, why should the disabled children enjoy the benefits of mainstream education only on a temporary basis? Would this not have serious implications, such as not accepting and accommodating the disabled at all?

(h) NATURAL SCIENCES

According to LIBERTY INDEPENDENT NEWSPAPER [s.a] [s.p] the definition of natural sciences is, "...(t)he systematic study of the material universe - including natural and human-made environments - as a set of related systems. A variety of methods, that have in common the collection, analysis and critical evaluation of data, are used to develop scientific knowledge."

1.9 OUTLINE OF THE RESEARCH

The researcher intends to achieve the following in the following chapters:

Chapter 1 covers the following aspects: the introduction, problem statement, research question, aim and objectives, research hypotheses, methodology, the audience, definition of terms/concepts featuring prominently in this work and outline of the research.

In **chapter 2** the researcher critically analysed previous education systems in order for the reader to know their strengths and weaknesses in paving the way for Outcomes-based Education and Training. These systems are African education, People's education, the inclusive education policy and a historical perspective on Outcomes-based Education and Training.

Chapter 3 addresses the nature and structure of biology and the impact this subject/learning area has on blind learners and their learning mediation in general. The researcher covers the following aspects: the importance of biology to blind learners and society in general, the nature of the subject of biology, the structure of the subject of biology, the syntactic structure of the subject of biology, the commencement of science process skills, the relationship between substantive and syntactical structures, the instruction of biology to blind learners through inquiry, factors influencing the learning mediation of biology and the qualities of the biology educator, especially regarding blind learners.

Chapter 4 focuses on learning mediation strategies for blind learners, the origin of blind learners' mediation needs, the importance of learning mediation strategies to blind learners, the role of biology educators during learning mediation processes, the requirements to foster blind learners' talents, guidelines for mediating biology to blind learners in an Outcomes-based Education and Training classroom, how learning mediation takes place and the importance of educator-training in order to effectively include blind learners at inclusive schools.

Chapter 5 deals in much detail with the data collection techniques and strategies applied, the data and content validation of inventories, the composition of the research sample and the selection of the participants, data collection processes and the application of the focus group, and the method of data analysis. **Chapter 6** discusses the findings while the final chapter (**Chapter 7**) provides a synopsis of the research, evaluates the significance of the research, and furnishes resolutions, recommendations and possible research questions.

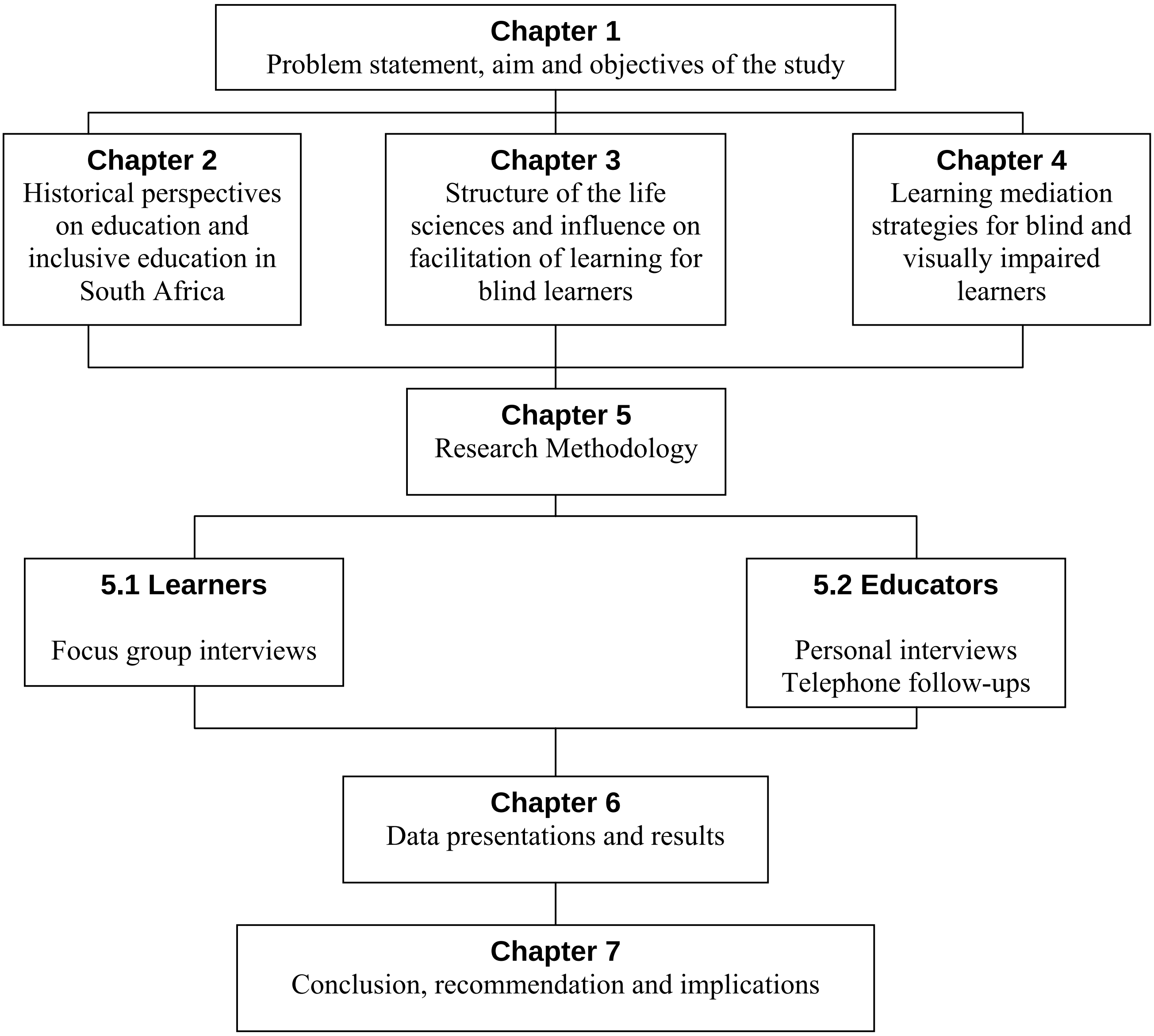
According to the researcher, this work has achieved its goal because it has been able to draw attention to, as well as to expose, the challenges and difficulties posed by both biology and Outcomes-based Education to blind and visually impaired learners, as too much emphasis is laid on visual ability. Further, the work endeavours to suggest appropriate mechanisms of addressing those challenges and difficulties. The researcher also highlighted the neglect of blind learners in special education and the lack of adequate government support and resources, emanating from either ignorance or the lack of educator competences, and mentioned the skills necessary to be accurately and effectively used during the adaptation of learning mediation and learning techniques in the educators' quest to mediate and accommodate blind learners.

A fundamental change in how educators in special and inclusive education approach and mediate Outcomes-based Education to blind learners is essential. To be able to do this, these educators' mind-set has to change. Educators/facilitators and the public at large have to heed Kehoe's advice, as indicated in Ntsika Enterprise Promotion Agency (2001:45), when he said: "(s)omewhere during this decade we find ourselves living in the future. Its arrival is both thrilling and overwhelming. Thrilling because of the tremendous opportunities it presents us, and overwhelming because it necessitates that we redefine who we are and where we are going. To survive and prosper in the new millennium means to change, learn and constantly re-invent yourself."

In addition, the researcher intends to dispel the misconception in the minds of many people that blind and visually impaired learners cannot learn, benefit from and cope in life science subjects, and at later stages use biology in their careers or fields of study. Finally, the researcher compared and contrasted Outcomes-based Education with inclusive education in order to establish their similarities, differences, and importance to blind learners and to consider how adaptations could make both Outcomes-based Education and inclusive education user friendly.

FIGURE 1.1: OUTLINE OF THE RESEARCH

The figure illustrates issues dealt with under 1.9



1.10 SUMMARY AND CONCLUSION

It has been the researcher's aspiration to comprehensively cover the aspects discussed under the researcher's intended achievements. As a result, the purpose of this research has been realistic and realisable. The researcher has been able to acknowledge the findings, apply those recommendations and above all, attain his envisaged goal by investigating the teaching of the life sciences to visually impaired learners in special schools and its implications for an inclusive life science education policy in an Outcomes-based learning environment.

CHAPTER 2

HISTORICAL PERSPECTIVES ON EDUCATION, INCLUSIVE EDUCATION AND OUTCOMES-BASED EDUCATION IN SOUTH AFRICA

2.1 INTRODUCTION

In this chapter, the researcher desires to make readers understand and value the historical development of the South African education system as it applies to education in general and to special education more specifically. The understanding derived from the history of our education, should help one to distinguish between the various approaches and practices towards education. Therefore, one will be able to explain and interpret the processes of transformation and in particular of Outcomes-based Education. It is also important to know and understand the principles on which Outcomes-based Education is based. Finally, based on this understanding, one will be able to describe the nature, structure and process of Outcomes-based Education.

Furthermore, in this chapter, the researcher intends to indicate to what extent the restructuring process in South Africa is influenced by both local and international trends. The South African National Council for the Blind draft discussion document (1997:4) pointed out that South Africa does not exist in isolation and that the restructuring process of South African education is greatly influenced by international trends. In a similar way, modern thinking about the education of blind learners is also influenced by international views and developments.

In supporting the previous statement, Ntsika Enterprise Promotion Agency (2001:45) made the following assertion: "(w)e are in one of the most exciting periods ever known. It is a time for stupendous and radical change." In addition, the researcher wishes to highlight the importance of an integrated education and training system. The researcher argued in this and other chapters that the education of persons with disabilities was and still is an integral part of the general education system. In addition, the researcher also highlighted the principles, policy and practices of Outcomes-based Education and Training. The education authority has therefore been made aware of the need to ensure the full exercise of their right to education by all South Africans (both black and white).

Finally, the researcher envisages investigating what the responsibilities and obligations of stakeholders towards blind learners receiving Outcomes-based Education in special schools are, and how inclusive the education system should be.

An unknown author stated: "(t)he road to success is always under construction." This statement holds water in the present situation as the democratically elected government of South Africa was mandated to bring about drastic change, and embarked on a process of both reconstructing and redeveloping, inter alia, the education system, now known as "(O)utcomes-Based Education and Training".

The considerable knowledge and experience accumulated from different education systems will in various ways enable one to understand why, how and where Outcomes-based Education and Training has originated. Therefore, one should be in a strong position to have a clear and broad picture and refreshed memories of what education used to be and why, and of the unbearably harsh conditions (characterised by segregation, improper schooling facilities, et cetera), in which multitudes of people had to receive education in South Africa. From those references, one will be equipped with knowledge and appropriate skills to make sound judgments, both as to whether one feels change is necessary to redress the imbalances of the past apartheid period or not.

The different education systems put in place by different education authorities and stakeholders should be seen in conjunction with other factors such as:

- The need to integrate education and training systems;
- The desire to offer to all South Africans (Black and White, young and old) lifelong learning;
- The need to offer to all South Africans proper skills for being productive and competent in both the industrial and information ages;
- The need to guarantee equal access to education and resources as well as educational equity, and the redressing of the imbalances of the past, which played a constructive and meaningful role in the revision of South Africa's education system and the Curriculum.

It is highlighted in *Curriculum 2005: Lifelong learning for the 21st century* (1999:3) that the Curriculum has to be revised to meet new demands. Regarding this view of "curriculum revision" Ntsika Enterprise Promotion Agency (2001:45) added the following: "(t)he illiterate of the 21st century will not be those who cannot read and write but those who cannot learn, unlearn and relearn."

Are these issues of transformation and reconstruction not challenges and demands? The researcher entirely concurs with Ntsika Enterprise Promotion Agency (2001:45) when it argues that as patriotic South Africans, hopefully, we want to be the fittest, those who can best adapt and change, those who can obtain the information they need and learn skills quickly. It was further argued that like surfers we must ride the crest of the waves, using our intellect and vitality to take us where we want to go. Rather than trying to resist change, surfers seek harmony with it.

The previously indicated factors and the following systems of education played an instrumental role in the shaping and the revision of our curriculum. They include among others, African Education and People's Education. To be specific, churches such as the Roman Catholic Church, to give but one good example, with its system of "open schools", positively and appropriately played a pivotal and constructive role in the transformation of our education system.

Throughout South African history, fundamental human rights have been denied to people of colour and disability (including blindness), owing to political motivations, ruthlessness, ignorance, indifference, racial intolerance, et cetera. Mohlala (1994:59) relevantly asserted that previously, education was a system based on a racial, sexist and xenophobic ideology.

Correspondingly, Bertram *et al.,* (2000:76) indicated that government schools in the early 1950s were established to teach the Africans to accept their proper place. The government, according to the above-mentioned authors (2000:76), was only interested in instilling respect for Christian values (as understood by them) and for the nation in all learners. The purpose of the schools was largely to mould both Black and White children into apartheid citizens, holding the values appropriate to this society. The education offered to South African learners was a form of social control geared towards reinforcing the government policies of "separate development". Mohlala (1994:60) took this argument further when he emphasised that education was a way of controlling the hearts and minds of indigenous inhabitants of the country and that it perpetuated White supremacy.

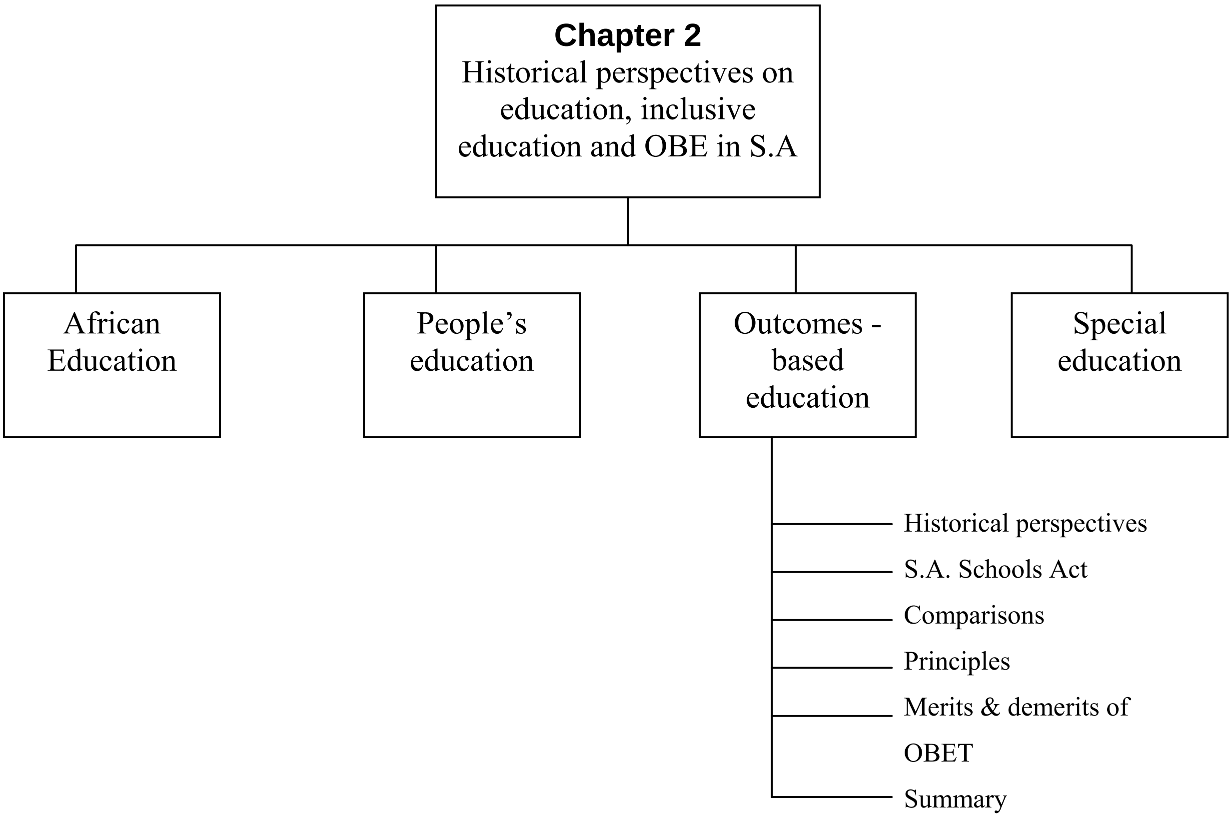
The government spent much more money on White learners and the education resources presented to Black learners were inferior and unequal. As Bertram *et al.,* (2000:76) put it, the curriculum was racist, sexist, Eurocentric, authoritarian, prescriptive, context-blind and discriminatory.

It therefore seems that, as a result of those factors and intentions indicated above, most people, most probably, forgot or ignored the fact that, "(e)very human being, from the richest to the poorest, from the youngest to the oldest, from the most physically fit to the most misshapen, has the inalienable right to existence and to as normal a life as possible under existing circumstances" (Konar 1988:3). Education was, and still will be, a fundamental human right as long as humankind inhabits planet earth. It was not, and never would it be, a privilege.

Therefore, references to these systems endeavour to determine why the current government feels that change as far as the education system is concerned is of the essence. Hopefully, Outcomes-based Education and Training will be crucial in addressing the problems and issues, which emanated from and characterised the systems that preceded it.

Various approaches are capable of helping us to understand and come to terms with the practices of the previous education systems and also the different stages, as well as the treacherous roads, on which all South Africans (Black and White, young and old) have travelled until these groups have safely arrived at the present destination of Outcomes-based Education and Training. The researcher regards these totally oppressive education systems as "a pollution of education" and does not hesitate to term them such. The following are the researcher's arguments; used as examples to illustrate processes, stages and education systems.

FIGURE 2.1: ILLUSTRATES THE OUTLINE OF ISSUES DEALT WITH IN CHAPTER 2.



2.2 AFRICAN EDUCATION

What is African education? Why was it put into place? Did it definitely achieve its aims and objectives? Did most people find it interesting, productive, constructive and meaningful? The answers to those and other questions are given in the discussion that follows.

Prior to the 1950s, the education of African children, including blind children, was mainly the responsibility of the churches, through their mission schools. Bertram *et al.,* (2000:76) maintain, "(e)ducation was compulsory for white children." Therefore, a proper definition for "African Education" would be as follows: African education is the education policy that was prevalent during the rule of the Dutch East India Company and stretched well into the 1940s.

Behr (1978:159) wrote, "(a)lthough sporadic attempts at educating and evangelising the African tribes were made during the rule of the Dutch East India Company, it was not until the first quarter of the 19th century that a concerted effort was embarked upon, resulting in the establishment of a network of mission stations and schools spread over a large part of the Cape Colony and elsewhere. The overseas missionary societies that were involved in this undertaking include the Moravian, the London, the Rhenish, the Wesleyan, the Berlin, the Paris, Evangelical and the Glasgow missions, the Church Missionary Society and the American Board of Missions."

During that era, South Africa was divided along racial, ethnic and tribal lines. During those days, full citizenship rights were not indiscriminately extended to all Africans. Africans were segregated or marginalised to a large extent, educationally and in other ways, from the dominant society. Some people, in the then government, saw this rather as an appropriate and relevant education system and were only concerned about the growing manifestations of resistance to the existing social order rather than with redressing the educational imbalances. The African education policy only gave rise to a gang spirit. Indiscipline within the schools themselves as a form of defiance of the unwanted education system became the order of the day.

African education (including special schools for blind children) was poorly financed. Behr (1978:159) maintained that state participation in the education of Africans was slow to develop. Until well into the 19th century the missionary societies carried on without any financial help from the government. The government itself made little provision for schools for Non-Whites.

Behr emphasises the above statement when he remarks, “(i)ndeed, ... little was accomplished in regard to the State education for Africans.” Rose (1970:47) alleged that the general character of Bantu Education under the missions was both paternalistic and sporadic in its growth - one of the greatest barriers to the expansion of mission education had been the parsimonious attitude of the subsidising governmental agencies up until 1945. It is further argued in the Report on Education in South Africa (May 2001) that the quality, availability and use of learning support materials were undermined by scarce financial and human resources and that the capacities of the provinces to ensure the provision of adequate training and support for educators in the classroom have suffered because of the shortage of both human and financial resources. As a result, inadequate physical and learning resources had hamstrung implementation in classrooms. That trend, of inadequate human and material resources, still prevails at schools for the blind which have been visited by the researcher.

Beale (1991:33) pointed out that Z.K. Matthews launched a vociferous criticism of the government in the 1950s. Z.K. Matthews “... registered impatience at the pace of African ‘integration’ into the dominant society.” Bertram *et al.,* (2000:76) also indicated that apart from Matthews’ registration of his utter dissatisfaction as far as unequal education was concerned, individuals, and organised movements, were also engaged in registering their utter opposition to unfair and unequal education opportunities. Bertram *et al.* further stated that, “... these ideas were not accepted by everyone in South Africa and there was much contestation and conflict in the area of education...”.

Matthews as a way out from this problem of segregated schooling, proposed the integration of Africans on the selective basis of individual merit, based also on the principle that there were enormous differences in the level of development that the individual African had by and large achieved. Mohlala (1994:28-29), in support of Matthews’ view concerning integration, argued as follows: “(i)t is a truism that Blacks in South Africa will like to see the demise of apartheid education and its replacement by a system of education that will be beneficial to people of all racial and class backgrounds.”

He further argued that South Africa needs an education enterprise that will serve the broader interests of a united and democratically continued society.

Matthews' tough posture on the abolishment of the African education system, was an endeavour to discourage this system as well as to put on record, to both the government of the day and the public at large, his extreme dissatisfaction and belief that segregation in all respects was immoral and should therefore be condemned in the strongest possible way. Matthews was strongly in favour of an education policy or curriculum, which addressed very broad and sophisticated aspects and not one, introduced in the then Transvaal, that was shallow, unsophisticated and less meaningful.

Behr (1978:162) showed how unsatisfactory in the above respects that education system was: "(i)n the Transvaal a new curriculum for African education was introduced in 1915. This curriculum provides, inter alia, moral and religious education, aimed at the cultivation of habits of cleanliness, obedience, punctuality, tidiness, orderliness, self-independence, self-restraint, temperance, chastity, social training aimed at acquainting the Africans with the law of the country, and industrial training adapted to the environment." Nowhere in this curriculum is the importance of science, mathematics, advanced technology, history, geography, et cetera, indicated.

Blind learners in the past and also at the present moment, according to sources studied during this investigation and also to empirical data gathered by the researcher and discussed in detail in chapter six, did not and still do not enjoy doing life sciences primarily because of the attitudes of their educators and/or lack of adequate resources. The consequences suffered by blind learners then and at the present moment, could also be ascribed to the weaknesses of African education and special schools education in the sense that they are taught by inadequate and inappropriately trained educators, the non-recognition by and non-involvement of their parents in education matters, as well as poverty, inadequate policies and legislations, an inflexible curriculum, inappropriate languages of learning and teaching, inappropriate and inadequate support services, et cetera.

Matthews vehemently opposed racial, ethnical and tribal sanctions. He believed that tribal sanctions propagated unnecessary hatred and the neglect of African needs.

Those essential needs, which according to him were supposed to be satisfied, included and are not limited to:

1. The creation of a healthy and intelligent public opinion. Marcum (1982:116) argued that the creation of such an opinion, provided through progressive and adequate means, would enable every South African inhabitant to obtain the essential minimum of knowledge, skills and values which must be recognised and maintained as of highest priority in the programme for the provision of education.
2. The development of those "habits of industry and persistence in work whether for (the individual himself) or in the service of others" (Kros 1990-1991:33).
3. The need for learning mediation on issues of health and sanitation.
4. The need to enhance "the general development of the character of the people" (Kros 1991:33).

Matthews was a strong and influential force behind integration. He always maintained that a non-integrated education system over utilised the limited available resources. Therefore, equality and integration as far as education was concerned constituted a positive solution to this mammoth problem. This opinion was supported by Marcum (1982:116) who observed, "(t)he demand of equality in education is of special relevance as a result of the restriction of available resources and when the real danger exists that as a consequences of the existing obstruction persons or groups may be denied their rightful share in the benefits that education offers." The rightful share referred to, should be understood in the context of "distributive justice" as pointed out by Marcum (1982:117).

Marcum (1982:80) remarked that the aftermath of the Soweto unrest of 1976 in which general dissatisfaction with "Black education" figured so prominently, obligated the South African Institute of Race Relations to appoint a committee to examine education in South Africa and to set alternative policy guidelines for the country.

According to Marcum (1982:80-81) this commission believed that a desirable education system "... for South Africa should be based on the following principles:

1. There should be an emphasis upon equality of opportunity (for different geographical areas, sexes, social and ethnic groups), with supplementary location of resources for disadvantaged groups.
2. No form of separation of the various race and language groups into separate educational institutions should be laid down in laws and regulations, and every effort should be made to integrate educational institutions at all levels.
3. The curriculum should stress not only the learning of basic linguistic, mathematical, and scientific concepts and skills, but also the stimulation of a critical scrutiny of society and encouragement in all pupils of an understanding and appreciation of the religions, music, art, literature, and history of other groups within South African society as well as their own.
4. A comprehensive programme of adult education in cultural, political, and vocational fields. Such a programme would definitely ensure that particular attention be given to the establishment and promotion of functional literacy and numeracy programmes for all those adults who do not have these skills.
5. Education for the entire country should fall under a single ministry, and the system of educational decision-making and management should be designed to ensure effective participation of all interested parties at local and regional as well as national levels.
6. Independent (i.e. non-state) educational institutions, often centres of excellence and innovation, should be recognized, subject to state scrutiny in broader terms, to ensure basic compatibility with the spirit of society and the maintenance of acceptable educational standards."

Matthews advocated liberal government support. He anticipated an elementary education for everyone. Today the constitution of South Africa fully supports his ideas.

The South African Schools' Act No. 108 of 1996 categorically states in (Section 29 (1)) that "... everyone has the right:

1. To further education, which the state, through reasonable measures, must make progressively available and accessible" (Department of Education 1999:1).
2. To a basic education, including adult basic education.

As argued by the Department of Education (1999:1) Matthews' dreams seemed to have materialised because the government of the day sees as its obligation the necessity to provide basic education to all learners and is guided by the recognition that a unified education and training system has to be based on equity, on redressing past imbalances and on a progressive raising of the quality of education and training.

The Report *Education in South Africa* (May 2001) maintained, "(t)he demise of apartheid in 1994 was heralded nationally and internationally as a victory for democracy and human rights. It offered unique opportunity - and responsibilities - to reconstruct a fragmented and deeply discriminatory education system, and established a unified national system underpinned by democracy, equity, redress, transparency and participation." However, this social reconstruction, as indicated above, has to be linked to economic development in the context of global economies and internationalisation.

Matthews was deeply disturbed by the fact that the practical needs of the rank and file were not met outside the classroom in adult education programmes and that the government of the day forgot that "... a broad range of learning needs exists among the learner population at any point in time, and that where these are not met, learners may fail to learn effectively or be excluded from the learning system" (Department of Education 1999:3).

Matthews proposed to the then government that for the African education system to improve drastically and in terms of quality, it was better to have better schools than more schools. His uncompromising opposition to African education prompted the Nationalist Government to appoint the Eiselen Commission of Enquiry. It probed, as its major task, Native Education. It was the Eiselen Commission of Enquiry which determined the educational needs of the Africans and, as a result, Bantu Education came into being. Bantu Education was merely an extension of African Education. For this reason, it will not be discussed in detail.

Owing to Bantu Education's ill intentions, largely similar to those of African Education, democratic forces in the 1980s denounced its policy. Bertram *et al.,* (2000:76) pointed out that there was much opposition and conflict, particularly during the 1976 Soweto uprisings when the masses registered their opposition to this education system. He further articulated his view as follows, "(i)n the 1980s and early 1990s those involved in the struggle against apartheid attempted to introduce an "alternative curriculum" such as People's Education but the state curriculum remained the dominant one in schools." The denunciation of African or Bantu Education by the majority of people prompted the setting up of Commissions of Enquiry whose task was to probe into the causes of the dissatisfaction brought about by the system. As an initial aim, it was hoped that these commissions would come up with amicable solutions and recommendations.

There were different commissions: the De Lange Report, commissioned by the government of the day, the Syncom Report by the business sector and the Buthelezi Report by the chief minister of Kwazulu homeland. All of them forwarded their respective reports in 1991. Different as they were, they more or less concurred with one another in their findings and recommendations that: "... education for blacks be managed for economic growth and that redundant labour be kept at the bantustans" (Nkomo 1990:398).

Education for the disabled in South Africa dates back to the 1880s. The Grimley Institute for the Deaf was begun by six Dominican sisters and later expanded into two schools, one exclusively for White children and the other one for Coloured children. The expansion of the above-mentioned institute led to the provision of education for the differently abled based on racial, ethnic and tribal lines.

For quite a considerable amount of time, the school for Coloured children served all ethnic groups other than White. Behr (1978:197) noted that one hundred years later there were 9 schools for handicapped African children. Those special schools catered for the deaf, visually impaired, cerebral palsied and physically disabled children. That type of education was carried out in accordance with the Bantu Special Education Act, No. 24 of 1964.

However, the best solution to that enormous and difficult problem of desegregated education systems was to introduce a curriculum that is transparent and transformational in nature and character. It had to be a curriculum that enabled all learners, both black and white, to interact with the sources of knowledge by way of problem solving and the discovery of skills, and thus to reconstruct knowledge for themselves (Burden 1999b:24). Burden believes that this type of education will be of great significance (such as problem-solving, investigation, acquisition of competences that are job related, etc.) if it is about gaining understanding rather than absorbing information, as was the day-to-day practice in other education systems.

Grovė and Hauptfleisch (1985:1) suggested that, in order to solve the previously mentioned educational problem, which caused Black people not to be analytical, creative and innovative, ways and means had to be found in helping the learner to build sound foundations for his total development. The researcher is of the view that blind learners should also build sound foundations for their total development, including access or exposure to all learning areas, with great emphasis on life sciences so that they can become active as well as productive citizens of South Africa. Therefore an educator's association with a particular able-bodied or blind learner, will help in equipping that particular learner with a sound foundation for meeting the tasks and challenges of future learning and of life as a whole. Grovė and Hauptfleisch (1985:1) wrote that "(e)xciting, pleasant early learning experiences go with the child when he enters school and on into his whole life-time ahead."

A good education system is generally one that focuses on meeting ever-changing employment needs as well as on encouraging individuals to make meaningful contributions towards their respective societies. Smit (1999:26) observed that education "… strives to educate people so that they are able to live in and are prepared to make their contributions to a … society."

2.3 PEOPLE'S EDUCATION

What is People's Education? What role did it play in the lives of Africans? Was it meant to be oppressive or was it intended to emancipate Africans educationally? Is its impact, whether negative or positive, still felt today? Are there any lessons and experiences that could be drawn from it as a system, which would help shape the current education system? An attempt is made to answer these as well as other questions that cropped up during the analysis of this education system.

Hislop (1988-1989:78) defined People's Education as "People's education in process," and "People's education in the future." During the mid and late 80s, the slogan that was mostly chanted was "People's education for people's power." Black people adopted this slogan as they realised that there was consistent educational oppression. *Research on Education in South Africa Paper Number Two, Bantu Education as a Reformist Strategy of the South African State* (1988:21), noted that People's Education advocated a totally different system of education in terms of content and organisation.

This was a loud and unequivocal call to eradicate apartheid as well as to transform the education system that was commonly known for its corrupt practices and oppressive methods. It became very clear that as the regime itself provided greater access to education, the Mass Democratic Movement called for the democratisation of education, for transformation of the curriculum and for closer links between education and the wider struggle against apartheid. The education transformation referred to, should be seen in the context of something to be struggled for in the process of national liberation.

In support of the earlier perception discussed above, Mohlala (1994:3) observed that Blacks were tired of being subjected to "... poor living conditions, exposure to inferior and unequal education, exclusion from the economic structures, ... the ... policies of apartheid that get into the hearts and minds of most Black South Africans ... young and old." The author (1994:3) supplemented his argument by stressing the fact that Black South Africans were totally opposed to Bantu Education because they realised that "(s)uch abasement does get in the way of most Blacks, and unconsciously or consciously hinder them from making progress in their lives."

Notably and inevitably so, Hislop (1988-1989:78-80) saw People's Education not as a completed or perfected theory but a process, which was supposed to be beneficial to people of all racial and class backgrounds. It had to be, indeed, an education enterprise that truly served the broad interests of a united and a democratically continued society. This process needed to do its best to equip all South Africans with high quality and very useful knowledge.

Mohlala (1994:30), in relation to what people should be able to perform and achieve after going through that education system, aptly stated, "... whatever future type of education people talk about, it should be able to empower students and the community so that they can see the hidden messages of apartheid education."

As one of its most intriguing, important and relevant features, People's Education endeavoured to make explicit the links between education and political, economic and cultural reproduction. People's Education aimed at enabling people to take charge of their education as well as at empowering them in many ways. Furthermore, it also aimed at providing quality and relevant education to the masses. According to the researcher, quality and relevance in education can be attained if the people, through the curriculum, always and by all possible means strive to develop and promote the intellectual and cognitive abilities essential for personal and citizenship development.

People's Education was similar to Outcomes-based Education and Training. Both approaches are aimed at everyone, including the young and the old, illiterate and literate, working and non-working, the rich and the poor, et cetera. In addition, both systems do not undermine people's inputs but aim to make them the "best of the best".

It is mentioned in Mashamba (1990:52) that "... everyone must be involved in discussions and in making plans for the future. People's Education must come from the people. We must all become involved in the development of People's Education and in the implementation of programmes which will ensure People's Education for people's power."

The researcher understands the term "people" here to be referring to all Black and White South Africans who are not politically, economically, educationally and sexually segregated. Rose (1970:67) saw "people" as all those whose primary objective regarding education was in the first place to develop the individual as a member of society, so that he could take his rightful place within the society to which he belonged. By "people" the researcher refers to all those who do not or never sought to destroy other people's culture because of their dominance. By this term, the researcher finally includes, as well, all those who collectively, consultatively and collaboratively struggled against educational imbalances and sought for a better understanding of education and its relevance. They were people willing to fight against poverty, unemployment and the HIV/AIDS pandemic. This was possible because people wanted change and, as such, joined forces specifically for this reason. Mashamba (1990:55-56) commented that South Africans would not have achieved things they would otherwise have imagined impossible if they had not been organised, and if they had not used their collective strength.

People's Education was instrumental in calling for a sudden and rapid change in terms of finance, capacity building, infrastructure and the curricula. Mashamba (1990:58) pointed out, "(i)n People's Education, the struggle for change is a struggle for fundamental, qualitative change, whereby both black education for domestication and white education for domination will be superseded by non-racial and democratic people's education for both national liberation and social emancipation." Furthermore, the struggle for change was vital for the main aim of overturning "... the legacy of apartheid by enabling teachers to change their understandings of what is possible and thereby transform classroom practice ..." (*Report Of The Review Committee on Curriculum 2005*, 31 May 2000).

A qualitative education should be able to arm individuals with the appropriate skills and capabilities necessary for executing tasks in society. It should be an education that really serves the interests of the individual, the interests of the state, the interests of classes and race, the interests of profit and profit-making institutions, the interests of academic prestige, politics and religion, and, indeed, the interests of the people as a whole and especially the poorest of the poor, who are vulnerable and the most oppressed of the oppressed. It is argued in the Report *Education in South Africa* (May 2001) that all South Africans should have equal access to lifelong education and training opportunities, which would contribute towards improving the quality of life, and building a peaceful, prosperous and democratic society. Therefore, transformation in education is of paramount importance to South Africa's economic prosperity, in order to assist all South Africans, both individually and collectively, to escape the "poverty trap" characterising many South African communities.

People's Education was of strategic importance in demanding and pursuing equal access to and resourcing of education for all in South Africa. Nonetheless, it tried in vain to eliminate racism from textbooks, print and electronic media, teaching and organisations in education. The previous regime, embarked upon a campaign to win the hearts and minds of Blacks. Even though this was rejected on a massive scale by Blacks, the regime continued to perceive this campaign as a key objective; hence its large investment in education and its violent attacks on the student movement, the youth, and the leadership of educational organisations like the NECC.

2.4 AN OVERVIEW OF SPECIAL EDUCATION AND REASONS FOR EMBARKING UPON AN INCLUSIVE EDUCATION POLICY

Mashamba (1990:63) commented, "(p)eople's Education thus proposes a process of socialization for a united, non-racial and democratic South Africa which, at the same time, lays a basis for a future education system." According to the researcher's comprehension, that education system highlighted in Mashamba's discussion, is none other than Outcomes-based Education and Training. By the look of things, Outcomes-based Education and Training holds the key to educational transformation and success for the entire country. We are given hope and encouragement by an unknown author when he points out in Ntsika Enterprise Promotion Agency (2001:35) that "whatever we vividly imagine, ardently desire, sincerely believe, and enthusiastically act upon must inevitably come to pass."

As alluded to under African Education, Behr (1978:156-163) argued that disabled learners in South Africa were introduced to formal education at the "Doofstommen en Blinden Instituut" at Worcester in the Western Cape in 1881. Formal education for the blind started ten years later in 1891 when Mr. J. Besselaar was charged with the responsibility of mediating a class of four blind learners. This section developed and grew into what is today known as Pioneer Institute for the Blind.

The establishment of the South African National Council for the Blind (SANCB) in 1929 made the education of blind learners a priority. This organisation played an instrumental role in the past, and still plays a fundamental role at the present moment, in both the support and the development of further schools for this particular group of learners with special education needs.

In the not so distant past, the further support and the development of education as well as other related services for blind learners, in South Africa, was characterised by a slow but steady growth and progress. There are now approximately twenty schools or sections where blind learners receive special education. These schools for the blind or schools with sections for the blind are: Pioneer School for the Blind, Athlone School, Khanyisa School, Efata School for the Deaf and Blind, Zamokuhle School, Arthur Blaxall School, Ethembeni School, Bartimea School, Thiboloha School, Sibonile School for the Blind, SneThemba School (former Katlehong School), Filadelfia Secondary School, Prinshof School, Silindokuhle School, Re-Tlameleng School, Bosele School for the Deaf and Blind, Siloe School, Setotolwane Secondary School, Tshilidzini School for LSEN and Letaba School.

It is highlighted in the South African National Council For The Blind draft discussion document *Education for the Visually Impaired* (1997:9) that some of these schools are well developed and resourced and accommodate relatively large numbers, while others are still in the process of development, have limited enrolment and need some basic resources.

Not all blind learners in South Africa are admitted to separate schools which solely specialise in the education of blind learners. As a result, a number of learners, especially in secondary education (grades 8-12) in the Further Education Training Band have to attend ordinary schools in the mainstream of education. The Department of Education's Policy should therefore, be seen as a system that endeavours to integrate blind learners in the Senior Phase and Further Education and Training Band with sighted learners. Inclusive education further entails providing for blind and visually impaired learners in regular schools in what is known and understood as "the mainstream of education." Therefore, the present research focuses on these learners who are in special schools but who may, because of education transformation, end up in inclusive schools.

In 1994, when most of the previous education systems (homelands, self-governing, White, Indian and Coloured systems) were transformed, so was "special education". This transformation was made possible by the passing of legislation such as the South African Schools Act (1996), the Higher Education Act (1997), the Further Education and Training Act (1998) and the Adult Basic Education and Training Act (2000) and the accompanying White Papers, which provided the basis for the establishment of an inclusive education and training system. All stakeholders put this system in place to ensure and facilitate appropriate expertise and proper representation. Representatives of various communities would further enable advisory bodies to give expert advice and to determine goals and priorities.

It is argued in Education White Paper 6 (2001:27) that inclusive education in South Africa, as in other parts of the world, has been introduced to provide the basis for overcoming the causes and effects of barriers to learning. It therefore, by implication, advocates the admission of blind learners to all education settings, such as designated full-service or mainstream schools and settings.

It is anticipated that the inclusive education policy will encourage the establishment of an effective management, policy, planning and monitoring capacity in the national and provincial Departments of Education. According to the researcher, this policy is a broad one, which should not only serve disabled learners' educational interests and needs, but also serve as a vehicle to sensitise and conscientise the public regarding disability related issues, advocacy campaigns, and the development of appropriate and necessary capacities and competences. The inclusive education system focuses on and calls for the abolition or revision of all former policies, legislation and structures, that may be necessary to facilitate and enhance the transformation process.

Other factors that cause inclusive education to be considered a relevant education alternative are discussed hereunder. The researcher is of the opinion that inclusive education and schools have the ability to provide a quality mediated learning experience characterised by fully developed education plans in order to improve the quality of all educational activities. This quality education should accommodate, if possible, all disabilities and all learners should contribute and participate actively and meaningfully and also benefit from social, educational and sporting environments. In support of the previous arguments, the Education White Paper 6 (2001) maintains that inclusive education is both adopted and implemented in order to strengthen special schools rather than to abolish them.

Inclusive education takes place in many forms. These forms include:

- The regular classroom, without the help of experts. In that instance, the classroom or learning area educator handles the problem him or herself.
- The regular class, but the educator receives support from one or more specialists. Kapp (1991:71) maintained: "(t)he latter could be the special educator who acts in a consulting capacity or the itinerant teacher who advises teachers within a certain geographical area."
- The regular class, where the learner is only removed from the class for certain periods and is offered additional or supplementary learning mediation activities. In most instances, the resource educator gives to learners individualised mediation or, in small groups, conducts supplementary learning mediation activities. The class educator and the resource educator are expected to work together in order to continue assisting those learners.
- The special self-contained class, where a specialist educator would teach learners with the same disability in separate but small classes. However, according to Kapp (1991:71), "(c)ertain periods, such as those for music or physical education, are still taken together with the other children."
- Special schools as separate institutions, where specialised mediation for a particular category of disability is provided. Special residential institutions (often referred to as hostels) give twenty-four hour care to children.

In the researcher's point of view, both inclusive and special education systems have challenges and drawbacks.

These challenges include the following three factors:

A The expansion of access and provision of quality education and support

According to the researcher and to experience, it has been and it will continue to be a challenge to afford access to special schools, and expand that access and provide quality education to other blind learners, because of the expenses that will be incurred. This became evident during the research to schools project, in which the researcher was involved during April to June 2002, in his capacity as the SANCB's Co-ordinator: Education Services. This project revealed that the government could not run and properly maintain existing schools.

B Necessary physical and material resources

It is, and it will be, challenging to adapt and make physical and material resources readily available to blind learners. At most schools, educators and support staff should be adequately trained in order to be effective and supportive during learning mediation for blind learners. The challenge will therefore be to provide adequately trained educators and support staff and relevant equipment.

C Curriculum

The curriculum for blind learners at special schools comprised only a few subjects: languages and human social sciences. In the researcher's view, both special and inclusive education systems will be faced with a difficult task in making Outcomes-based Education (especially life sciences, mathematics and technology) accessible. Both systems have the responsibility to facilitate and guarantee the provision of unrestricted education which would enable all blind learners, if possible, to access different subject groupings (human social sciences, economic management sciences, natural sciences, mathematics, art subjects and technology related subjects). All subjects have to be accessible so that blind learners can be in a position to make informed career decisions and practise professions.

Furthermore, it was and it is still a challenge for stakeholders and education authorities to understand and come to terms with blind learners' unique needs, which do not warrant being addressed merely as general needs. This group of persons needs Braille, Orientation and Mobility, Activities of daily living, Sensory development, etc. It will be a challenge for inclusive educators to master Braille codes, which is apparently a daunting task to educators at special schools.

Lastly, it will be a challenge to structure inclusive education in such a manner that blind learners would acquire skills to operate assistive devices independently and competently.

The researcher is concerned that in inclusive education, Braille and independence training specialists are not part of this system and it would be advisable that those individuals continuously be involved in all aspects of the education of blind learners. Their knowledge is absolutely instrumental for improving and making education accessible.

It is also the researcher's serious concern that most blind adults who went through the education system, also serving as role models to both blind learners and youth, are not afforded the opportunities to contribute, that could be of immense value in the consideration and implementation of changes in the education system. The same applies to organisations of and for the blind.

However, for both special and inclusive education systems to succeed, all stakeholders should make an effort, be dedicated, have perseverance, be diligent, show love, demonstrate compassion, exercise patience, be both hopeful and trustful, and possess both the ability to handle and an in-depth knowledge of challenges, needs and concerns, in order to effectively provide access to barrier-free education for blind learners.

2.5 A HISTORICAL PERSPECTIVE ON OUTCOMES-BASED EDUCATION AND TRAINING

Throughout various education systems or programmes, the researcher has noticed various incidents of racism. The African National Congress-led government felt it was just and proper to get rid of them. According to (Bertram *et al.,* 2000; Mohlala 1994; Van Der Horst and McDonald 1997; Rose 1970; Report *Education in South Africa* May 2001 and *Report of the Review Committee On Curriculum* 2005), changing the education approach was essential for giving the youth of today the knowledge and skills essential for the future economic growth of our country. South Africa wanted an education approach that is capable of significantly improving and enhancing the welfare, both materially and psychologically, of the masses of its population. South Africa, just like first world countries, has opted for an education approach that is initiative, innovative, creative, productive and responds directly to the aspirations of the majority of the population. There was, and still is, a need to redress the imbalances of race, gender and disability, both in access to training and in jobs. Locally and internationally, governments are adopting education approaches that have the potential significantly to improve skills, incomes and job satisfaction for their citizens. In essence, the education approach known as Outcomes-based Education and training aims at giving all citizens, young and old, and, in particular, those who were totally denied learning mediation opportunities, unbiased and unrestricted access to education and training situations, so that they can attain qualifications that will allow them to compete successfully and efficiently for jobs on the basis of merit.

Morrow (1989:170), in supporting the aforesaid reasons for curriculum change, reported that society at large needed first to develop a vision of a desirable outcome, and then think out how schools could be used to achieve that outcome. He (1989:170) added that the phrase “education for the future” is appropriate here. Morrow (1989:170) further asserted that the desirable outcome was a vision of an ideal society, which is a kind of package, specifiable in advance, of the kind of society one wanted to achieve. Education reform, in one way or another, is both a true and a positive result of the demands of both the local and the international economy and society, which have placed mankind in the middle of the information age. As such, the complex and technologically dominated, multi-cultural and constantly changing world demands far better learning mediation results from all educational institutions than they have ever produced. Spady (1994:28) indicated that Outcomes-based Education and Training has the inherent potential to meet these demands.

It is also an indisputable truth that our technological age educational system embodies and perpetuates patterns of practice that prevent or impede many learners from learning successfully. The education emphasis which previously concentrated on the means, when and how of educational programmes, has negatively influenced and seriously (but not irreparably) damaged schools and education, because schools compromised on these issues. Outcomes-based Education and Training has capabilities to revise and redirect both organisational priorities and patterns.

Spady (1994:28) concurred with other authors who reported on the auspicious impact of Outcomes-based Education and also reported that Outcomes-based Education and Training shared many philosophies and approaches which are instrumental for redefining organisational purpose, processes and effectiveness in the corporate world. Hence, the principle of total quality management, reengineering the organisation, systemic change, corporate excellence, and a range of other organisational improvement approaches were all compatible with the philosophy inherent in OBE which stated that "all can learn and succeed," that one should "create the conditions for all to succeed," and aim at "continuous improvement".

It is strongly believed by advocates of this approach that when authentically implemented in a consistent and systematic fashion, it could live up to its inherent potential, thus fostering major improvements in learners' learning mediation and staff effectiveness in schools of all kinds. Outcomes-based Education and Training, as an approach, is capable of going beyond the vague symbols, labels and scores used as indicators of learners' learning mediation and achievement. Outcomes-based Education and Training focuses more on the documentation and substance of what the learner has in reality learned and experienced during Mediated Learning Experiences and can properly do. The value of this system is evident because it is capable of giving educators, parents/guardians, institutions of learning and likely employers a much more accurate picture of learners' capabilities.

Of pivotal importance too, education is renewed in order to both promote and guarantee the most balanced view of it, that is by actively and diligently developing learners' critical thinking powers and their problem-solving abilities. All learners should receive adequate education characterised by equal financing, resourcing, better qualified as well as more competent staff, and better learning mediation facilities. In South Africa, the renewal of education is also instrumental for integrating the segmented education departments, which operated along racial, ethnical, political and tribal lines.

2.5.1 WHAT IS OUTCOMES-BASED EDUCATION AND TRAINING?

OBET/OBE is an acronym for "Outcomes-based education and training." According to Spady (1994:2) Outcomes-based Education and Training implies making unambiguous statements about the values and attitudes that are being promoted as learners engage in learning mediation processes.

Outcomes-based Education and Training, as an approach, expects of all learners (able-bodied or disabled) and, in particular in this case, blind learners, through the assistance, dedication, motivation and commitment of educators, to achieve certain outcomes during learning mediation. Outcomes should be understood as clear learning mediation results that educators expect from learners, requiring that learners must effectively, sufficiently and competently demonstrate these at the end of significant and comprehensive learning mediation experiences. Outcomes are not in any way values, beliefs, attitudes, or psychological states of mind. Outcomes are rather what learners could in the true sense do with the acquired knowledge or learnt skills. Clearly, they are practical applications of what has been acquired or learnt.

To support the previous statement, Spady (1994:2) states that outcomes are actions and performances that embody and reflect learner competence in using content, information, ideas and tools successfully. Education should, as advised by Spady (1994:3), be based on outcomes. This implies that people should be able to define, decide, organise, structure, focus and operate "... what the system does according to some constituent standard or principle."

2.5.2 DIFFERENT TYPES OF OUTCOMES

When working through documents covering the extent of outcomes and OBE it becomes clear that outcomes embrace various ideas and functions.

Content focus outcomes:

Content focus outcomes base the classification of outcomes on the disciplines, subject areas, or the content they represent. Examples where content focus outcomes, generally speaking, are used include the areas of mathematics, life sciences, economics, accounting, history, geography, reading, writing, spelling, et cetera.

Time-referenced outcomes:

Entail that outcomes should be classified according to the time blocks to which they are linked. The following are a few examples of time-referenced outcomes: elementary school outcomes, middle school outcomes, semester outcomes, Craft Guilds of the Middle Ages, Apprenticeship Training in the Skilled Trades, Personnel Training in Business, Professional Licensing, Military Training Programmes, Fire-Fighting Programmes, Scouting Merit Badges, Karate Instruction, Scuba Instruction, Flight Schools, Ski Schools, One-room Schools, houses, "Alternative High Schools and Parenting", short, middle and long-term outcomes, and grade-level outcomes.

Curriculum scope outcomes:

According to Van Der Horst and McDonald (1997) these are classified according to the scope of the curriculum segment/s to which they are linked. Examples of these outcomes are lesson, unit and programme outcomes.

Jurisdictional domain outcomes:

Entail the classification of outcomes on the basis of the organisational jurisdiction that both defines them and effectively uses them for accountability or reporting purposes. Examples of such outcomes include state, district, regional, provincial and departmental outcomes.

Competence complexity outcomes:

Could take place and as well be directed by the nature, character, scope and the complexity of the competence that should be employed during their performance. Examples of these outcomes include discrete skills, complex unstructured tasks, and complex role performances.

Operational function outcomes:

Are outcomes classified according to the function/s they serve within a design framework. Examples of these outcomes include culminating, enabling and discrete outcomes.

2.5.3 THE ORIGIN AND DEVELOPMENT OF OUTCOMES-BASED EDUCATION AND TRAINING

The origin of Outcomes-based Education and Training as an educational approach can be traced back to and also associated with the following approaches:

2.5.4 EDUCATIONAL OBJECTIVES

This approach is the brainchild of Tyler ([s.a.] [s.p.]). The curriculum that Tyler both envisaged and anticipated, identified a number of key issues which both developers of curricula and educators have to seriously consider when developing curricula and planning various forms of instruction. This is to say that, as a ground rule, education should be the main purpose. Furthermore, education should possess content. Education that is purposeful and has content, should also be both well organised and well implemented in order for all learners to be able to acquire knowledge that they can practically use in their day to day activities. Finally, educators should from time to time evaluate and revise both the curricula and learning mediation planning in order to bring about both drastic and meaningful change and improvements if need be.

Bloom ([s.a.] [s.p.]) added some aspects to what Tyler had initially proposed, which include learning progressing from simple to complex, that is knowledge through understanding, application, analysis, synthesis and evaluation.

2.5.5 COMPETENCY-BASED EDUCATION (CBE)

This approach emerged towards the end of the 1960s in the United States of America ([s.a.] [s.p.]). People from all walks of life, lacked confidence in and exhibited strong reservations about an education that was not geared for preparing learners for life after school. The concerned public advocated that learners be equipped with skills, which would be instrumental in a working world.

According to the American public, competency-based education was required to focus on an integration of outcomes, goals, Mediated Learning Experiences, and, above all, assessment devices. The disadvantage of this educational approach is that education "... was in practice often merely reduced to a testing and remedial programme" (Van Der Horst and McDonald 1997:10).

It is further reported by Van der Horst and McDonald (1997:10) that the lack of consensus on what were considered essential "competences" led to a debacle in that movement and what it stood for. The term "competences" possesses meanings ranging from: survival or life skills, basic skills, psychomotor skills, professional and vocational skills, intellectual skills, to both interpersonal and personal skills.

On the other hand, Voorhees (2001:9-10) noted that with regard to competency-based education there are multiple definitions of student learning outcomes, objectives and skills. In Voorhees' quest to eliminate confusion, he adopted the following as the definition of competency-based education. According to his view, a competency is "(a) combination of skills, abilities and knowledge needed to perform a specific task". He went further, noting that the term performance-based learning was commonly used in this volume as a framework for learning systems that seek to document that a learner has attained a given competency or a set of competences.

Voorhees (2001:9-10) suggested that a pyramid of competences that embraces the following rungs/aspects, which are interrelated, should be acquired by all learners in order for them to be both competent and productive members of society.

Traits and characteristics:

Traits and characteristics constitute the foundation for learning and depict the innate makeup of individuals, on which further experiences could be built. Further, differences in traits and characteristics help explain why people pursue different learning experiences and acquire different levels and kinds of skills, abilities, and knowledge.

Skills, abilities and knowledge:

This is the second rung of the ladder/pyramid. Skills, abilities and knowledge are developed through learning experiences, and are broadly defined to include, among other things, work and participation in community affairs. Therefore, competences are the result of integrative learning experiences in which skills, abilities and knowledge interact to perform learning bundles.

Demonstrations:

These are the results of applying competences. At this level, performance-based learning could be assessed. The bundling and unbundling of competences drive competency-based initiatives. The most daunting task, however, is to determine competences that could be bundled together to provide and produce different types of learners with the optimal combination of skills, abilities and knowledge needed to perform various tasks.

According to the researcher's point of view, both competency-based education and Outcomes-based education have the same advantages and similarities. Because in both systems, learning can be described and measured in ways that everybody can understand, competences or outcomes permit the learner to return to one or more competences that have not been mastered or outcomes that have not been attained in a learning process, "… rather than facing the unwelcome prospect of repeating one or more traditional courses" (Voorhees 2001:11).

Both competences and outcomes provide learners with a clear map and the navigational tools which are essential for moving expeditiously towards the envisaged goals. In an ideal world, competences and outcomes would logically and clearly build on other competences/outcomes. Competency-based education and Outcomes-based education enable time horizons to become more manageable, yet provide flexible learning situations, processes and activities to learners regardless of their pace and style of learning.

2.5.6 COMMUNITY SERVICE LEARNING

According to Kinsley (2002 [s.p.]) community service learning is a combination of Freire, Tyler and Taba's theories. It is closely related to competency-based education. According to various authors, the acquisition of various skills amounts to nothing if those skills do not benefit the entire community. The use of different methods such as reading, writing, observation, research, problem solving, discussion, graphs, art, music, drama, et cetera, should, encourage community interaction.

In reality, programmes have to be identified and appropriately planned by those who participate in them, and be based on real needs. Kinsley (2002 [s.p.]) indicated that Freire, who is the proponent of the community development theory, believed that the most successful programmes emanated from the grassroots level with input from all constituencies involved.

This type of education has the following advantages:
Service experiences could be used to teach basic skills and apply research as well as help learners develop the social and personal skills, which are crucial for understanding the concept of community. According to Kinsley (2002 [s.p.]) service experiences enhance educators' understanding of community service learning as a process and as a learning mediation strategy. Integration of service experiences affects how mediation of learning takes place and could be viewed as a learning mediation strategy to enhance educational reform. Such experiences give learners opportunities to develop a sense of community by "... experiencing community within their classrooms, school, neighborhood and city".

Kinsley (2002 [s.p.]) further asserted that service experiences expose learners to a variety of learning situations because they are involved in active and cooperative learning, problem-solving, multicultural experiences, and offer ways for all learners to participate, which is a key to the development of young people.

MASTERY LEARNING
This is an approach that enables learners to focus strictly on learning goals. It is capable of making learners realise that it is of high value and cardinal importance to learn and that outcomes are achievable. Through mastery learning, the ability of learners is improved significantly. Mastery learning simply means that: "... if the proper conditions can be provided, 90-95% of learners can actually master most objectives" (Van Der Horst and McDonald 1997:11).

The mastery learning concept moved away from the notion that learners merely have more or less potential, and, therefore, achieve more or fewer learning mediation successes. Mastery Learning expected and compelled education providers to provide the most suitable, pleasant and propitious conditions for effective learning mediation. Mastery Learning always strove to ensure that all learners are granted ample opportunities in order to be successful at most learning mediation activities, by providing an appropriate learning mediation environment (specifically adapted for blind learners), learning mediation materials (adapted for blind learners), and back-up guidance.

Outcomes-based Education and Training in the researcher's view has used aspects of each of the Educational Objectives, Competency-based Education, Community-service Learning and Mastery Learning approaches as its point of departure.

Outcomes-based Education and Training curriculums takes, according to Bertram *et al.,* (2000:283), different forms. These authors (2000:283) argued that most countries have stayed with government-defined syllabuses and resources (inputs models) while a small number of countries have opted for outcomes models (specifying what students should know and be able to do). Among the outcomes approaches there are significant variations.

Some countries, the United States of America, Canada and South Africa, do offer Outcomes-based Education and Training. In the United States of America, it is also referred to as National Standards. Profiles (an Outcomes-based approach), as it is called, was also introduced in Australian schools in 1990s. In the United Kingdom and New Zealand it is often referred to as the National Curriculum.

All these education approaches share some common features, motivations and ambitions. Further examples of these education approaches are resource based learning, the Target Oriented Curriculum implemented in schools in Hong Kong in 1997, et cetera.

As a result, the "(S)outh African curriculum reflects the needs of the country and its people. It is called Curriculum 2005 and uses an Outcomes-based approach. While designed for South Africa, it is nevertheless compatible with curricula in other countries" (Liberty Independent Newspaper [s.a.] [s.p]).

2.5.7 MAJOR REASONS BEHIND THE IMPLEMENTATION OF OUTCOMES-BASED EDUCATION AND TRAINING

How did it come about that the government of the day dissolved the old education system and resorted to the implementation of the new system of Outcomes-based Education and Training? The reasons are manifold. These, and other factors discussed above, contributed to the renewal of our education system.

The present government surely wanted nothing else than to facilitate as well as to fast-track educational change. In addition, the government was eager and determined to totally eliminate the legacy of the past education systems which history has been discussed in this chapter, where it became apparent that their curricula have perpetuated race, class, gender and ethnic divisions and have emphasised separateness, rather than common citizenship and nationhood.

Botha (2002:362) contended that all facets of education were arranged according to the dictates of the system of apartheid, so this meant that people of the different race groups were provided for in terms of their racial identities. Malcolm (2000:10) commented that by contrast, Outcomes-based Education in South Africa was introduced, in part, to loosen up a system that was seen to be too rigid (with its syllabuses, textbooks, exams and inspectors), and too divided (as a result of the background of apartheid). Roles were generally distinct and narrowly defined: this is what a teacher does, this is what a principal does, this is what a learner does to fit into bureaucratic structures and management. Principals, teachers and learners worked more as technicians than critical professionals. Delegation and avoidance of responsibility were common.

According to Malcolm (2000:11) Outcomes-based Education had to be implemented because of having the capacity to provide the tighter structures and accountability sought by many countries, and also greater freedom for learner-centred education. The provision of capacity is made possible by this system being able to prescribe a single set of outcomes for all schools (defined loosely enough to allow local variations), and then devolve to all schools the responsibilities for achieving these outcomes. Malcolm emphasised that the success of the strategy lies in defining outcomes with the right balance of freedom and control, providing appropriate systems of accountability, and building schools' capacities in curriculum design and management.

In addition, Botha (2002:362) maintained that the implementation of Outcomes-based Education is a way to root out apartheid education and to create a new vision of empowered citizens for the future South Africa. The new system should ensure that crisis in the education system is eliminated. As an instrument of reform, Outcomes-based Education promises to improve the quality of education in South Africa by guaranteeing success for all; developing ownership by means of decentralised curriculum development; empowering learners in a learner-centred ethos; and making schools responsible and accountable in their quest to ensure success and effectiveness.

As noted by Botha (2002:362), "(t)he formulated outcomes of the model underscore the above aspects and emphasize the development of critical, investigative, creative, problem-solving, communicative and future-oriented citizens … Outcomes-based Education, without a shadow of a doubt, constitutes a radical break with the previous education approaches … of South Africa of earlier."

Despite Cross, Mungadi and Rouhani (2002:179) agreeing in principle with all the factors stated by both Botha and Malcolm as leading to the implementation of Outcomes-based Education, they in addition view the introduction of Outcomes-based Education as being of immense value in the sense that it endeavours to:

- Align schoolwork with workplace, social and political goals;
- Emphasise experiential and cooperative learning;
- Pursue the value of diversity in the area of race, gender and culture;
- Develop citizens who are imaginative, being able to manage themselves and their activities responsibly and effectively;
- Help them to work effectively with others in a team, group, organisation and community;
- Assist them to collect, analyse, organise and critically evaluate information;

- Guide them to use science and technology effectively and critically, showing responsibility towards the environment and the health of others;
- Encourage them to understand that the world is a set of related systems.

Furthermore, it became necessary as a matter of urgency to implement this curriculum so that, as suggested by Tiley (1997:1), the educator would no longer be merely the one-who-teaches, but also the one who is himself or herself taught in dialogue with the learners, who in turn while being taught, also teach. According to Tiley (1997:1), both the educator and the learners "... become jointly responsible for a process in which all grow."

The same author (1997:2) added that theory without practice is sterile, while practice without theory is blind. This is exactly how the old system used to function.

If one changed or endeavoured by every means to change one's way of doing something, this way of doing something would also rapidly and remarkably change. However, for change to be successful, all of us should be in a position to know and appreciate what we are doing, to (more than before) love what we are doing, and fervently believe in what we are doing.

Tiley (1997) pointed out the above-mentioned aspects as being critical for a proper and essential change. For this to happen, he suggested that people should start by changing how they think, arrange the classroom, plan, use educational materials, books, resources, and stationery. Furthermore, educators should assess learners, ask questions, consult and collaborate with other educators, and manage the classroom.

The implementation of this programme would help both educators and learners to change a great deal regarding what they (educators) should mediate and learners should learn. In the past, planning for each week was based on and centred around what the scheme of work, school's year programme or syllabus prescribed. Now, educators need to consider, and also reconsider if necessary, which specific learning mediation activities will most certainly provide and facilitate the most adequate and richest opportunities for each learner to satisfactorily progress at his or her own pace. Botha (2002:362) put this well by holding that the implementation of Outcomes-based education is a means to emancipate learners and teachers from a content-based mode of operation, but is also a response to international trends in educational development.

The Government of National Unity led by the African National Congress found it to be of significance that: "(t)he curriculum be restructured to reflect the values and principles of our new democratic society" (Senior Phase Policy Document 1999:7). This new curriculum is founded on four pillars as indicated by Tiley (1997): assessment, planning, implementation and reflection.

Due to the country's past history, and to a great extent its legacy of inequality, the government took a tough, uncompromising but fair decision to deploy its resources according to the principle of equality and fairness so that those resources might be utilised especially to provide and promote essentially the same quality of learning mediation opportunities for all citizens. For all these envisaged plans and educational programme

(Outcomes-based Education and Training) to materialise and to be protected, the South African Schools Act was passed.

Though there are numerous reasons behind the implementation of Outcomes-based education, the researcher believes that those discussed in this section most encapsulate the general thinking behind the introduction of this system in South Africa.

2.5.8 THE SOUTH AFRICAN SCHOOLS ACT NO. 108 OF 1997

What role did the South African Schools Act play in the implementation of the Outcomes-based Education and Training programme?

In order to answer this question, we should acquaint ourselves with the provisions of this Act.

In the researcher's opinion, the Act regards the education of all South Africans of all racial groups to be crucial for future growth and development, and above all, for the upliftment of its entire population. This simply means that a good education system should indisputably produce the skills our industrialising economy needs, the society we so much want, and the most responsible citizens upon which our new democracy will depend.

It is stated in *Sowetan* (April-May 1997:1), that the South African Schools' Act, which came into effect on January 1, 1997, consigns to history the sub-standard and unequal schooling of South Africa's apartheid past, and creates "... a single school system in which people can work together to improve education quality and ensure that all children have an equal opportunity to learn."

As a result of this desire, people in different sectors and communities were consulted about and collaborated in shaping this new education system. By involving all stakeholders, South Africa performed a commendable task. Spady (1994:3) commented that: "... outcome design and development deliberately ... engage a community's key constituents and stakeholder groups. With the future of all students at stake, no one group should have the privilege or carry the responsibility for unilaterally determining this critical process."

People involved in the shaping of this education system included: parents, learners, educators, organisations interested in education and members of the community at large. This extensive research achieved, as the *Sowetan* (April-May 1997) put it, many "firsts", all of them being the foundations of the desired democracy.

For the first time schooling became compulsory between the ages of six and 15. For the first time all learners would have equal access to all schools. For the first time the rights of learners, parents and educators are protected. For the first time true representatives, in the form of School Governing Bodies (replacing school committees), are introduced in the governance of schools.

For the first time provincial education authorities, as an obligation, would admit young people with special education needs (for inclusion) to ordinary public schools, "... where this is reasonably practicable, and provide suitable educational support services for them. Physical facilities at public schools must be made accessible to disabled learners" (*Sowetan* April-May 1997:1).

2.5.9 THE MAJOR AIMS OF SOUTH AFRICAN SCHOOLS ACT

This Act aims at the following:

1. Helping people learn how to make sound, compassionate judgments in a changing world.
2. Enabling people to make informed decisions, to challenge policies, to adjust and adapt to change, and to apply the acquired knowledge.
3. Developing people's skills, confidence and competency.
4. Making education better, more accessible, more reconstructive, more transformative, more efficient, more effective, more worth providing, more worth investing (in all respects) in it, more applicable, more worth learning, more equal (in all respects), more empowering, more enabling, more inclusive, more relevant and meaningful, more practical and more just.
5. Creating a single non-discriminatory society, which would strive to promote and cater for the economic, social, spiritual and political needs, interests, demands, and aspirations of our country.

This should be possible if all citizens involve themselves in protecting and advancing our diverse cultures and languages. Education should inculcate in learners skills to uphold the rights of all learners, parents and educators. Through education, the South African society should promote the acceptance of responsibility for schools, in partnership with the state.

The Act further aims at building a unified future, by creating a single, unified schools system co-ordinated by the national Department of Education and run by the 9 provincial departments.

To curb divisions, racism and ethnicity, Tiley (1997:3) advises that the education and training system should undergo change so that it can provide the full range of learning needs. Education should develop learners' strengths, empowering and enabling them to participate effectively, actively, fruitfully, meaningfully, productively and critically in the learning mediation process. Tiley (1997:3) further maintained that the education and training system should be structured and function in such a way that it is able to accommodate a diversity of learner needs.

Public schools are divided into ordinary schools and special education schools, and are again subdivided into schools on public property and those on private property. To enhance transparency and efficiency in the schools' governance, School Governing Bodies, where in some instances learners from grade 8 upwards might represent or be represented by fellow learners in this structure, will now replace committees. The new education system will strive to create a culture of learning and teaching, especially at devastated black schools. It will be expected of the culture of learning mediation to inculcate into learners discipline, application, determination to succeed, diligence, et cetera, in its quest for improving education at all levels.

What the researcher finds to be exciting about this Act is that it makes provision for the education of learners with special education needs. As a prerequisite, stipulated in this Act, schools should take every possible step to make their learning mediation facilities accessible to the disabled community. In situations where learners cannot be properly catered for in ordinary public schools, special schools still exist for this purpose.

2.5.10 COMPARISON AND CONTRAST OF HISTORICAL EDUCATION SYSTEMS

According to Spady (1994:6) the main differences between Outcomes-based Education and Training and historical systems fall into four key areas, which as noted above are in the curriculum, learning mediation strategies, assessments and performance standards. As he puts it, an "(o)utcomes-based system builds everything on a clearly defined framework of exit outcomes."

Historical education systems placed emphasis on aims and objectives, while Outcomes-based Education and Training places its emphasis on Outcomes based Education. The former were prescriptive, while Outcomes-based Education and Training is descriptive. Spady (1994:6) asserted that "… traditional systems already have a largely predefined curriculum structure with an assessment and credentialing system in place. They usually are not structured around clearly defined outcomes expected of all students. By and large, curriculum and assessment systems are treated as ends in themselves."

According to educators who were present at the Outcomes-based Education and Training workshop held at Tshilidzini School for Learners with Special Education Needs from 19-21 March 2001, historical education systems had many Departments of Education, while Outcomes-based Education and Training has one national Department and 9 provincial Departments. Historical systems focused largely on content, while Outcomes-based Education and Training focuses mostly on skills. Educators in the traditional systems transmitted much of the knowledge to pupils; whereas in Outcomes-based Education and Training learners construct their own knowledge and practise acquired skills. This stimulates and encourages, to a large extent, creativity and critical thinking. In the historical systems, educators took the responsibility for learning mediation, while in Outcomes-based Education and Training learners share responsibility for their learning mediation.

Tiley (1997:4) emphasised the importance of this advantage by referring to the following two crucial outcomes:

1. Learners work effectively with others in a team, group, organization and community.
2. Learners organise and manage themselves and their activities responsibly and effectively.

To support this point Tiley (1997:4) advised that in order to practise these skills learners need to sit so that they can talk to and work with each other in groups. This could be regarded as cooperative learning in the making.

In traditional education systems, assessment was normally done at the end of a section of work, while in Outcomes-based Education and Training it is suggested that assessment is ongoing, in order to establish and to respond to each learner's day-to-day needs. In order to support this thought, Spady (1994:6) indicated that in Outcomes-based Education and Training assessment should be viewed as a flexible and alterable means for accomplishing clearly defined learning "ends".

In the traditional education systems, tests and examinations were used to compare, place and grade pupils, while in Outcomes-based Education and Training, learners are assessed in a variety of ways and different situations. Spady (1994:6) pointed out that the traditional systems operated around comparative/competitive approach standards, linked to a predetermined "curve" or quota of possible success. Furthermore, Outcomes-based Education and Training is effective in emphasising co-operation, supplemented by mutual support to learners.

Historical education systems divided learning mediation into fixed subjects and fixed periods of time, while in Outcomes-based Education and Training learning mediation is integrated and time is used flexibly. In traditional education systems, time defined most system features. In other words, time used to be an inflexible constraint for both educators and learners. In most instances, both the schedule and the calendar controlled the learner's learning mediation and the learner's success.

Traditional education systems were characterised by passive learners, while active learners characterise Outcomes-based Education and Training. Tiley (1997:6) supported this argument as follows: "(i)f learners, even very young learners, have an opportunity to take charge of their own learning, follow their own interests and work with others, they become more committed to the learning process." According to Behr 1978; Marcum 1982; Rose 1970 and Mohlala 1994 historical education systems were meant for domestication and domination, while Outcomes-based Education and Training is meant for liberation and empowerment.

In the traditional education environment, learners were textbook or worksheet bound, while Outcomes-based Education and Training is learner centred. Traditional systems expected of educators to be responsible for learning mediation, while Outcomes-based Education and Training expects of educators to be facilitators, to use group work and a variety of resources. In the traditional education systems, motivation depended on the personality of the educator, while in Outcomes-based Education and Training learners take charge of their learning mediation, and are motivated by constant feedback and affirmation. In traditional education systems political topics were forbidden in class discussions while in Outcomes-based Education and Training controversial topics, to enhance critical thinking and ability to reason, are pursued. Finally Outcomes-based Education treats all languages equally as languages of instruction including sign language.

2.5.11 THE GENERAL PRINCIPLES ON WHICH THE OUTCOMES-BASED EDUCATION AND TRAINING APPROACH IS BASED

The Outcomes-based Education and Training approach is predominantly based on the active involvement of all learners in the learning mediation process. The second most important principle is that: what is taught should be flexible, so that learning mediation will be relevant to learners and will always meet their learning mediation needs.

In addition, learners should continually be encouraged to critically think for themselves and above all, be creative problem-solvers. Carin and Sund (1989:105) stated the following: "(i)f you want your students to be problem solvers, learn ... and do things for themselves, you must give them practice in all of these things. The more they solve problems ... the greater will be the chances that transfer of training will find its way into new situations."

All learners should be accorded both equal and ample opportunities to make progress at their own pace. By so doing, all learners will be granted expanded opportunities rather than constrained opportunities. Learners have to be constantly made aware of, as well as to know in advance, what they are working towards and, in reality, what is expected of them. Malcolm (2000:15) noted that outcomes have to be defined with sufficient generality so that they will enable learner-centred education – a curriculum that is matched to the experiences and contexts of learners in a particular school and location – but precisely enough so that learners throughout the country can properly claim that they have achieved the same outcomes.

2.5.12 THE MERITS AND DEMERITS OF OUTCOMES-BASED EDUCATION AND TRAINING

All programmes or systems, despite any popularity, efficiency and effectiveness, possess both merits and demerits. The same applies to Outcomes-based Education and Training. Its merits and demerits include but are not limited to the following:

MERITS

Outcomes-based Education and Training strictly demands of all educators to plan carefully by making preparations with a very clear purpose in mind. As a result of this, the learning mediation outcomes should guide the educator's content and selection of material as well as his or her strategic planning. Learners are constantly made aware of what is expected of them and why, and are always able to measure their achievement or failure. Van Der Horst and McDonald (1997:14) pointed out that self-assessment was thus an integral part of a successful Outcomes-based Educational programme. Schools could, as a matter of fact, accurately monitor the learners' progress in terms of specific learning attainments.

Outcomes-based Education and Training emphasises creativity. Therefore, learners' initiative, ideas and participation contribute to the promotion and maintenance of a healthy instruction and learning mediation environment. The programme takes all learners on board (from the most gifted to the least gifted), and all learn according to their own pace and level of functioning. In other words, Outcomes-based Education and Training provides all learners with ample opportunities to achieve to the level of their individual potential.

Battistin (December 1998:3) observed, "(t)he most basic premise of Outcomes-based Education (OBE) states that all students are capable of learning and can achieve high levels of competency when teachers delineate their expectations. When this is done, students feel they are participants in classroom decisions and tend to be more supportive of all aspects of the class."

Outcomes-based Education and Training enhances proper and effective management as well as strategic planning for anticipated outcomes. Furthermore, Outcomes-based Education and Training is, in the true sense of the word, people-driven. That is to say, all stakeholders have a cardinal role to play in this curriculum. Its success and failure lies in the hands of all people. All could contribute positively towards its improvement, effectiveness and implementation.

Outcomes-based Education provides the learner with much greater instructional support because learners are helped along the way to properly master content, concepts, skills and habits of mind. Van Der Horst and McDonald (1997:15) stated, "(i)f learners have not mastered these sufficiently, they will be guided to try again and again until they succeed." This is the kind of support all learners greatly need and deserve in any education programme.

It endeavours to eliminate permanent failure, for good; that is, any learner who has not yet achieved the required standard will be granted more and more opportunities to do so. It further reduces memorisation to a great extent and encourages a deeper understanding of the content.

In Outcomes-based Education and Training both educators and learners become cooperative partners who take equal responsibility for successful learning mediation outcomes. Outcomes-based Education and Training's objectives are clearly defined. This makes it easier for both learners and educators to carefully aim at and attain them. Outcomes-based Education and Training also offers learners a wide range of choices and opinions. This, of course, enables them to perform at higher levels of competency.

Learners are given opportunities to either gain from others or benefit others as well, and rapidly build a hierarchy of learning mediation skills, which are instrumental for Outcomes-based Education and Training. Evaluation by both peers and educators is ongoing. This means that as soon as the learner exhibits a problem, this will be noticed. The learner will be helped as early as possible and lagging behind might be curbed. In Outcomes-based Education and Training, the time allowed for learning mediation is varied according to the needs of each learner and the complexity of the task. Learners are always given many opportunities to work with the [2]core and [3]alternative curriculum. Finally, as a result of this, all learners are assured the opportunity for personal success.

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[2] Core curriculum comprises all learning areas on blind in the revised National Curriculum statements.

The researcher believes that the new education system has the potential to both transform and liberate. It is colour blind. It should treat all people equally, and, most importantly, all learners could start to think about the same expectations, ambitions and aspirations. All people would be equally empowered.

DEMERITS

As far as disadvantages are concerned, Van Der Horst and McDonald (1997:16) commented, "(t)he effectiveness of OBE depends mainly not on the underlying principles of the approach, but rather on the teacher's ability to implement such an approach since it requires hard work, a lot of planning and sensitivity to the learning process." Lack of adequate resources makes it extremely difficult for Outcomes-based Education and Training to be easily and effectively implemented. In most instances, educators feel they are not properly given in-service training. That is, the time allowed for in-service training is not sufficient. Some educators who attended the Outcomes-based Education and Training workshop held at Tshilidzini school for Learners with Special Education Needs (on 19-21 March: 2001) argued that facilitators were not sure about, and were less competent concerning, Outcomes-based Education and Training with reference to learners with disabilities. When confronted with the fact that they were not delivering the Outcomes-based Education and Training "goods", the response of the facilitators was: "We are learning and getting used to Outcomes-based Education and Training like any other person in South Africa. Remember, it's like driving a manual car while you were used to an automatic one. During the first days, you make a lot of driving mistakes. When time goes by, you improve and drive with ease and confidence. We shall definitely improve and deliver the goods as you expect of us."

Neither learners nor educators are sure whether they are approaching the learning mediation of Outcomes-based Education and Training as intended. Outcomes-based Education and Training is characterised by vaguely worded outcomes which cause most educators to retain the status quo (content-driven learning mediation) and in fact, these vaguely worded outcomes do not contribute to raising learners' achievements or success. Educators are not always able to correctly translate the vaguely worded outcomes into practical learning mediation activities with specific content.

As a general criticism of Outcomes-based Education and Training, the outcomes which define what all learners should master, often indicate behaviours and beliefs that are vaguely worded and largely associated with emotions (attitudes of mind and values). Many of these outcomes, as Van Der Horst and McDonald (1997:16), put it: "... do not focus on core academic content. A sound content base is naturally always a prerequisite for critical thinking and problem solving which have been indicated as the heart of Outcome-based Education and Curriculum 2005."

The other problem prevalent in Outcomes-based Education and Training is the fact that when the government prescribes outcomes that include values and attitudes, it should in fact, take on a parallel responsibility to allow parents to exercise their parental right by choosing amongst a wide range of

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[3] Alternative/expanded curriculum is composed of subjects that are specific and important to blind learners such as Braille, O & M, ADL (activities of daily living) etc.

schooling opinions. Van Der Horst and McDonald (1997:17) warned, "(i)f this is not the case ... a backlash against the Outcomes-based approach can develop, and parents might not agree with the attitudes and values forced upon them by the government and its schools."

Furthermore, other critics of Outcomes-based Education and Training strongly believe that schools using an approach based on Outcomes-based Education will need to lower their standard to the least common denominator since not all learners have the same potential to learn according to the same high standards. Most people, justifiably so, fear that Outcomes-based Education and Training would hold back the gifted learners and that slower learners would hinder class progress. In essence, this means that, if all learners are expected to achieve the same outcomes, there will obviously be a tendency to lower standards, as all learners do not have the same potential, do not work equally hard, and are in no way whatsoever equally motivated to learn. For Outcomes-based Education and Training to be successful, there should, as a matter of urgency, be a balanced grading system for educational outcomes, which have to be integrated into the learning mediation process. In other words, those learners who are slow should be required to work towards achieving learning mediation outcomes at a relatively minimum level of competency, whilst those with far greater potential would need to work at an accelerated and higher level of complexity.

The implementation of Outcomes-based Education and Training is costly. Educators need to receive in-service training, curricula have to be revised, new assessment criteria and procedures developed, learning mediation support material acquired, et cetera. All these steps encompass financial implications. Can our country, which needs to use much money in terms of the reconstruction and development programme, afford to maintain this costly new system? Whether this is possible or impossible, remains to be seen.

2.5.13 SUMMARY AND CONCLUSION

This chapter extensively covered the educational programmes implemented by the previous government, political organisations and religious structures. Those educational programmes included: a discussion of African education, People's education, inclusive education policy and perspectives on Outcomes-based Education and Training.

The complex problems of those programmes have given us what we are today proud of, namely Outcomes-based Education and Training. We have indeed come to terms with what the South African Schools Act No. 108 stipulates regarding education, learning mediation and the effective running of institutions in our beloved democratic country. It is very pleasing to take note of the fact that for the first time schools will not produce large numbers of unskilled people, but highly skilled, productive, efficient, competent and determined South Africans, all equal before the law.

Though our society has not yet arrived at a point where it could boastfully claim that segregation is totally eradicated, we are slowly but surely getting there. There are South African men and women, black and white, who are eager and committed to bring about change. These men and women should be commended for this bold step.

The South African community should encourage and whole-heartedly support this type of venture. We dare not fail. To do so would jeopardise the entire education programme and the country itself. Konar (1988) has assured one that given the right kind and degree of professional help, the potential of many persons is both real and realisable. South African citizens should, through Outcomes-based Education and Training, also cause the potential of the young and the old, literate or illiterate, rich and poor, able bodied or differently able, et cetera, to be real and realisable.

Through Outcomes-based Education and Training, all citizens of our country should strive to develop in all spheres of life thus making all her people well equipped and empowered so that they can satisfy their current needs and the needs of their country. Much research needs to be done, however, before we will be able to say that there really is an opportunity for a visually impaired child to develop into a person who could lead a dignified life through the constructive role played by Outcomes-based Education and Training.

Maguvhe in his unpublished paper written in (1997a: 15) observed, "(t)his should be a major challenge to us ... that we have to roll up our sleeves and intensify our efforts to provide the services and programs to meet the day to day needs.... Those who are educated, those who are able, those who have interest, those who are touched, those who always think about others, should emancipate the voiceless, illiterate and oppressed." The researcher hopes that the present government, through its Outcomes-based Education and Training programme, will see this as not too daunting a task. If there is the will, there will surely be a way.

CHAPTER 3

THE STRUCTURE OF LIFE SCIENCES AND BIOLOGY AND ITS INFLUENCES ON THE FACILITATION OF LEARNING FOR BLIND LEARNERS

3.1 INTRODUCTION

After the careful study and critical analysis contained in this chapter, it is hoped that valuable knowledge will be obtained about the nature and structure of biology and will be available to the likely readers of this study, including educators, researchers and biologists or other scientists, et cetera, who will be equipped with essential skills for the identification, differentiation, evaluation and analysis of various biology concepts. Furthermore, the reader will be exposed to various biology activities such as observation, testing the validity of collected data, experimenting, inquiring into and assessing data. All people with a keen interest in biology will be exposed to the principles and standards that biology has to satisfy as a natural science subject. The reader should understand more fully how the nature and structure of biology impact on the learning mediation of blind learners. Finally, the reader will be able to understand the relationship between natural sciences and biology.

In this chapter, the researcher places emphasis on the exposition of issues regarding the nature and structure of biology itself, rather than on life sciences as a broad theme encompassing agriculture, biology, physiology, zoology, botany, and so on. Biology has simply been extensively used as a good example of the life sciences. In addition, the researcher shows the relationship between biology and natural sciences. Furthermore, the chapter covers both substantive and syntactical structures, the nature of the subject of biology and the importance of natural sciences to the human being.

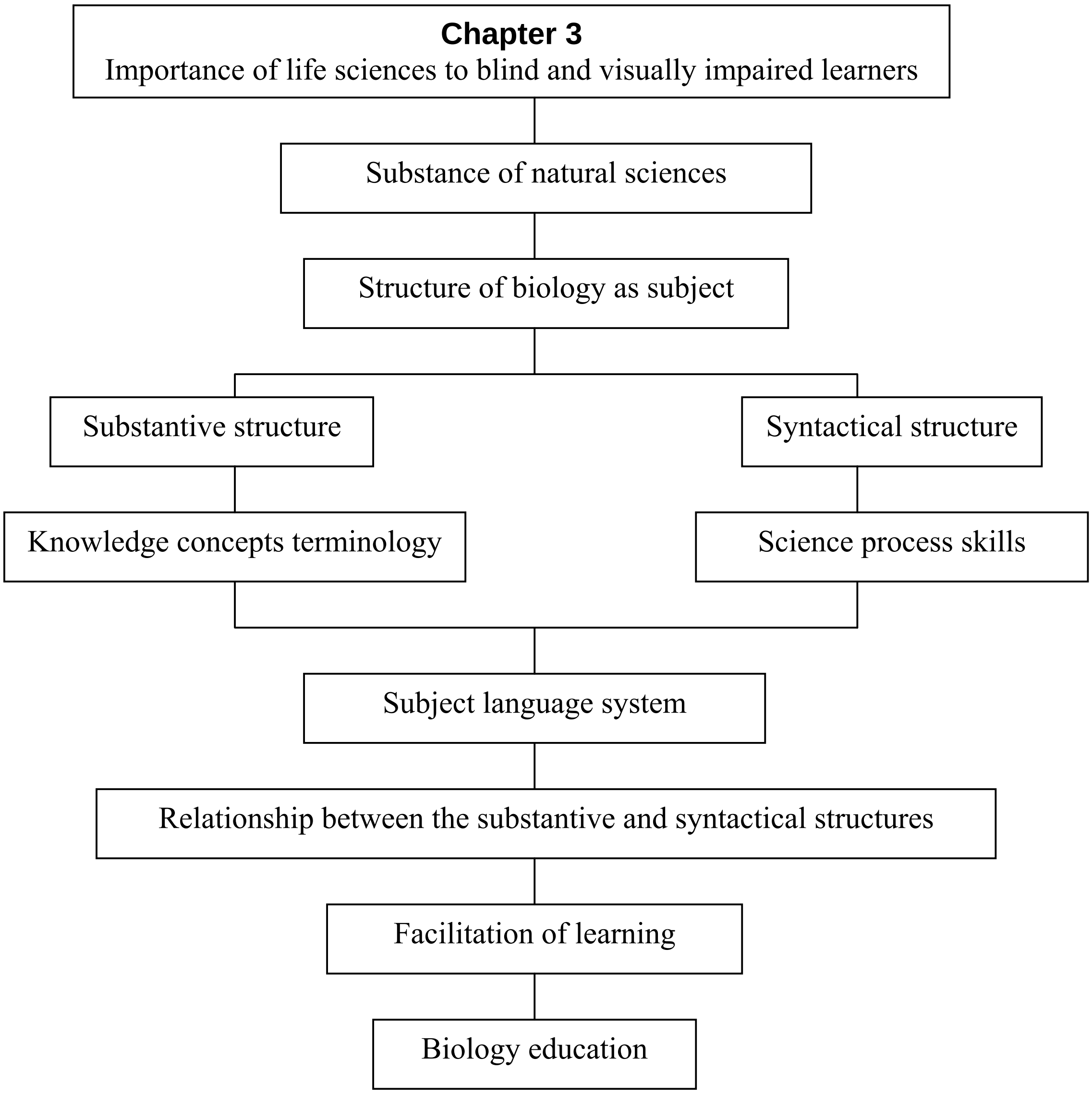
As a point of departure, we should understand the relationship between biology and natural sciences. This means that there are most certainly specific requirements, principles and characteristics that biology should exhibit in order to qualify as a natural science course or subject.

What is biology? Why does it fall under the natural sciences? What role do the natural sciences play in biology? Can biology not be independent from natural science and vice versa? These and other related questions are answered in the discussion that follows.

Liberty Independent Newspaper [s.a] [s.p] argued that natural sciences is the systematic study of the material universe - including natural and human-made environments - as a set of related systems. A variety of methods, that have in common the collection, analysis and critical evaluation of data, are used to develop scientific knowledge.

Collette (1989:5) defined science as a body of knowledge, a way of investigation or method, a way of thinking in the pursuit of an understanding of nature. Science as a discipline is characterised by a body of information obtained by exacting individuals (scientists) using whatever proof is in existence, specifically the various scientific methods. In reality, quite a number of types of scientific knowledge exist. These include facts, generalisations, concepts, principles, and theories, all of which are subject to error and change.

FIGURE 3.1: THE OUTLINE OF THE ISSUES DEALT WITH IN CHAPTER 3



On the other hand, Carin and Sund (1989:4) defined science as a system of knowing about the universe through data collected by observation and controlled experimentation. As data are collected, theories are advanced to explain and account for what has been observed.

Carin and Sund also made mention of the fact that the true test of a theory in science is threefold:

1. Its ability to explain what has been observed;
2. Its ability to predict what has not yet been observed:
3. Its ability to be tested by further experimentation and to be modified as required by the acquisition of new data.

Owing to the above definitions, the researcher concludes that science is a discipline characterised by inquisitiveness and therefore by many questions that compel scientists to probe into the universe by collecting data, experimenting and observing, in order to expand their scientific horizons.

All science disciplines (physical, earth and biological disciplines) qualify as science disciplines because of the following elements indicated by Carin and Sund (1989:4-5).

(a) Human attitudes:

These comprise certain beliefs, values, opinions, for example, the suspension of judgment until enough data have been collected relative to the problem. The researcher constantly endeavours to be objective.

(b) Process or methods:

This involves certain ways of investigating problems, observing, for example, formulating an hypothesis, designing and carrying out experiments, evaluating collected data, measuring, and so on.

(c) Products:

Facts, principles, laws, theories, for example, constitute these, according to the relevant scientific principle, e.g. metals expand when heated.

Natural sciences encompass three main disciplines of science, namely: physical sciences, earth sciences and biological sciences.

Physical sciences concentrate largely on what Van Aswegen, Fraser, Nortje, Slabbert and Kaske (1993:2) refer to as the "non-living-matter-and-energy universe" and cover both the subjects of physics and chemistry.

The question "what is physics"? might arise here. The researcher considers the following to be a good description of physics. It is the science that concerns itself to a large extent with properties and the nature of matter in general, all forms of energy, and most importantly, the mutual interaction-taking place between energy and matter.

Biology, defined as the "science of physical life of animals (Zoology) and plants (Botany)" (Hornby 1987:82), belongs to the discipline of biological sciences. Its sister subjects are Botany (the study of plants), Zoology (the study of animals) and Biochemistry.

As its principal purpose, biological science studies the structure and life processes of all living things in nature. Van Aswegen *et al.*, (1993:1) asserted that it comprises human activity which is directed towards seeking knowledge about living matter.

Having carefully scrutinised the above definitions of both natural sciences and biology, it becomes evident that they are even more closely related than one might have thought. Biology is a natural science, and natural science sets norms, standards and values for biology to strictly comply with. Biology, as a part discipline of natural science, has the task of collecting, analysing and critically evaluating data for the major purpose of developing scientific knowledge. Those common methods indicated above, employed by both biology and natural sciences, strengthen and support their relationship and dependency on each other.

3.2 THE IMPORTANCE OF LIFE SCIENCES (BIOLOGY) AND NATURAL SCIENCES TO BLIND AND VISUALLY IMPAIRED LEARNERS AND SOCIETY IN GENERAL

Having perused sources like Collette 1989:5; Wellington 1994:33-34 and the Department of Education Senior Phase Policy Document 1997, the researcher concludes that the following explains the importance of life sciences (biology) and natural sciences to blind learners and society at large. Life sciences (biology) is important to both blind learners and society in general because it is a close and appropriate study of the physical life of animals and plants.

On the other hand, natural sciences is instrumental for:

(a) The development of appropriate skills, interest, knowledge and attitudes as well as an understanding of the principles and processes of the natural sciences;

(b) The stimulation of human activity which leads to the development of responsible, accountable, sensitive and scientifically literate citizens who can engage themselves fruitfully and constructively in scientific debates.

Collette (1989:5) is of the view that scientifically literate learners and citizens in general are able to identify that which is supported by strong evidence and that which is mainly speculative; both groups should be conscious of the ever-changing nature of science.

Wellington (1994:33) concurred with Collette when he commented that learners explore the nature of science and are able to distinguish between claims and arguments based on scientific considerations and those which are not (the limits of science) and that they should study examples of scientific controversies and the way in which scientific ideas change.

(c) Encouraging the public (including sighted and blind learners) at large to participate and contribute in an informed way in democratic decision-making processes. Degenaar (1989:13) indicated that "... students who have progressed through the nation's school systems should be able to use both knowledge and products of science, mathematics and technology in their thinking, their lives and their work. They should be able to make informed choices regarding their own health and lifestyles based on evidence and reasonable personal preferences, after taking into consideration short and long term risks and benefits of different decisions. They should also be prepared to make similarly informed choices in their social and political areas."

(d) Encouraging people's positive contribution and participation in both creating and shaping work opportunities;

(e) Equipping people with proper methods and approaches for conserving, correctly managing, developing and utilising natural resources in order to ensure the survival of both local and global environments;

(f) Providing blind learners and the society at large with direct experiences of natural phenomena as well as of the collection and acquisition of knowledge;

(g) Helping people organise, and logically and sequentially interpret the information collected;

(h) Constantly equipping the society itself with innovative, creative and critical thinking skills.

In addition to the above, the researcher believes that natural sciences and life sciences (biology) are also crucial for:

Making blind and able-bodied learners aware of "(t)he benefits and drawbacks of applying scientific and technological ideas" and ensuring that they ... begin to understand "how science shapes and influences the quality of their lives (limits and context)" (Wellington 1994:33).

The benefits of scientific inventions are manifold. One example of the benefits people receive from science is the invention of drugs that prevent unborn babies from being infected with HIV/AIDS. This is but one of the major scientific contributions that has played a role in the development of the world. However, scientific inventions also have drawbacks. Examples would be human cloning and the chemical and biological weapons of mass destruction. In the hands of lunatics, they could be cataclysmic. Through natural sciences and biology, both blind and able-bodied learners could fully develop a knowledge of how scientific ideas change through time. Blind and able-bodied learners are exposed to and are given the opportunities to understand the limitations of scientific evidence and the provisional nature of proof. Natural sciences and biology equip learners with skills that are crucial for examining "the power and limitations of science in solving industrial, social and environmental problems ..." (Wellington 1994:34).

Finally, *Liberty Independent Newspaper* ([s.a.] [s.p.]), suggested that in view of its potential to improve the quality of life, learning in the natural sciences must be made accessible to all South Africans. The investigative character and the acquisition of knowledge in the natural sciences should be mirrored in education. Learners should be active participants in the learning process in order to build a meaningful understanding of the concepts, which they can apply in their lives.

3.3 THE SUBSTANCE OF NATURAL SCIENCE

The field of natural sciences is both intriguing and extremely challenging. It always strove and it still strives to give an in-depth understanding of nature and all its complex phases.

Van Aswegen *et al.*, (1993:2) stated that science will only be a complete discipline if it pays attention to the following three dimensions, namely:

(i) The body of knowledge (substantive structure);

(ii) The process by which knowledge is acquired (syntactical structure); and

(iii) The way of intense thinking that will lead to a better understanding of nature.

3.4 THE STRUCTURE OF BIOLOGY AS A SUBJECT

At this juncture, an attempt should be made to provide answers to the question: how is biology structured? Its structure comprises two major components, namely: its substantive and syntactical structures.

3.4.1 THE SUBSTANTIVE STRUCTURE

The substantive structure entails to a great extent the content of the subject of biology: the body of knowledge that is characterised by the facts, concepts and generalisations of this subject. Collette (1989:5) maintained that a number of types of scientific knowledge exist and that these include facts, generalisations, concepts, principles, and theories, all of which are subject to error and change. These types of scientific knowledge are centred around and depend on and are influenced by "... a way of investigation or method, a way of thinking in the pursuit of an understanding of nature".

(a) Facts

Collette (1989:5) views scientific facts as truth, reality, actuality, and as reflecting the state of things as they are. In a more strict sense, facts are unchanging and indisputable and are a product of a single observation. They are data from the world in which we live.

However, facts are subject to error. Two criteria could be employed to distinguish scientific facts from general or unscientific facts. First, scientific facts are directly observable and can be demonstrated at any time. When these two criteria are applied accordingly and accurately, objective discrimination between facts and relative uncertainties is possible.

Van Aswegen *et al.*, (1993) is of the view that facts should be characterised by:

- Name/s of the scientist/s,
- dates,
- events,
- terminology (etymology),
- conventions,
- taxonomical categories,
- propositions of rules,
- laws,
- theories, et cetera.

The previously stated co-authors (1993:4-5) stressed the importance of facts as an integral element of the substantive component of the structure of the subject of biology when they commented, "(w)hat is of utmost importance about facts is that ... facts, as isolated fragments of information, are meaningless and are not useful to the scientist or science student. Facts must be related to concepts and principles if they are to be meaningful." Facts, as the raw material, trigger the development of concepts and generalisations, which would eventually attach meaning to the unifying themes and by so doing, promote and enhance a better understanding of nature.

(b) Concepts

What are concepts? Are they of any significance in the structure of the subject of biology? Hornby (1987:175) explained the term "concept" as an idea underlying a class of things, or that it could be a general notion. The researcher believes that this meaning could further be stretched to encompass generalisations of science data and experiences, constructed through the reasoning power and the imagination of the individual, in a continuing attempt to make sense of the object and events around him or her.

Collette (1989:6) wrote, "(a)s facts accumulate, they begin to show certain relationships and patterns. The explicit description of the patterns or relationship is commonly referred to as a concept." A concept should also be understood as really an abstraction of a class of events, objects or other phenomena having in common particular characteristics.

According to Van Aswegen *et al.,* (1993:5) some constancy or permanency of both an object or event should first of all be identified, with the aim of categorising it into some class. The above-mentioned authors consider concepts to be building blocks for coming to terms with the structure of the subject of biology. Concepts may be either abstract or concrete.

(c) The importance and relevance of concepts

Having read Collette 1989:6 and Van Aswegen *et al.*, 1993:5, the researcher concludes that concepts are important for the following reasons:

(i) Condensing masses of raw data (carefully selected facts) into more strong and convincing and manageable clusters of information.

(ii) Concepts play an instrumental role in organising science into a comprehensive description of the world and nature in general.

(iii) Concepts are important because they serve as springboards for further and future investigations by first verifying and determining the range of concepts and, second, trying to find explanations for the relationships discovered.

(iv) Concepts make, or always endeavour to make, both predictions and speculations possible.

3.5 SYNTACTIC STRUCTURE OF THE SUBJECT OF BIOLOGY

A clear distinction has to be made between syntax from the linguistic point of view and syntax from the biological point of view. The former implies sentence construction, while the latter implies the description of the way in which the knowledge (substantive structure) of the subject is obtained. Both kinds of syntax are governed by ground rules.

The syntax of the subject of biology involves both the methodology and processes of the subject. This structure contains certain competences that have to be mastered. Van Aswegen *et al.,* (1993:6) aptly stated, "(a)ll competencies described by Gardener (1975:8) have their foundation in another more basic and fundamental classification." Stemming from this classification, the researcher distinguishes three kinds of competences, namely: sensorimotor skills, cognitive skills and techniques.

Biology, like any other subject or course, should act in accordance with all principles as laid down by the discipline itself. However, cognisance should be taken of the fact that biology possesses its own unique nature and structure, which gives it its distinct character from any other science. Van Aswegen *et al.,* (1993:3) state that the nature and structure of biology should not be tampered with. It should instead remain intact and its nature has to be reflected during learning mediation.

In reality, it is the nature of the subject that makes it teachable, understandable and learnable. Van Aswegen *et al.,* (1993:3) argued that without thorough knowledge of the structure of biology, it cannot be taught and learned according to the requirements it sets.

Additionally, the above authors (1993:3) are also of the view that no methods linked to biology are complete without a substantial devotion of effort to the development of some appreciation of the structure of biology as it is related to teaching. The researcher concurs.

Biology was and is still able to explain and predict scientific findings and the data acquired. Wellington (1994:33) argued that biology as a science subject is further characterised and affected by its social, moral, spiritual and cultural contexts. It is a subject that can thoroughly analyse the power and limitations of science in solving industrial, social, economic, technological and environmental problems. It is explorative in nature, hence claims, counter-claims and arguments based on scientific considerations and those which are not, can be distinguished.

Apart from the above-discussed features, this subject possesses other equally important features, namely: extensive and intensive testing, observation, evaluation, assessment and discovering. In very unsophisticated terms, the nature and structure of the subject biology could best be described as the collection of data and objective knowledge, obtained through tested and retested processes which always appear to be reliable; but this is in one way or another, subject to continuous change because of the never-ending search for meaning, further evidence and at times the solution of scientific puzzles.

3.5.1 SENSORIMOTOR SKILLS

Carin and Sund (1989:22) consider a sensorimotor child as someone who is stimuli-bound and as a result would not be able to imitate and initiate internal thoughts. According to these authors, a sensorimotor child who is both stimuli-bound and is also unable to imitate and initiate internal thoughts, will not or will to a lesser extent develop basic scientific skills, because the physical environment is the provider of such skills. The under-development of those skills hampers, at a later stage, the development of advanced science skills, since basic science skills serve as the foundation of advanced science skills. For children to internally imitate and initiate thoughts, they have to start building their own "... structures of thoughts".

Learners will only be able to learn and internalise biology thoughts if they are able to actively, purposefully and meaningfully interact with stimuli from the physical environment, so as to internalise those acquired thoughts. As a result, the blind learners' remaining senses need to be used to gather instrumental information.

The above authors (1989:22) further noted that through physical action, children slowly construct physical knowledge and begin the life process of developing action schemes. Those schemes help them adapt their behaviour so that they can interact more appropriately with their environment. Lack of visual ability deprives the blind learner of the opportunity to interact comprehensively with the environment. Due to this, the blind child's physical actions will be limited and often impeded by the lack of visual ability. As such, according to the researcher, the development of the blind child's action schemes will be much slower than those of the sighted child. The blind learners' interaction with the environment will, as a result of the lack of visual ability, not always be carried out appropriately. The blind child's remaining senses will not be in the position to accumulate all the information the mind clearly needs in the construction of schemes, and in the interpretation and integration of the acquired information necessary for perceptual depth.

Carin and Sund (1989:22) argued that Piaget believed that cognitive mental structures originated from physical action. These co-authors, in support of the previous statement, wrote that children later use what they have learned to solve practical problems. As they develop and use their minds, children are finally able to recall mentally. This is how all children, including blind children, should begin to acquire basic science skills.

Sensorimotor skills play a cardinal role in the acquisition of basic science skills, leading to both the acquisition and, most importantly, the integration of information or knowledge. Sensorimotor skills entail all the primary reception of sensory impressions from the environment, including looking, hearing, touching, feeling, tasting and smelling and the execution (expression) "...(o)f the most basic spontaneous motor movements" (Van Aswegen *et al.,* 1993:6).

3.6 THE SCIENCE PROCESS SKILLS IN THE LEARNING MEDIATION OF BIOLOGY

In order to understand the importance of the science process skills, terms such as process should be explained. The term process here refers to the development of or a practice leading to a course of action. In addition, Van Aswegen *et al.,* (1993:15) maintained that the term "process" encompasses the mediation which is in line with what scientists do mainly, that is, the processes they carry out in their own scientific activities. Through this process, scientists gain valuable information through observing, classifying, inferring, measuring, using space or time relationships, using numbers, communicating, hypothesising, and performing experiments. According to Erwin *et al.,* (2001:338), "(s)cience is an exciting process that involves observation, discovery, critical thinking, and reflection about the environment. Science education presents the opportunity to forge an interactive relationship between children and the world around them."

These authors further stated that "(i)f the primary focus of science education is to help children make sense of their world then teachers have an enormous responsibility to design learning opportunities and experiences that foster children's natural inquisitiveness and thirst for knowledge."

In support of the above perception, Van Aswegen *et al.,* (1993:15) commented that "process" refers to human intellectual development, which involves the complex way of thinking characterised in the individual's growth, encompassing all concrete and abstract knowledge. Furthermore, of great significance to the present study, these authors (1993:15) indicated that the process approach makes it possible for all learners to "… develop a sound knowledge of science and its methods."

In addition, Erwin *et al.,* (2001:339) commented that learners who have acquired basic science process skills "…(h)ave positive, frequent, and successful experiences in science that will allow them to explore, discover and ask questions about the world in which they live, so that they can develop deep respect not only for the environment in which they live, but all living things."

Basic science process skills are a prerequisite for advanced science skills, which, in the researcher's view, should be phased in and integrated only once the learner has mastered the basic process skills.

The researcher views the commencement of the learning of basic science skills, through sensorimotor and cognitive skills, as of great significance because this leads to the development and enhancement of other advanced science skills such as discovery, observation, inquiry, investigation, experimentation, analysis, measurements, prediction, problem-solving, evaluation, and so on. As pointed out by Land and Fotheringham (1999:70) these skills influence learning mediation because, if both science educators and learners are unable to direct and monitor Outcomes-based Education activities, especially at special and inclusive schools, they will fail dismally to control the learning mediation that is supposed to happen. This also means that scientific errors may not be instantaneously corrected. As such, learning will be negatively influenced.

This further means that some of the aspects of learning formulated with unambiguous purposes of learning mediation might not be realisable, or effectively used in the science curriculum and assessment. Van Aswegen *et al.,* (1993:14) in support of the previous statement remarked, "…(e)ffective biology teaching and learning is only possible if both the product and process dimensions of science are stressed." The aspects indicated above include but are not limited to: the nature of science, the need for science education, the approach to science education, and the essential science competences, attitudes and values which learners in the Natural Sciences should acquire and develop.

The researcher concludes that a failure in the acquisition and development of science attitudes and values will result in blind learners being not able to make an effective and positive contribution to education and biology as a discipline. All learners' acquisition of knowledge and conceptual development will be hampered. If this keeps on happening, it will then be extremely difficult to challenge the perception that biology is predominantly a sighted discipline. Furthermore, Outcomes-based Education and Training, as outlined in the *Curriculum 2005 Lifelong learning programme for the 21st Century* (1997:9), would not be realisable. It should be borne in mind that Outcomes-based Education and Training aims at increasing the general knowledge of the learners as well as developing their skills, critical thinking, attitudes and understanding. As a result of this, too many blind learners would be "…(d)eprived of too much for too long" (*Curriculum 2005 Lifelong learning for the 21st century* 1997:9).

This further means that if blind learners do not acquire basic science process skills they will only possess superficial knowledge instead of a knowledge that is profound. For example, let us just imagine how gratifying, informative and edifying it is for a sighted learner to visually experience the movement of a frog jumping, a bird flying, a fish swimming in the water, a flower bud opening, et cetera. This will unquestionably give the sighted learner an edge over the blind learner during the learning mediation of life sciences (biology) and will further result in blind learners lacking scientific experiences and data gathered through observations, predictions, experimentation, measurement, problem-solving, communicating, inferring, evaluating, et cetera. Lack of basic science process skills will deprive blind learners of the stimulation and motivation which are crucial during learning mediation. Lack of these skills will deprive blind learners of the enhancement afforded by the provision of inquiry activities that are crucial for helping all learners to develop problem-solving skills.

Problem-solving skills are crucial in science because learners become creative, initiative and innovative. Authors such as Van Aswegen *et al.,* (1993:14) and Erwin *et al.,* (2001:339) argue that these skills enhance the development of higher thinking skills in learners; thus, the main goal of biology teachers should be to make pupils effective problem-solvers. These authors state that biology inquiry activities help learners enormously to develop questioning and problem-solving abilities in a methodical, scientific manner, through the use of science process skills.

Blind learners always enjoy investigation if and when material is accessible and the climate is also favourable. In support of this argument, Erwin *et al.,* (2001:351) commented as follows: "(o)ne of the most important responsibilities that teachers of students who are visually impaired is to create a climate of inquiry that is both accessible and meaningful for all the students. Given that children learn by doing, they need multiple and consistent opportunities to engage in hands-on, cooperative, and fun activities that are driven by their own interests and questions. Creating an accessible and meaningful learning environment that balances student-driven and teacher-guided opportunities enables children to follow their own natural curiosity and assume responsibility for their own learning. When children are active participants in their own learning, important science-related outcomes can be achieved. These and other skills are vital because they serve as the knowledge base that children can use throughout their lives."

Basic science process skills are essential because they enable learners to acquire the necessary background knowledge and experience to understand the purpose and procedure of practical work, which also encompasses the performing of experiments. Therefore, when conducting experiments, according to Erwin *et al.,* (2001:348) educators should encourage blind learners to "… decide for themselves the ways in which they wanted to experiment with the materials, by saying "you can decide what you want to do" or "what would you like to do to finish this activity?" Such learners are able to make meaningful decisions about their own learning. In addition, learners are encouraged to 'have a say' and to give voice to their own opinions, engaging in what often appeared to be a classroom in which children's voices, strengths and wishes are … taken seriously."

In addition, Van Aswegen *et al.*, (1993:151) strongly believe that learners equipped with basic science process skills are able to determine the validity of the explanations that are in the process of being formulated.

They maintain that such skills further help learners to:

- Be able to give practical meaning to practical science activities;
- Be curious and knowledgeable about recent issues and problems;
- Use each others' comments, questions and activities as possible resources to motivate each other.

Basic science skills also have the ability to make learners curious and as a result, to follow up on this. Learners are therefore more willing to work, as "…(o)pposed to mainly giving them instructions" (Van Aswegen *et al.,* 1993:14).

Basic science process skills, according to the above mentioned authors (1993:14), have the ability to address the unique needs of the learners (very important for blind learners in an Outcomes-based Education and Training classroom) "…(a)s they become adults functioning in and shaping society." These skills help learners in the acquisition of "…(f)acts that inspire imagination, reflection and investigation in science classes" (Van Aswegen *et al.,* 1993:14). The acquisition of these skills helps and encourages learners to develop critical thinking skills and increase their understanding of the "… social, technological and natural environment in which they live and work" (Van Aswegen *et al.,* 1993:14).

Furthermore, blind learners should strive to acquire such skills, as failing to do so would have an effect on their mastery of concepts, as it is believed that they master ideas by being involved in activities and that they could learn successfully by practising. It is argued in the Senior Phase Policy Document (1999:9) that learners should be active participants in the learning process in order to build a meaningful understanding of concepts which they can apply in their lives.

Blind learners could be active participants if they occupy themselves in the following basic science process skills or activities:

(a) OBSERVATION

Observation is the cornerstone of the basic science process skills. It involves collecting data, observing the process, observing the product, conversing and conferencing, and organising the collected data.

Observing the process

When one observes the process, one does so driven by intuition and as a result, one wants to give a response to the process observed. Observation might be done spontaneously or deliberately. Engelbrecht, Green, Naicker and Engelbrecht (1999:117) state that a deliberate observation is a conscious analysis where we question our snap judgments and plan ways of verifying or negating them, rather than jumping to conclusions without real evidence.

Carin and Sund (1989:4) took this argument a step further when they maintained that processes are ways of investigating problems, observing, formulating hypotheses, designing and carrying out experiments, evaluation of collected data, measuring, and so on. Furthermore, this entails demonstration of an event or activity, from which and about which the biologist learns.

Both blind and able-bodied learners and scientists alike are able to reflect on the process observed and, by so doing, they gain the gist of what has been noticed; hence, patterns of performance begin to be recognised. Engelbrecht *et al.,* (1999:117) are of the view that in an inclusive classroom or Outcomes-based Education classroom, observation should become a deliberate, skilled tool - a conscious gathering and systematic recording of information in class. Metaphorically speaking, observing the process should strive to sharpen the totally blind learners' eyes, their ever-interested ears and most importantly, inculcate a sound memory in order for observation to be relevant and worthwhile doing.

Engelbrecht *et al.* (1999:118) further held that observing the process should encourage all learners (the totally blind included) to:

(i) Look until they see or notice.

(ii) Listen until they thoroughly hear.

(iii) Discuss until they know and thoroughly understand.

Erwin *et al.,* (2001:343) challenge and encourage blind learners to persist in trying "…(e)xperiments in spite of unexpected outcomes or wrong turns. Persistence is also evidence of meaningful engagement and active participations." Furthermore, these authors (2001:344) maintain that inquiries instil in learners "…(a) sense of pride in their work and their discoveries."

Observing product

Product comprises facts, principles, laws and theories. The things that are done or created are the source of vital information. They, in most instances, reveal patterns, style, form, character, nature, structure, type, quality, shape, appearance, et cetera, that the scientist wishes to know, learn, understand and correctly apply in life sciences/biological activities.

Conversing and conferencing

In the researcher's estimation, constructive, enriching chats with peers in the same discipline offer people ample opportunities of collecting data. People discover what others think and know through positive and constructive talking. Conversing and conferencing could provide a researcher with a wealth of information about developments in the discipline. Interpersonal relationships comprise one of the best ways to keep abreast of developments in one's field. They promote like-mindedness, the sharing of vital information and of resources available to colleagues. They stimulate interest and constructive discussions based on the discipline. This researcher, for instance, could obtain clarification of issues through contact with colleagues.

Organising the collected data

It is mandatory that data collected should be organised, logically, sequentially and meaningfully. The organised data will help the researcher in making informed decisions and reaching sound conclusions. In addition, the researcher is more likely to make correct evaluations.

As indicated above, observation involves noticing facts or finding out about matters. Therefore, in the biology context, the biologist should observe natural phenomena. The natural science outcome in the Senior Phase Policy document (1999:11) urges all learners to use observation, which is one of the basic science process skills, to investigate phenomena related to the natural sciences. By so doing, learners will be able to demonstrate an understanding of biology concepts and principles, and acquire knowledge in natural science and biology in particular. Furthermore, this skill should encourage learners to constantly, resourcefully and significantly apply scientific knowledge and skills to problems of any nature and complexity in innovative ways. The previous statement has been fully supported by Van Aswegen *et al.,* (1993:6) who assert that scientific knowledge is about the sensible world, originates in science experience and is ultimately tested against the standard of science experience. Furthermore, they are of the view that thinking in biology begins, continues and ends in the area of observation.

Land and Fotheringham (1999:71) pointed out that observation will only be possible and learners will learn best when their needs, concerns and issues, which are important to them, are addressed. Emphasising this point, they claimed (1999:71) that, in that way, learning would become meaningful and relevant. Life sciences (biology) educators should endeavour to address the blind learners' needs, concerns and issues so that observation does become meaningful to them. The observation should be adapted in such a manner that the blind learner is active.

Observation as one of the basic science process skills is the initial step in the chain of events. It precedes leading scientific discoveries. Observation employs all senses in its quest for scientific discoveries, namely touch, sight, hearing, taste and smell. Observation concentrates on the identification and classification of the objects or processes under investigation into known categories. Through observation, scientists are able to distinguish and systematise the scientific data obtained from such observations.

Blind learners learning life sciences (biology) in an Outcomes-Based Education and Training classroom could observe to a limited extent, from either a natural (spontaneous) or experimental point of view. Van Aswegen *et al.,* (1993:15) asserted that natural or spontaneous observations are aimed at the identification of general elements in a natural environment without being contaminated by natural manipulation or other limiting control measures. Through natural observations, blind individuals will be able to record similarities and differences between organisms, samples and populations. Blind learners could also, through adapted devices, measure and count. Experimental observations take place in scientific environments. Such observations are characterised by testing hypotheses "…(u)nder experimental conditions involving different variables" (Van Aswegen *et al.,* 1993:15).

Both natural and experimental observations improve learners' ability in the following manner:

- Natural and experimental observations improve accuracy if what is being observed proves to be accurate;
- Learners are able to decide whether the data that is to be observed is relevant or irrelevant;
- Observations give learners the opportunity to observe the actual objects;
- The selection of practical work, new experiments, et cetera, relating to the past experiments and experiences (prior knowledge), enables learners to comprehend science more fully than before as this fosters an understanding of the things to be observed;

Observation enhances and stimulates interest because learners experience, experiment and investigate in a challenging and interesting way. Further, as far as the importance of observation to learners is concerned, Van Aswegen *et al.,* (1993:16) mentioned that learners will "… find an experiment or investigation interesting if it is understandable, has importance, is useful to them and stimulates or satisfies their curiosity."

The biology educator should undoubtedly endeavour to make the goal of observation to all learners as clear as possible. If biology observation activities are adapted, and the learners are aware of the different biology goals, blind learners in an Outcomes-based Education and Training environment will be able to demonstrate and contribute through their scientific understanding the proper management, development and utilisation of natural/biological and other resources. Adapted scientific observation would enhance blind learners' opportunities to support decision-making. Observation should concentrate and promote meaningful learning mediation, which is characterised by in-depth knowledge, the application of that acquired knowledge, awareness of the relationship between science and other learning areas, and so forth. Observation, which is important for learning mediation to take place, should include a variety of skills, specifically seeing, listening, speaking, smelling, writing, and so on.

This will however, depend on the type and nature of observation. In most observations, the educator should be the facilitator. Observation should be done in a professional and accommodating manner so that it will inspire confidence in the blind learner, who will therefore be able to demonstrate an understanding of the changing and ferociously contested nature of knowledge in the life sciences.

Observation, because of its significance, should employ all the senses of a human being. The importance of senses in observation cannot be accurately over-emphasised. Pauw (1990b:20-21), in order to show the importance of observation, cited the following: "...(i)n taking its first breath, a baby immediately has the ability to make contact with its environment through its senses: The central nervous system of the human organism is so constituted that it experiences a continuing hunger for stimulation through the sense organs in order to establish contact between the body and the external surroundings."

Pauw (1990b:21) further pointed out that "(a)s sensory experiences are repeated, they begin (vaguely at first) to acquire meaning (perception)." Gradually, perception becomes involuntarily grouped and stored in the memory (conceptualisation).

The question that needs to be answered is: how can observation be effective? Only if relevant, observations are made in both breadth and depth. Further, observations are effective if and when learners are able to demonstrate an understanding of the interaction between the natural sciences and socio-economic development. As a prerequisite for observation, life sciences/biological issues have to be communicated in great detail in order for biology to have significance for and contribute to society in general, above all amongst those who study science in particular.

(b) USING SPACE OR TIME RELATIONSHIPS

Pauw (1990b:156) commented that all objects which people observe, experiment on or investigate, including fixed and unfixed objects, are in spatial relation to each other. He further pointed out that everything that people observe or accept, as material reality exists in space. Even human bodies are surrounded by space. And, as such, our bodies feel part of space itself.

Erwin *et al.,* (2001:344) concurred with Pauw when she too maintained that blind learners make important connections to the world in which they live in many ways. They not only master the new vocabulary associated with the activities, but they often generalise the new vocabulary and concepts across time and contexts.

Objects that are in space are near, far, higher, lower, before, behind and next to other things. In addition, Pauw (1990b:156) maintained that space includes what is alongside and close to us, but also what is far and even at infinity. Blind learners should be encouraged to employ the use of investigation and the use of shapes, direction and spatial arrangements, motion and speed, symmetry and the rate of change during biology learning mediation.

Blind learners could find the above-mentioned process to be useful in the study of the shapes of plants and animals, changes in positions, movement of objects or the determination of the speed of motion in various directions. Blind learners might, however, encounter technical hitches when it comes to spatial awareness, as visual ability is in most instances the right tool for recognising and determining space. According to the researcher, the ear also plays a meaningful role in spatial awareness. However, for it to work appropriately, audible disturbances of any kind should be avoided, minimised or eliminated.

It should be understood that blind learners do not experience things in the same way sighted learners do. Exceptional methods such as walking short distances, feeling objects, using ladders to reach out to high objects, using tactile maps and tactile graphics, could for example be employed so that blind learners can become aware of the space in which they live. as pointed out by Pauw (1990b:162) biology educators should help blind learners to become acquainted with the environment themselves. But the environment should be such that it encourages them to do so. Sometimes the environment has to be structured in order to stimulate the children.

Space should encourage and allow blind learners to constantly search for more scientific knowledge by independently moving around in different conditions and environments. Moving around enhances exploration because blind learners "…(a)lso discover objects which they were not looking for" (Pauw 1990b:163).

Siekierska *et al.,* (2003:491) pointed out that the availability of tactile and audiotactile maps is crucial for enabling blind and visually impaired learners to understand and make use of geospatial information. Tactile maps and graphics are therefore important mediation tools because of their ability to encourage and allow blind and visually impaired learners to obtain images of the world, thus becoming acquainted with the changing (geographic and spatial) realities. They argued further that ideally, all of the types of maps available to sighted users should also become available in the tactile format, including thematic, reference and mobility maps. Reference and thematic maps are required for educational purposes (primarily for children but also for adults).

Maps could significantly help blind and visually impaired learners, because these learners would under normal circumstances have no access to standard learning mediation aids, including maps and atlases, to learn subjects such as geography and earth sciences. These co-authors further noted (2003) that in addition to helping one to learn about distant environments, tactile maps could also provide blind and visually impaired learners with the proper development of an understanding of their immediate surroundings. Mobility maps, for example, could help learners navigate both interior and exterior environments by depicting the space in a simplified, readable format that includes the necessary location cues. The use of geospatial technology can help blind and visually impaired users become aware of their immediate environments and live more independently by allowing them to negotiate these environments without assistance. These environments need not only be those pertaining to a user's residence or place of work. Visually impaired tourists, for example, would also benefit from tactile maps of their destinations. Maps make it easier for learners and other users to learn spatial information by encouraging interaction with the maps themselves. Finally, tactile maps allow blind and visually impaired learners "…(t)o access the vast amount of real-time data that are available to sighted persons …" (Siekierska *et al.,* 2003:491).

Blind learners should also understand the use of time, as time controls our daily activities. Pauw (1990b:166) stated that "(t)he organisation of modern society depends on detailed timing." Educators should expose blind learners to situations where they will become familiar with time through experience. Biology educators should use Braille or talking watches when timing is needed for certain experiments to be conducted. Blind learners can discover time in various ways. Sounds, weather, distance, et cetera, could help them discover time. Awareness of agricultural products, birds, traffic congestion, rain, snow, wind, could tell blind learners whether it is during the day, during peak hours, during the night, whether it is winter, summer, autumn, or spring. Blind learners can understand that time is constituted by events/concepts such as now, then, when, before, after, immediately, later, et cetera. Time could be learned in two ways, namely the sequence of events in time and duration. Pauw (1990:166) argued that blind learners in both cases (sequence of events in time and duration) are part of the experience, just as sighted learners are.

(c) USING NUMBERS

According to Van Aswegen *et al.,* (1993:16) educators should make blind learners aware that numbers form an integral part of any scientific activity. Blind learners should be encouraged to use numbers when measuring in home environments, school environments, social environments, scientific environments, et cetera. Measuring involves counting, drawing graphs, classifying objects, or working out equations. Blind learners should be trained to use numbers "…(b)efore they are needed for exercise in the other processes" (Van Aswegen *et al.,* 1993:16).

(d) MEASURING

Measuring will allow blind scientists to express their observations in more precise terms. Measuring is crucial for scientists because they acquire quantitative data, "…(w)hich can be dealt with graphically and statistically" (Van Aswegen *et al.,* 1993:16). Blind learners should be provided with tactual, Brailled or voice synthesised measuring instruments in order to be able to perform scientific measuring tasks. In all situations, quantitative data are based upon scientific measurements through the use of measuring devices with equal intervals.

According to these authors examples of quantitative data include the reaction rate of enzymes in seconds, the mass of rabbits in kilograms and the temperature of water in degrees Celsius. Blind learners, like their sighted peers, in order to acquire this basic science process skill should "…(b)e given practice in quantifying their observations by using the proper measuring device" (Van Aswegen *et al.,* 1993:16).

(e) CLASSIFYING

Blind learners should be taught how to group together objects, organisms, events or ideas in terms of selected features or criteria. By so doing, blind learners will be able to arrange, group or classify objects. For example, blind learners could group air, water, road and rail transport by sound, plants (for example citrus trees or flowers) by smell, animals by odours or the different sounds they make, or fur and fabrics by texture, scientific apparatus by size and shape, et cetera. It should be emphasised to blind learners that classification is crucial for bringing order to their inquiries about nature. They should also be involved in both formal and informal classifications.

Formal classification involves the sorting of organisms into groups on the basis "…(o)f their overall evolutionary relationships" (Van Aswegen *et al.,* 1993:16). On the contrary, informal classification is based on non-evolutionary considerations or on one or a few characteristics, for example, "…(t)he characteristics used to describe leaves, compound, lobed, serrated or simple" (Van Aswegen *et al.,* 1993:16).

(f) COMMUNICATING

Blind learners should continuously be encouraged to communicate about what they do and what they observe to fellow learners and their teachers. They should be given unrestricted opportunities to think, analyse and communicate their thoughts in spoken and written words, diagrams, drawings, graphs, illustrations, pictures and mathematical equations. Thoughts could be communicated on an individual or group basis.

(g) PREDICTING

Prediction, to scientists, is of immense importance because they ask themselves questions that trigger predictions. Predictions are the results of people beginning to wonder about observations and measurements. Predictions also encourage validation. Blind learners should be encouraged to predict and verify or validate what they predicted.

(h) INFERRING

Inferences are valid explanations or interpretations, based on observations, for making proper connections with other ideas or information. Inferences as basic science process skills, according to Van Aswegen *et al.,* (1993:16) are effective in motivating and stimulating learners to think clearly, logically and meaningfully when making observations.

When learners have acquired and mastered basic science process skills, they should be introduced to sophisticated skills (advanced) skills, which integrate basic science process skills and significant complex skills. These skills are useful to Senior Phase and Further Education and Training Band learners. For a learner to meaningfully use these skills, s/he should be cognitively developed. Through these skills, learners are able to arrive at operational definitions and state problems. Learners who have mastered these skills are able to learn, identify, distinguish and interpret definitions that are functional and those that are non-functional.

Advanced science process skills are essential because they equip learners with the ability to communicate and reason both logically and scientifically, "… using terms that have definite operational meanings" (Van Aswegen *et al.,* 1993:17). These authors further argue that these skills assist learners to identify, explain and mention what they regard as being necessary conditions for an experiment in order for the experiment to be repeated successfully. It is further argued that if learners encounter educational as well as scientific problems, those learners will develop the ability to construct operational definitions in problems that are new to them.

Furthermore, worth noting is that learners, as future scientists, formulate hypotheses characterised by explanations and theorems of what they think the outcomes of their research will be. Learners who have acquired advanced science process skills are able to speculate or assume. They then test all their assumptions/speculations through experimentation. Tests are done in order to verify or falsify speculations through the evidence obtained, which either supports the hypothesis or does not.

Blind learners should be able to interpret collected data on their own or be helped by peers. They should become used to both qualitative and quantitative data. Interpretation as an advanced science process skill enhances the learners' ability to determine the validity of a hypothesis. This skill accords the blind learner the opportunity to organise information logically and sequentially. The end result is generalisations supported by experimental findings.

Learners with advanced science process skills are in a position to control independent/manipulated, dependent/responding and controlled or fixed variables. Independent/manipulated variables are always expected to produce outcomes. They are deliberately controlled because they are always under the control of the experimenter. They are independent of dependent variables.

What characterises dependent variables is their dependency on the treatment they receive. In other words, dependent variables represent the outcome/effect in response to the treatment or cause. On the other hand, fixed variables are characterised by conditions which could in many ways affect the outcomes of experiments but do not actually affect them because "… they are deliberately held constant" (Van Aswegen *et al.,* 1993:17). Blind learners should acquire both basic and advanced science process skills that will help them to grow mentally: an element crucial for identifying, quantifying, qualifying, verifying, interpreting, analysing and explaining data.

Blind learners should experiment, since experimenting is the ultimate process that combines basic and integrated science process skills. Blind learners should be encouraged to compile and submit written reports, assignments, homework, classwork, exercises and projects. They must strictly follow the steps sequentially, including stating the problem, formulating a testable hypothesis, identifying and controlling variables, making observations and measurements, interpreting data, communicating procedures and drawing tentative conclusions. However, it should be borne in mind that their lack of visual ability will adversely limit the experiments they can conduct.

It is stated in the Senior Phase Policy Document (1999:32) that advanced science process skills provide learners "…(w)ith opportunities to acquire, develop a range of more advanced knowledge, understanding and skills". Furthermore, these skills ensure that learners are given "…(a) sound basis from which to take advantage of choices …". According to the researcher, these skills have the capability to motivate learners to perceive objects in broader, deeper, more analytical and meaningful ways. They take learners to a scientific destination where their knowledge of scientific options is evaluated.

In addition, it is maintained in the above-stated work (1999:32) that this is done to ensure that the scientific decisions at which these learners will arrive concerning their future choices, are informed ones. Advanced science process skills make it possible for learners to become more self-reliant and clearer about their own scientific aspirations. These skills consolidate, reinforce and support the observational, experimental, analytical, problem-solving, hypothesising, measuring and innovative abilities of learners.

Learners with these skills mature cognitively and also develop self-reliance. This is due to the development of abstract thinking. The Senior Phase Policy Document (1999:33) aptly stated that learners have to concentrate on thinking in abstract terms and in terms of hypotheses and on the use of lateral reasoning. At that level sophistication of thought processes really begins and with appropriate support, the learner could analyse events and have some understanding of probability, correlations, combinations, positional reasoning and other higher-level cognitive skills.

In instances where the sensorimotor skill is guided by thinking (the mind), the process encompasses cognitive skills. For example, seeing is, a cognitive skill since what we perceive (perceptualisation) is both guided and interpreted by the mind. That is, the cognitive skill enables learners to learn and interact positively in an environment comprising both direct exposure to stimuli and Mediated Learning Experiences. This skill further enhances the learners' ability to mentally digest information in a more sophisticated manner. Van Aswegen *et al.,* (1993:14-16) further elaborated that the more complex cognitive skills such as classification, for example, are derived from a combination of sensorimotor skills, such as looking at objects as well as touching them, with the aim of putting them into groups.

Feuerstein (2001:4) believed that cognitive skills have the power to empower people mentally because they enable individuals to acquire behaviours, learnings and operative structures that allow those individuals to enjoy "...(t)he greatest benefits from direct exposure."

The cognitive skill plays a paramount role in all learning areas. How the learner interprets, processes information, integrates information, attaches meaning, associates or classifies types of information, and so on, reveals to the educator an idea of the background knowledge comprising the basic science skills the learner possesses in a subject, the rate and level at which the learner is able to express the subject's principles, the learner's intentions about the subject, the learner's general attention, how the learner could be evaluated or assessed, and the progress the learner is making in that particular subject.

To all learners, the physical environment is the source of vast unrefined information. Pauw (1991c:92-93) observed, "(t)he brain receives information (data) from the outer environment by means of the sensory organs and interprets it partly as a result of data previously received and registered. The registration and reactions of the brain constitute what is known as the perceptual process."

Therefore, the researcher regards perception as the conscious deliberate mental registration of a sensory stimulus. After an individual has perceived, what follows next is conceptualisation, depending largely on the ability of the brain to both process and integrate data. Van Aswegen *et al.,* (1993:7) stated, "(t)he complexity of the thinking activities which have to be executed determines the complexity of the cognitive skill." It is also possible for the cognitive skill to consist only of an activity of the mind and in no way to have a complementary sensorimotor skill to accompany it.

It is also indicated in the Senior Phase Policy Document (1999:33) that learners with advanced science process skills have the ability to perform controlled experimentation. Furthermore, they are able to hypothesise variables before experimentation, in order to "…(r)everse direction between reality and possibility." They could, in addition, "…(u)se operations, combining propositions by conjunction, disjunction, negation and application."

These skills ensure that learners remain focused as far as their attitude, development and understanding towards science is concerned. They also know and understand the special role they should play as young and budding scientists. In the researcher's view, these skills make learners aware of scientific challenges and aspects having an influence on scientific concepts.

Advanced science skills enable learners to learn by "using" rather than only "knowing" what is theoretical about objects. Some of these skills, more especially for the blind, encourage the determination and recognition of their needs, concerns and challenges. If blind learners' needs are met, concerns and challenges addressed, learning mediation takes place accordingly.

Other advanced science process skills learners should acquire are called techniques. Techniques should be understood as mechanical skills executed when for example, a technological instrument, apparatus or machine is used as an extension of the human body. A microscope, to cite just one good example, extends the optical observation of people and includes the sensorimotor skill of perception and the cognitive skill of registering and interpreting what has been seen. Van Aswegen *et al.,* (1993:6) pointed out, "(T)he technical manipulation of the instrument, apparatus or machine is added as a cognitive skill to form a technique."

It should always be borne in mind that inclusive education is constituted by able-bodied individuals, as well as by differently-abled, such as blind, learners. Engelbrecht *et al.,* (1999:72) observed that "(l)earner diversity is inevitable in any classroom and teachers can expect variation in the pace and style of learning." They added, "(i)n the inclusive classroom some learners have special educational needs for a variety of reasons, either intrinsic or extrinsic, which have to be accommodated. There may be learners with physical or sensory disabilities who require assistive devices in order to learn." Through the inclusion of blind learners in an Outcomes-based classroom, they might or might not, depending on circumstances, develop useful skills and life sciences (biology) concepts that could to a great extent assist them in living more productive lives.

An educator faced with this situation has to cater for these individuals in such a way that all benefit equally. This means that, for the blind person to learn and develop the advanced science skills referred to above, s/he should be exposed to and be provided with special modified learning mediation material. According to the researcher, modifications are of cardinal importance because they make the facilitation of learning or learning mediation by blind learners effective, goal-directed, meaningful, idealistic and so on. Blind learners learn and benefit from reading machines, talking machines, speech-time compressors, paperless Braille machines for taking notes, talking calculators or talking science apparatus. Collette (1989:282) maintained that blind learners learn and develop advanced science process skills through both the materials and experiences that are commonly used in hands-on approaches during science teaching and learning mediation.

Blind learners also learn and enjoy the psychosocial atmosphere of both special and inclusive schools, as well as classes which do not in any way hinder but rather promote successful life sciences/biology facilitation and learning mediation by providing a safe and ever-supportive atmosphere where all learners are prepared to take life sciences/biology risks and "...(l)earn from their own mistakes without being reprimanded or ridiculed" (Engelbrecht *et al.,* 1999:72).

By so doing, emphasised Bertram *et al.*, (2000) learners would be adhering to Outcomes-based Education and Training's key principles, which encourage that:

1. Learners should at all times be active.
2. Learners should be competent, and this is the main goal of Outcomes-based Education.
3. Learners have, as a matter of fact, to experience and must always strive to put emphasis on meaningful learning mediation.
4. All learners are able to read, listen, speak and write during learning mediation.
5. Learners should use life sciences (biology) grammar or vocabulary as essential tools for learning mediation.
6. Learners are constantly prepared to consider error as a sign of development and not failure.
7. The educator fully knows and understands his/her role as a facilitator.
8. Learners are encouraged to do self-directed learning mediation.
9. Learners are encouraged to be critical, innovative and creative.
10. Educators inspire confidence in learners.

There are some instances where individualised or differentiated instruction and learning mediation should occur. Educators should, however, also allow the blind learners together with sighted learners to work in groups. This is crucial because "(l)earners work in ... groups to help each other learn,..." (Engelbrecht *et al.,* 1999:75). Learning mediation in this regard would allow equal opportunities to take place and should be non-competitive. Peer tutoring is also vital to both the sighted and blind learner as they help each other along the learning mediation path.

Blind learners learn from objects or tactile sketches. Collette (1989:282) suggested that when teaching blind students about an object, it is advisable to begin with the actual object so that the student can experience the actual size, shape and feel of the object. "(t)his will minimise the possibility of the blind person incorrectly generalising from a small, hard, cold model of an object to the real thing." This will also provide the blind learner with tactile experiences of the object. Thus, models could be used to reinforce concepts. However, the danger of models or tactile sketches is that they either exaggerate or compromise veracity in terms of size, texture, and so on. Please see appendix A where the size of an Amoeba in a tactile format is exaggerated. Furthermore, the blind learner will then never feel colours, behaviour of living animals, and so on.

In addition, the blind learner will not even be able to "feel" most experiments or observe them tactually. A good example would be that of conducting an experiment to determine the effect of a temperature change on the size of a metal sphere. In this experiment, a metal sphere at a room temperature "...(s)hould pass freely through the ring".

However, when the metal sphere is heated, the sphere does not pass through the opening when it is hot. Its size has increased. The blind learner will not be able to observe the heated sphere tactually when it is still hot. The blind learner will only be privileged to observe and take part when the metal sphere is not heated. When it is hot, s/he will not be able to experiment with it because his/her fingers will be burnt.

Another example is that of testing the degree of acidity or alkalinity. The scientist, on a numerical scale called the pH scale, indicates both the degree of acidity and alkalinity it was pointed out that to each acidic or alkaline solution a number is given which is known as the pH of the acid or alkali solution [s.a.] [s.p.] Acids have a low pH value and alkalis have a high pH value, ranging from 1-14.

The colours of universal indicators depend largely upon the pH of the acid or alkali to which they are added. The main problem with an experiment of this kind is that the blind learner cannot observe the colour change. The blind learner's learning mediation might be restricted to knowing and associating the colours with the numbers and he/she will not be able to visually observe the experiment. These are some of the problems often posed by Outcomes-based Education, which lays much emphasis on visual ability. The question arises: is this not indicative of the fact that the blind learner might not achieve some of the Outcomes-based Education outcomes?

Blind learners will also learn from and benefit from raised and tactual diagrams, which are important learning mediation aids. According to Collette (1989:282), objects and diagrams have limitations because they cause blind learners not to "...(p)erceive the same things as individuals without visual handicaps do when they see an object."

Blind learners learn more effectively in and prefer an environment that is not full of gestures, complicated symbols and phrases like "this and that". The educator has to mediate looking directly at the blind learner. Furthermore, the educator has to be selective and use words such as "see and look" with care. Such learners will learn better if their needs, concerns and challenges are taken into account. They should be encouraged to use tactile examinations if it is safe and beneficial to do so. Diagrams, experiments, observations, and so on should not be detailed as those students might fail to grasp the anticipated message or results. They will also learn better if they are given additional time to complete their projects.

The blind learners will learn, and appreciate learning, if an inclusive Outcomes-based Education environment is able to foster appreciation, acceptance, tolerance and caring in all learners and educators. This is what Engelbrecht *et al.,* (1999:73) refer to as the psychosocial environment. Hence, the educator's chief duty should be finding ways and means to create an atmosphere conducive to nurturing the personal, emotional, cognitive, and social development of all learners.

In the researcher's opinion, blind learners learn best where there are few or no physical and information barriers. Lack of physical barriers ensures the accessibility of the classroom for "...(l)earners with disabilities" (Engelbrecht *et al.,* 1999:73). Learners who are blind might, in most instances, be able to learn if they are provided with instruction in Braille, audiotapes, computers with speech synthesisers, and so on. As far as the classroom learning mediation environment is concerned, equipment and material relevant to the learning mediation needs of the blind learner should be provided.

Inclusive education and Outcomes-based Education learning environments should be modified in order to accommodate blind learners. Failure to do this, in the researcher's view, could lead to:

Blind learners being passive during science or biology activities. Blind learners will be less competent; hence learning mediation would be meaningless to them. Modification/adaptation of environments encourages learners' critical and creative thinking. If advanced science skills are not modified, blind learners will not benefit from self-directed learning mediation, hence they could experience inclusive education to be unfriendly or hostile.

3.6.1 THE DEVELOPMENT OF THE SUBJECT LANGUAGE SYSTEM

Before the researcher discusses the development of the language system of biology, it is imperative to highlight the importance of language.

According to Higgins and Ballard (2000:164) the acquisition of language is instrumental because:

- It allows the individual to objectify and typify his/her subjective experience;
- Language transcends the here and now; and,
- Language builds up meanings and a social stock of knowledge, which is distributed and passed from generation to generation. According to the above-stated authors (2000:164) "(l)anguage thus apprehends and produces the world and conversation is the tool used to maintain this world. Conversation, written or oral, helps to legitimate societal institutions that are dialectically formed to control individuals and which also, through the socialisation process, provide individuals with roles and identities that maintain society."

The following two questions are central in helping us understand how and why any subject language system (of biology in this case) develops.

1. How does the subject language system develop? and
2. Why should the subject language system develop?

It is worth noting that the development of the subject language system happens when the observer starts to attach meaning to an observation. The major reason for the development of the subject language system for biology and other subjects is to enable learners to learn, as well as getting them acquainted with the culture, values, norms, ground rules/principles, practices, beliefs and habits relevant to biology.

Therefore, according to Land and Fotheringham (1999:71), learners will be able to learn the biology language system through a conscious study of its rules and careful practice of them. The biology language should positively reinforce the proper use of the language amongst all learners. These co-authors are of the view that learners master things, including language, by being involved in activities and that rules ought to be laid down for practising such activities. As a result of this action, the subject language system originates. The observer takes trouble to name the observation precisely according to his or her own conceptualisation. Furthermore, the observer, in addition, takes the trouble to critically compare and contrast his or her own personal meaning (concept) with those already existing concepts (labels) about the subject which constitute the subject norm.

The issues discussed in 3.3.1 are still pertinent here. In the development of the subject language system, the observer tries her best to find the subject language system's place in the conceptual framework, or to expand or change the framework to include the new observation and new concepts in the framework. Hence, the subject language system of biology is composed of its unique terminology as well as of various means of communication including, but not limited to, aspects of visual presentations (illustrations, sketches, diagrams, photographs, et cetera) and mathematical ways and means of both recording and representing observed data, such as: tables, symbols/patterns, graphs, and histograms. The vocabulary of learners expands through communication. Hence, learners "...(l)earn ... best by using ... rather than knowing only about ... rules" (Land and Fotheringham 1999:71).

Various learning mediation strategies play a pivotal role in the development of the subject language system. For example, the audio-lingual method advocates and views language learning as a matter of habit formation. This method absolutely reinforces the use of correct language and immediate correction of errors. Biology, as does any other subject, expects of all learners to adhere to its language's rules and regulations.

The other equally important learning mediation strategy is the grammar or language based method. This simply means that all subjects have their unique languages. Through the conscious study of biology rules and careful practice of these rules, learners and educators alike will use, effectively and appropriately, biological terms, concepts, phrases, and so on.

A communicative approach is crucial in the development of the subject language system because learners learn by constructive talks, debates, discussions, and so on. This approach promotes good sentence construction, logic and sequence. The approach allows learners to use the language with confidence, rather than knowing only about the biology language's rules.

The popular education approach is also one of the best learning mediation strategies. In this approach, the needs, concerns and challenges of learners are addressed. It is also the belief of the researcher that the learning mediation of each subject also depends on, and is also influenced by, the fact that its issues are also addressed. These might include observations, the collection of data, interpretation of data, analysis of data, testing and retesting, evaluation and assessment of experiments, and so on, because all these contribute to the development of the language system of biology.

Exposition of the science learning mediation approach is also an important approach to the development of the subject language system. Though educators are the primary focus in expository science mediation, by being the doers, their learners are also mental participants. In some instances, this approach is appropriate in the presentation of information to one's learners directly. One could do this by telling them, demonstrating or making use of science apparatus, carrying on a discussion, reading to learners, showing learners a film, filmstrip, slides, or television presentation, or having a resource person present something to them. Of vital importance to the mediator, "...(i)s to know how much your children know before you present any scientific concepts to them" (Carin and Sund 1989:100).

Inquiry or free discovery learning mediation develops the learner's ability to manipulate, control and process information from a wide range of sources. This should, indeed, be done academically, socially and experimentally. Inquiry allows learners to identify and determine problems, generate hypotheses about likely answers, test and retest hypotheses in the light of available data, attempt to apply conclusions arrived at to the new data, problems or situations. All these activities are crucial for the development of the subject language system of biology.

Discovery enables learners to internally rearrange data so that all learners can go beyond the data and form concepts new to them. Discovery concerns concentrated efforts to find or seek to find the meaning, organising and structuring of ideas, interpreting, and so on. Through their discovery, learners are able to recognise the relationship between an idea and an observation, or, "...(b)etween two ideas, or between two observations" (Carin and Sund 1989:103).

Other additional methods crucial for the development of the language system include but are not limited to such methods as the inductive and deductive, cooperative, narrative, discussion, question and answer, non-formal and formal biology learning, drill and thinking aloud methods. Carin and Sund (1989:100) advised that a variety of these methods have to be used during instruction "(b)ecause each of your children is unique, there is no one best way to teach everyone."

Due to biology's dynamic nature, it would be extremely difficult, if not impossible, to confine it to descriptive terms. It has to abide by the most recent discoveries.

3.6.2 COMPETENCES NEEDED FOR DISCOVERY

The competence for discovery is interdependent with the first two competences: observation and the development of the subject language system. These three competences jointly describe what is called methodology, which in turn comprises the following activities: the identification and the formulation of the problem, obtaining all existing information about the problem, formulating of an hypothesis (possible solutions to the problem, designing the execution of investigations, interpretation of data and reaching conclusions), et cetera. The competences for discovery enhance participation and to a large extent promote active learning mediation. Discovery assists learners to pursue valuable knowledge. According to Collette (1989:50) the competences for discovery involve learners "...(i)n exploration, questioning, problem solving, inductive reasoning, invention, labelling and discovery." Through their competence for discovery, scientists try as best as they can to reconcile and associate concepts and biology rules.

3.7 THE RELATIONSHIP BETWEEN SUBSTANTIVE AND SYNTACTICAL STRUCTURES

The relationship between the substantive and syntactical structure of biology is considered by Van Aswegen *et al.,* (1993:7) to be of paramount importance because that is where the crux of its consequences for learning excellence lies. This relationship can, furthermore, be noticed in the fact that the syntactical structure is responsible for both the generation and understanding of substantive structure while, in one way or another, the substantive structure directs and to some extent induces the course of the syntactical structure.

This means that people should exercise some caution, by not falling into the trap of viewing theory and practice as if they are two separate and totally independent entities.

Therefore, the facilitation or mediation of biology would be most effective only if biology is presented:

- firstly as a product,
- secondly as a process and,
- thirdly as a way of intensive thinking.

Van Aswegen *et al.,* (1993:7) argued that science as a body of knowledge (product), a way of investigation (process) and a way of thinking should, therefore, be stressed in biology instruction and learning mediation activities since this has the potential to provide an opportunity to involve pupils/learners in the scientific enterprise.

Not only do people acquire valuable knowledge from biology. Biology, in most instances, also strives to equip people with certain desirable qualities such as objectivity, careful and accurate observations, the use of inductive and deductive approaches, and, of equal importance, the ability to arrive at tentative as well as valid and sound conclusions. The biology syllabus will only achieve its envisaged goals if much emphasis is laid on the understanding, interpretation and application of biological data.

3.8 THE FACILITATION/MEDIATION OF LIFE SCIENCE (BIOLOGY) THROUGH INQUIRY

According to the researcher, enquiry anywhere in the life, learning mediation, political, religious or economic situation, for instance, plays an instrumental role because it stresses the investigative aspects of this activity. The key features of enquiry are to ask questions and figure out things for oneself. Enquiry reflects the scientific enterprise. In addition, as pointed out by Collette (1989:48) enquiry emphasises the fact that knowledge is acquired through investigation and that knowledge contains discrepancies and is subject to change. The same applies to the facilitation or mediation of biology. It stresses the investigative aspects of science and also how through investigation, knowledge can be acquired and / or altered.

3.8.1 THE IMPORTANCE OF INQUIRY SESSIONS

In specific terms, enquiry sessions are crucial because they present "... science as a way of looking at the world around us, a way that one seeks knowledge on one hand and questions knowledge on the other hand" (Collette 1989:48).

Generally speaking, enquiry sessions are instrumental in encouraging pupils to:

- Think logically and creatively.
- Speculate, question and attack problems.
- Discover, problem-solve, deduce and induct reasoning and discrepant events.
- Build the self-concepts of pupils, because mediating through inquiry is always pupil-centred.
- Develop and nurture talents and skills that are necessary not only for their development of cognitive structures but also for their powers of reasoning.

They also:

- Give learners intrinsic rewards because when learners are engaged in enquiries, they begin to consider success and failure as information rather than as rewards or punishment from the educator.
- Give learners self-satisfaction.
- Enable learners to discover the heuristics of discovery learning. Collette (1989:50) argued that an effective practice of this process should enable students to develop the ability to sense the relevance of variables, make intuitive leaps, and cast problems into forms with which they know how to work.
- Aid one during the memory process. This is to say, when learners integrate material into their own cognitive structure, "... the material is made more readily retrievable" (Collette 1989:50).
- Familiarise and make learners comfortable with science.
- Allow learners to become scientifically literate and able to solve problems by actually participating "... at their appropriate level in ... activities with ... assistance" (Carin and Sund 1989:103).
- Help them to acquire knowledge that is uniquely and exclusively theirs because they discover it themselves. As such, learners should be able to determine and distinguish their expectancy levels of achievement and performance. Learners are also capable of assimilating and accommodating what they encounter in the environment.

Carin and Sund (1989:106) acknowledge that if learners' self-concepts during inquiry sessions are positive, the following things happen:

- Learners feel psychologically secure.
- Learners are open and exposed to new experiences.
- They are willing to take risks and develop the interest to explore.
- They tolerate minor failures relatively well.
- They become more creative, innovative and initiative.
- They generally find themselves in good mental health. And
- They eventually become fully functioning, competent, educationally productive and confident individuals.

Enquiry sessions in inclusive education and the facilitation or mediation of biology in an Outcomes-based Education learning environment might pose numerous, even endless, difficulties to both the educator and the learner if they lack innovative, creative and initiative problem-solving skills. Problems encountered during enquiry sessions by blind learners might emanate from a lack of adapted learning mediation support materials and apparatus with which they can test and explore their ideas, dangerous or complex experiments, inadequate enquiry approaches, and so on. However, the general and special educators (if available at an inclusive school) should "(t)hrough the process of problem-solving, ... use their collective expertise in a collegial, equal-status relationship ... This partnership allows special education teachers to propose alternative teaching strategies or supplementary instructional material as a result of suggestions generated by the general education teacher" (Engelbrecht *et al.,* 1999:163).

3.9 FACTORS INFLUENCING THE FACILITATION OR LEARNING MEDIATION OF BIOLOGY AMONG BLIND LEARNERS

3.9.1 INTERACTIONAL/SOCIAL-EMOTIONAL ENVIRONMENT

All learning mediation, whether formal or informal, takes place in a social-emotional or physical environment. The learner is a social being. By interacting with fellow learners, parents, educators, scientists, et cetera, she will know what the society expects of her. The interactional environment should always provide learners with adequate support in their daily learning mediation activities. This kind of environment not only nurtures learners but also, to an extent, the educator as well, personally, emotionally, cognitively, socially and otherwise. Prospects are good for both learners and educators to broaden their horizons by being exposed to new scientific experiences, information and ideas during interaction. Experienced biology educators might serve as blind learners' mentors or consultants during these kinds of interactions. Through interaction, learners can receive continual feedback regarding their learning mediation and, as such, be in a position to determine and strive to improve their participation, innovation, creativity and effectiveness.

The interactional/social-emotional environment, to a great degree, depends on and is also influenced by how the educator interacts with her learners. Any educator who is at ease with her learners, who loves his/her subject and is highly competent, will do everything to the best of his/her ability to create a healthy and constructive learning mediation environment. That is, he/she will always and by every possible means endeavour to accurately identify and determine services needed and educational priorities of every blind learner under his/her supervision.

Furthermore, the biology educator should also be able to recognise the various complex needs of his/her blind learners and if possible, do his/her best to design what would be a more comprehensive and effective facilitation or learning mediation atmosphere. By so doing, s/he should also be able to set both idealistic and realistic goals for his or her learners.

Van Aswegen *et al.,* (1993:10) noted that "(a) pupil's academic performance and ability to adapt socially depend to a large extent on the social-emotional environment of the classroom." They further argued that this kind of environment not only affects how much is learned and retained, but also influences future attitudes towards learning mediation. Therefore, any environment that is tremendously hostile, and not conducive to learning mediation in any way, encourages learners in Van Aswegen *et al.*'s terms to "disengage" rather than "engage".

The mutual support much needed by both the educator and other staff members will be wanting in such a situation. Hence, the blind learner might perform dismally during learning mediation. This negative type of environment will discourage blind learners from maximising their full potential for useful and meaningful participation in the learning mediation environment. A healthy learning mediation environment greatly helps the blind learner to achieve important outcomes and the educator's experience, personal growth and satisfaction are, without any reasonable doubt, also increased.

Van Aswegen *et al.,* (1993) further indicated that effective facilitation and learning mediation of biology depends on both the educator and the interactional environment in which the mediation and learning processes daily take place. On the other hand, Engelbrecht *et al.,* (1999:72) held that interaction either promotes or impedes successful learning mediation. Both the facilitation/learning mediation and environment factors help shape biology as a subject in order to make it a very interesting, variable and pleasant learning experience. It is this interactional environment that promotes and enhances a facilitation or learning mediation situation that is safe for and supportive to all learners in the sense that these learners become thoroughly prepared to take learning mediation risks.

3.9.2 THE INCLUSIVE OUTCOMES-BASED EDUCATION LEARNING ENVIRONMENT

The researcher argues that the atmosphere that should prevail in this learning environment, in the form of a classroom for example, should be one that allows and fosters appreciation, acceptance, accommodation, tolerance, dedication, determination, love and care in all learners. This is crucial for creating an atmosphere conducive to nurturing the personal, emotional, cognitive and social development of all learners. Blind learners do best in an environment which is not hostile.

It is expected of this environment to have available readily adapted material that meets the learning mediation needs of blind learners. Educators should supplement regular facilitation of biology with individualised learning mediation to help blind learners catch up with their work, which in most biology assignments requires the visual ability of learners. Learners should constantly be encouraged to help each other during learning mediation.

In the inclusive environment, the role of the educator is threefold. First, he should be able to assess the knowledge of learners or check it from time to time, in order to inform the development and growth of the inclusive programme. Second, the educator should adapt and promote the accessibility of the inclusive programme and also provide relevant and adequate support to blind learners. Third, the educator should embark upon processes for the recognition of blind learners' prior knowledge.

3.9.3 THE PHYSICAL ENVIRONMENT

The physical environment refers to learning mediation facilities or infrastructure. For learning mediation to be appropriate and effective, all the learning mediation environments have to be accessible to all, that is educators and learners alike. By accessibility the researcher means the ability of all people to approach, enter and effectively use the facilities to the maximum. This should address all the environmental as well as architectural barriers, which might, in one way or the other, be discriminatory. Without proper access, there will be no equal participation.

The positive or negative conditions of the facilities influence the learning mediation that is to take place. It has been argued by (Van Aswegen *et al.,* 1993:10 and Engelbrecht *et al.,* 1999:73) that the physical environment plays an important role in promoting positive learning attitudes among learners, by stimulating their interest and curiosity in biology.

In instances where there are physical barriers, changes should be made to certain dimensions for the sake of eradicating those barriers for blind learners. Aisles should be made available to allow and promote free movement by blind learners while using their white canes. There should, as a priority, be landmarks comprising cues and clues to help them find their way while walking independently. Blind learners should be provided with assistive devices and learning mediation support material transcribed into Braille. These are the major factors to be considered in the facilitation or learning mediation of biology.

For educators to be able to create a physically conducive environment, the following factors have to be considered:

- Attractiveness and neatness of both the classroom and laboratory: effective learning mediation takes place in a well-organised and neat classroom.
- Movement of learners in classroom and laboratories: Rules and regulations for entry and leaving both the classroom and the laboratory have to be laid down and followed exactly. In other words, movement in laboratories should be controlled at all times: "(n)o running, rushing or pushing should be permitted" (Van Aswegen et al., 1993:10).
- Seating of learners: Seating in class should be determined by learners' needs. For example, learners with sensory problems (sight and hearing) should be accommodated near the front of the classroom. Those with photophobia (sensitivity to light) should not be seated near windows without blinds or where there is excessive light. Those with Attention Deficit Hyperactivity Disorder should not be seated next to the door or windows, to avoid distraction.
- Light, temperature and ventilation: "(m)uch of the work done in the science department is visually more exacting than work done in the ordinary classroom" (Van Aswegen 1993:10). This is an indication that lighting plays an instrumental role when microscopes are used or during dissections. Collette (1989:289) maintains that electricity is also essential for many laboratory activities, for

example, running microscopes, refrigerators, hot plates, centrifuges, clocks, variable power sources and electric meters. Efficient ventilation will help curb or regulate unpleasant odours. It will be advisable always to keep windows open in laboratories during warm or humid days in cases where thermostats do not control temperatures. The researcher is of the view that the regulation of temperature in laboratories will be much improved only if aircon is installed, though.

3.10 QUALITIES OF A BIOLOGY EDUCATOR

As indicated in this work, blind learners are a heterogeneous group with unique needs and demands. They learn at different paces and employ different styles and techniques. What complicates this situation further is that some are good in certain multiple intelligences (such as music, languages, mathematics, et cetera). While others facilitating learning for the blind is a more sophisticated, complex and demanding task than most people anticipate. Educators should become aware of the potential of their learners so that they can develop it. This compels the researcher to conclude that blind learners deserve to be taught by educators who understand their conditions. They need educators who understand what it implies to significantly and reasonably accommodate and facilitate learning in a way that will educationally be profitable to them. Such educators have to be thoroughly prepared to dedicate their hearts, minds, time, effort and energy to this cause, for proper facilitation or mediation to materialise. This is why educators in both special and inclusive settings should possess most of the qualities discussed hereunder. Apart from understanding the plight of blind learners, biology has its own demands, which educators have to consider when facilitating learning to make it more meaningful, challenging and interesting.

Duminy, Dreyer and Steyn (1990:66) stated, "(i)t is unfair to expect that teachers should be perfect. They are ordinary human beings. They have their ideals, their capacities and faults. Not every man or woman will be a successful teacher. Any profession has its demands." Biology also makes its own demands: it requires of educators to do their utmost during the facilitation or learning mediation. Proper facilitation qualities will help educators to act competently. Killen (2000:189) argued, "…(a) person who is acting competently will integrate knowledge with skills and values, and will do so in diverse situations." In addition, according to the above-referred author (2000:189), such an educator will be able to "…(p)repare students for their future life roles (self-directed learner, collaborative worker, complex thinker, community contributor and quality producer)."

Duminy *et al.,* (1990:66) further stated that "(t)he most important demand of teaching is a positive attitude." Any educator without the proper qualities will not be effective as an educator. Poor facilitation qualities impact negatively on learners whereas the proper qualities impact positively on learners. Qualities have an enormous power to make facilitation and learning mediation successful, or might cause it to fail dismally.

To avert this kind of predicament, the biology educator should possess at least some of the following qualities:

Interpersonal relationships

The biology educator should be in a position to establish good interpersonal relationships with peers and colleagues. These should be extended to communities, organisations and workplaces. The personal bond should always prevail. This kind of quality is crucial for teachers in mentoring one another, advising, supporting and encouraging each other. Through exercising it, the biology educator will develop what Webson (1997:40) called "like-mindedness". By means of interpersonal relationships, the biology educator will, most probably, gain new ideas, discover new abilities, et cetera. By so doing, s/he will start to expand his/her horizons. Furthermore, through this relationship, biology educators could share vital information about, for example, resources available to them, new biology publications, discoveries, and so forth. Finally, the biology educator may be able to assess himself/herself in comparison with others.

The biology educator should be an assessor

Assessments will help the biology educator in instances where s/he should give helpful feedback to blind learners. Both formative and summative assessments will enable educators to acquire valuable information about blind learners' needs. Detailed and diagnostic records of assessment should be kept so that the educator can acquaint himself/herself from time to time with blind learners' needs, the outcomes achieved and those still to be achieved.

Love for one's work

Any educator who loves his/her work generally shows enthusiasm for it. Collette (1989:162) maintained that "(p)ersonal enthusiasm ... is a great asset to science teachers. If they react to ... activities with interest and excitement, the prospects are good that their students will do the same." Such an educator tries to be perfect and does not mind walking an extra mile. Duminy *et al.,* (1990:66) warned, "(a) teacher who does not love his or her work, will never be a real educator."

The biology educator should be involved in a programme/s design processes

The educator should design research programmes, with national or local needs and standards as well as the needs of target learners and employers in mind. S/he should design programmes with outcomes, learning mediation and assessment strategies that are apposite to the process of qualification. S/he should frequently review programmes in the light of new developments in the field, as well as on the basis of feedback from employers, learners, tutors and assessment processes.

Mediator of learning

Any educator who accepts blind learners as they are, who even understands that they have likes and dislikes, who knows their capacities and deficiencies, will in turn be liked by them. They should know, like and above all, trust him/her. Their likes, dislikes, capacities and deficiencies are features contributing to learners' uniqueness. Engelbrecht *et al.,* (1999:70) cautioned that educators whose professional education takes place "...(i)n a climate which views intelligence as fixed and unmodifiable are likely to have limited expectations about learners' capacity or propensity for learning and to be pessimistic about their progress." Therefore, biology educators should understand, like and view each individual learner as unique and as having the potential to benefit from learning mediation. In addition, an educator who understands, likes and views each blind learner as a unique individual, will not have negative attitudes towards disability.

Biology educators should exhibit positive attitudes towards disability and possess the responsibility to accommodate and tolerate inclusive practices. Killen (2000:190) maintains that the educator should "…(m)ediate learning in a manner that is sensitive to the diverse needs of learners; construct learning environments that are appropriately contextualised and inspirational; and communicate effectively, showing recognition of and respect for the difference of others." The educator should "… demonstrate sound knowledge of subject content and various principles, strategies, and resources appropriate to teach in various contexts." It should, however, be borne in mind that biology educators, like other educators, "...(a)re human beings with individual attitudes to difference and disability, formed in a context of prevailing social attitudes" (Engelbrecht *et al.,* 1999:71). It is a truism that many educators might initially resist the notion of inclusion and the mediation/facilitation of biology to blind learners in an Outcomes-based Education classroom.

The previously mentioned co-authors (1999:71) pointed out that research conducted internationally has shown that educators with little or no experience of people with disabilities are likely to have negative attitudes to inclusion, which of course also applies to biology facilitation and learning mediation. If educators change their attitudes to accommodate learners with a diverse range of needs (including the blind), such learners will benefit from biology facilitation and learning mediation.

Basing their argument on the issues of educators' lack of experience and negative attitude, Engelbrecht *et al.,* (1999:71) advised that "(t)o support ... learners with special educational needs teachers have to be sensitive, not only to the particular needs of individual learners, but also to their own attitudes and feelings." This would be possible if biology educators were to receive training in how to identify and address special educational needs. Above all, biology educators should strive to develop a positive and critical understanding of common stereotypes and prejudices related to disability, and time and again reflect on how these could negatively or positively influence their own attitudes as educators.

The biology educator should have an appropriate personality

It is an indisputable fact that a healthy personal relationship between the educator and his/her pupils fosters positive learning mediation and creates a pleasant educational climate. The educator with an appropriate personality should at least be enthusiastic, motivated, lively, interested in his/her subject and work, have a good sense of humour and be both fair and consistent in his/her judgment.

The educator should be equipped with both professional and academic qualifications

It is of paramount importance that the biology educator be both academically and professionally qualified so as to educate his/her blind learners with greater confidence. According to *Norms and Standards of Educators* (2000:30), "… the roles and competences (norms) for educators and the provision of a qualification structure and specialists requirements (standards) are fundamental to the development of educators."

Educators' qualifications are instrumental in describing their roles, specialities, their level, the learners they can educate, their employability and articulation routes. Qualifications should be in line with local, national and international needs. Training should offer educators many scientific experiences. An educator who is both professionally and academically qualified could be an excellent source of ideas and information for all learners. Collette (1989:162) supports this view by maintaining that such educators serve as consultants to their learners. If possible, their academic and professional training should include special education. If those educators are acquainted with instructional approaches meant for blind learners, they will be better able to accommodate them during instruction and learning mediation.

Collette (1989:57) further maintained that educators always have to learn specific skills and techniques before they can successfully include any content in their mediation. Being academically and professionally qualified, will allow biology educators at inclusive schools to develop biology curriculum guidelines, and see to the construction and modification of tests to accommodate blind learners, the development of proper laboratory activities, the handling of controversial scientific issues in classrooms, and so on.

Furthermore, blind learners will in turn have confidence and trust in the educator who shows competency in his/her subject field. This implies that the educator's task is to guide all learners along the educational path. In order to do this, s/he needs knowledge of the subject matter as well as educational "training". Killen (2000:190) maintains that educators who are professionally and academically qualified will "… achieve ongoing personal, academic, occupational and professional growth through pursuing reflective study and research in their learning area, in broader professional and educational matters, in their related fields."

Educators should be scholars that are always in pursuit of new knowledge. *The Educators' Voice* (September 2001:21) maintained that educators who are scholars never stop challenging themselves, so that they can do the same for their students. They never stop learning, because they are educationally and academically addicted to it. Such educators should improve their mediation strategies and, therefore, should study new approaches in the field of education. Any educator should constantly search for new meaning and should always create new possibilities for learners also to discover something of the wonderful world in which they are privileged to live. The educator could always improve his/her academic and professional qualifications by reading the subject literature, enrolling with institutions of higher learning, following a course of his/her own choice, receiving in-service training, attending biology seminars, symposia, conferences, and the like.

Pauw (1984a:11) argued that special and inclusive schools should possess academically and professionally qualified educators in order to help mediate learning to blind learners. They have to be experts in the field of special education and should know and understand the historical background and the pedagogical principles on which the education of blind learners is based. They should constantly be aware of and possess knowledge of the psychological aspects of these learners' development and education.

Mani (2000a:16), as far as training is concerned, argued that "(f)or the effective implementation of inclusive education for all types of disabled children, general classroom teachers need training on understanding the educational needs of these children." This author took this argument a step further when he maintained that training is ideal for the acquisition of skills and knowledge during the pre-service teacher preparation course itself. He argued that teachers, thus trained, would be in a position to take care of the educational needs of learners, their special needs too, in general classrooms if appropriate disability-specific assistive devices are made available.

Professionally and academically qualified educators should know and understand types and degrees of blindness and the adaptations they have to make for the sake of accommodating these kinds of blindness. They should further understand the implications of ophthalmological and medical treatment of visual diseases and errors. They should fully be aware of a blind person's learning process and specialised didactics. They need to receive training on the use of special apparatus and other appliances, which make education accessible for the blind. According to Mani (2000a:17), professionally and academically qualified educators understand that inclusive education does not mean just enrolling a learner with a disability in the regular classroom. These educators understand that such learners should be given help to cope with their regular classwork. Therefore, in certain instances, they will adopt the learner-centred approach in their quest to mediate learning. Such educators should understand that the quality of their mediation depends upon and is highly influenced by the interaction between them and their blind learners.

In addition, professional and academic training exposes such educators to the incidence, nature, degree and extent of blind learners' learning disabilities. Finally, they should know the sociology of visual handicaps, appropriate learning and mediation strategies, and so on.

On the basis of the factors alluded to above, regarding the importance of professional and academic training, the researcher believes specialised training is important for:

- Ensuring that educators are better qualified and better able to represent, develop and promote this specific branch of the teaching profession "... with due authority and confidence" (Pauw 1984a:12). Educators need to know and understand anomalies of the eyes and how to adapt education according to those anomalies. Educators should also be aware of other learning difficulties, which blind learners exhibit. As such, educators can give appropriate attention and assistance.
- Knowledgeable educators in the field of special education are in a position to adequately help blind learners to find the relevant and vital sources of assistance for their predicaments. According to *Norms and Standards of Educators* (2000:32), specialisation is crucial for embracing context knowledge (knowing that), concepts and theories (knowing why), procedural knowledge (knowing how), strategic knowledge (knowing about why, when, where and who). Specialisation is therefore central to the development of competence and other important educational roles.

The facilitation/mediation approach of the biology educator

The biology educator should be pupil-directed rather than subject-directed. According to Holdstock (1987:101), a facilitator of learning who is pupil-directed will be able to teach learners with natural emotion and "…(a)llow them to externalise their pain, their anger, their grief, (whereupon) they will love to go to school. Learning will be a stimulating, challenging, exciting adventure … ." In addition, the previously mentioned author (1987:104) asserted that "(S)ince education occurs in the context of other people it is essential that the quality of the interpersonal relationships between the students and teacher be optimised in order to facilitate the learning experiences. One of the characteristics of the personal-centred approach is the realness or genuineness of the facilitator of learning …"

A good facilitator of learning always comes to the school or classroom thoroughly prepared. Preparation assists educators in deciding what to teach. Erwin *et al.,* (2001:346) is of the view that additional factors, such as the teacher's style, history and pedagogical practice, play a critical role in how activities are presented and how the students participate. The educators' personal perspectives drive the decisions they make about how to teach the science curriculum, which ultimately have a significant impact on how the science activities are implemented.

The facilitator of learning should mediate biology through experimentation and always engage his/her learners in problem-solving activities. The approaches s/he might employ in class may vary significantly and might be influenced by the occasion. This might include whole-class mediation as well as discoveries regarding direct mediation. Therefore, s/he should involve blind learners in these activities by explaining, interpreting, discussing and/or narrating to them the whole process, so that they too could be part of the activity. S/he could also utilise the expertise of the special education educator who could be of tremendous help to him/her in terms of making appropriate accommodations.

The biology educator should be able to stimulate learners' talents, skills and potential

The educator should be able to stimulate blind learners. Such an educator could be successful in stimulating learners' talents, skills and potential if s/he is innovative, initiative and creative. Blind learners enjoy being mediated by a creative educator, because not all the biology apparatus especially modified for blind learners is readily available. The biology educator should therefore endeavour to invent the apparatus he/she wants to use, in order to make facilitation or learning mediation easier. By so doing, s/he may save the school's hard-earned money, time and effort.

The educator should be prepared to adapt to change

Educators might accept change if they are prepared, determined, dedicated and interested in receiving feedback regarding their mediation. Feedback is crucial for helping educators to determine their effectiveness. Adapting to change also implies adopting new curricula, which make new demands on educators and their experience, which is understandably stressful. Educators should change; since they are the people "...(w)ho make learning possible, their own attitudes, beliefs and feelings with regard to what is happening in the school and in the classroom are of crucial importance" (Engelbrecht *et al.,* 1999:70).

The biology educator's ability to communicate with his/her learners

Communication involves good negotiation skills rather than dictation tactics. A biology educator should make an effort always to be a good listener rather than be a good speaker. If s/he listens intently and earnestly, the learners will listen to him/her too. S/he should endeavour to communicate in the language of learners in such a way that all receive an equal amount of what is being said and an equal degree of attention. Duminy *et al.,* (1990:68) stated that "(t)he teacher can teach and the pupils can learn because they can communicate." The educator's speech expresses his or her attitude to the work, to the learners and to life in general. Jargon should be avoided.

The biology educator and his/her preparation

According to Van Aswegen *et al.,* (1993:9) "(g)ood and effective teaching involves careful planning and preparation to make pupils interested while they are learning." In addition, educators should establish a "presence" in the classroom, listen carefully, be organised, and prepare thoroughly. Preparation is by and large the organisation of the content to be taught. Planning, on the other hand, involves carefully selected methods, approaches, tools, techniques, strategies, and so on during the lesson presentation.

The educator should be a leader, administrator and manager

A good leader, administrator and manager should always make his/her presence felt during activities. It is asserted by Slabbert (1990a:57) that the students must be assured of the teacher's presence, his proximity and help if a problem arises. "(t)his will ensure that the student will have the confidence to venture into working independently." The biology educator should consequently be able to command the attention and respect of all learners.

In addition, "(g)ood classroom control and management is important because it contributes towards learner's achievement. The management of his class and subject starts with the teacher himself (self-management)" (Van Aswegen *et al.,* 1993:9). The educator should always be presentable, punctual, dignified and well prepared. This will earn him/her respect.

A good leader with both administrative and management skills is able to make decisions appropriate to the level, pace and learning styles of learners, manage the facilitation or learning mediation in the classroom, carry out classroom administrative duties efficiently and participate in decision-making structures.

The researcher argues that any educator who has good classroom management and control possesses the following attributes:

- He/she is encouraging and receptive to learners' inputs, needs, aspirations, wishes, anticipated problems and concerns. The educator is able to monitor learners' behaviour and instantaneously end disruptive behaviour. S/he sees to it that classroom or laboratory rules are adhered to strictly. Such educators with good management and control give academic support and academic encouragement. Written work is given regularly to learners. Furthermore, the biology educator with leadership, administrative and management skills is able to implement and perform, at least very competently, the following duties:
- Running successful, constructive and enriching biology lessons.
- Being able to develop plans (including a scheme of work, daily lessons, a laboratory timetable if in charge of more than one class).
- Being able to identify the functions of fellow biology educators, laboratory prefects, and so on.
- Examine the biology syllabus in order to develop biology activities that respond to the needs, interests, wishes and aspirations of learners.
- Finally, the biology educator should be able to develop and deliver quality service in terms of education.

The biology educator should never personalise disagreements and controversies

According to the researcher the world of science is full of disagreements and controversies. The biology educator should never personalise those controversies or disagreements; instead, he/she should be strong enough to accept constructive criticism and heated debates.

The biology educator should respect the rights of other people

The researcher further believes that the biology educator should respect the rights, views and feelings of all people, young and old. S/he should know and observe the learners' right to learn and to be educated. Fellow workers have the right to dignity, information, et cetera.

The educator should be patient, possessing personal control and a calm personality

The educator should always be patient with learners. Some of these blind learners might have learning disabilities, which might make it hard to be taught, to be guided or controlled. According to Duminy *et al.,* (1990:68) "(t)he teacher who cannot maintain self-control under such conditions will alarm his or her pupils. A calm personality under tense circumstances encourages the teacher's pupils to behave correctly in crisis." These authors further state that: "(t)he people who cannot control what is under their hats will not be able to control what is under their roofs."

The educator should have manners in the classroom

The biology educator should always be well mannered. S/he is expected to be sympathetic, friendly and trustworthy. Duminy *et al.,* (1990:68) advised, "(i)f children behave irresponsibly, the teacher must still represent responsible adulthood."

The educator should have the willingness to accept additional responsibility

All educators who love their work, their learners are eager, enthusiastic and ready to do additional work. These educators experience their tasks and calling as meaningful. Therefore they are always willing to accept additional responsibility. Extra-curricular activities, which at times take place after knocking off time, form an important part of educators' duties.

The general behaviour of the biology educator

The biology educator should at least show the following: courtesy and good manners, loyalty to and respect for those in authority, respect for both public and private property, cleanliness and neatness.

In the researcher's view, however, it would serve no purpose for the biology educator to possess all these qualities but lack the skills to understand blindness as well as to master its facets. It should be borne in mind that general education teachers enhance their chance of success when they have mastered Braille reading, daily living skills, orientation and mobility, and so forth.

3.11 SUMMARY AND CONCLUSION

Biology is an interesting subject, which is dynamic and influential in people's lives. It should be developed and studied because it has and always will have its rightful place in the natural sciences. Its importance to human beings cannot be over emphasised.

Among other things, it plays an instrumental role in:

- Contributing towards the creation, shaping and the development of work opportunities;
- Conserving, managing, developing and utilising natural resources to ensure the survival of local and global environments;
- Collecting, analysing and critically evaluating the data used to develop scientific knowledge.

However, for biology to be effectively and meaningfully mediated, its nature and structure should be understood. The said nature and structure in the learning situation must satisfy all biological requirements and principles as stipulated by the mother discipline of biology. The structure of biology would not be complete if it did not cater for substantive and syntactical components.

The substantive structure concerns itself with the content of biology because that is what learners learn. Facts, concepts and generalisations constitute the content of the subject of biology. If learners can be introduced to these, they will participate competently and meaningfully in biology learning mediation activities. The syntactical structure, on the other hand, should address various skills (sensorimotor skills, cognitive skills and techniques) because they help us to come to terms with learning as we use these skills in various learning mediation situations.

Though this is not a chapter specifically discussing learning mediation strategies for blind learners, the researcher desires to highlight in advance that inclusive education and the mediation of biology to blind learners in an Outcomes-based Education classroom will be possible and effective if:

1. Learning mediation in the life sciences (biology) is made accessible to blind learners.
2. Biology is structured in such a way that it encourages active participation of blind learners in the learning mediation process.
3. It enables blind learners to build a meaningful understanding of the concepts of biology, which they could successfully apply in their respective lives.

Therefore, the learning mediation of biology to blind learners is possible because there are learning mediation strategies with which the educator communicates ideas, intentions and new knowledge to them. The educator will only be successful if s/he possesses proper learning mediation qualities. It is of primary importance to stress that strategies and proper learning mediation qualities will serve no purpose in the learning mediation of biology to blind learners in an Outcomes-based Education classroom if the envisaged learning mediation environment is not conducive. Above all, for learners to comprehend the subject matter, their different needs, wishes, concerns, interests and aspirations should be highly esteemed. Learners should constantly be guided to observe and develop their full potential. By so doing, they will master, and most likely develop a love and passion for, biology. It is incumbent on all educators to continually improve their qualifications in order to widen their horizons. Learners are more likely to love and trust competent, knowledgeable and enriching educators.

CHAPTER 4

LEARNING MEDIATION STRATEGIES FOR THE BLIND AND VISUALLY IMPAIRED LIFE SCIENCES (BIOLOGY) LEARNER

4.1 INTRODUCTION

In this chapter, the researcher discusses the learning mediation strategies for blind biology learners in the special schools' setting, since the points made will be crucial for the making of inclusive education policy and, in particular, for the learning mediation of biology in an Outcomes-based Education learning environment. He addresses aspects such as the importance of proper learning mediation strategies, the need for mainstreaming blind learners, the need for educators to receive specialised training in order to properly accommodate and effectively facilitate learning to learners with disabilities, and so forth.

The purpose of this chapter is to:
Bring to light the need and relevance of specialised educator training and suitable learning mediation strategies for blind biology learners. Relevant stakeholders in the education of the blind will be acquainted with possible means of making facilitation/learning mediation strategies accessible and user friendly.

In addition, the researcher wishes to show that facilitation/learning mediation for blind biology learners is influenced by many and varied factors. If the specific learning needs of blind biology learners with visual impairments are not identified, they will not do well in either the special schools or inclusive settings. Blind learners have other learning mediation difficulties besides their usual visual impairments and if these are not considered, such learners will experience difficulties in an Outcomes-based Education learning environment.

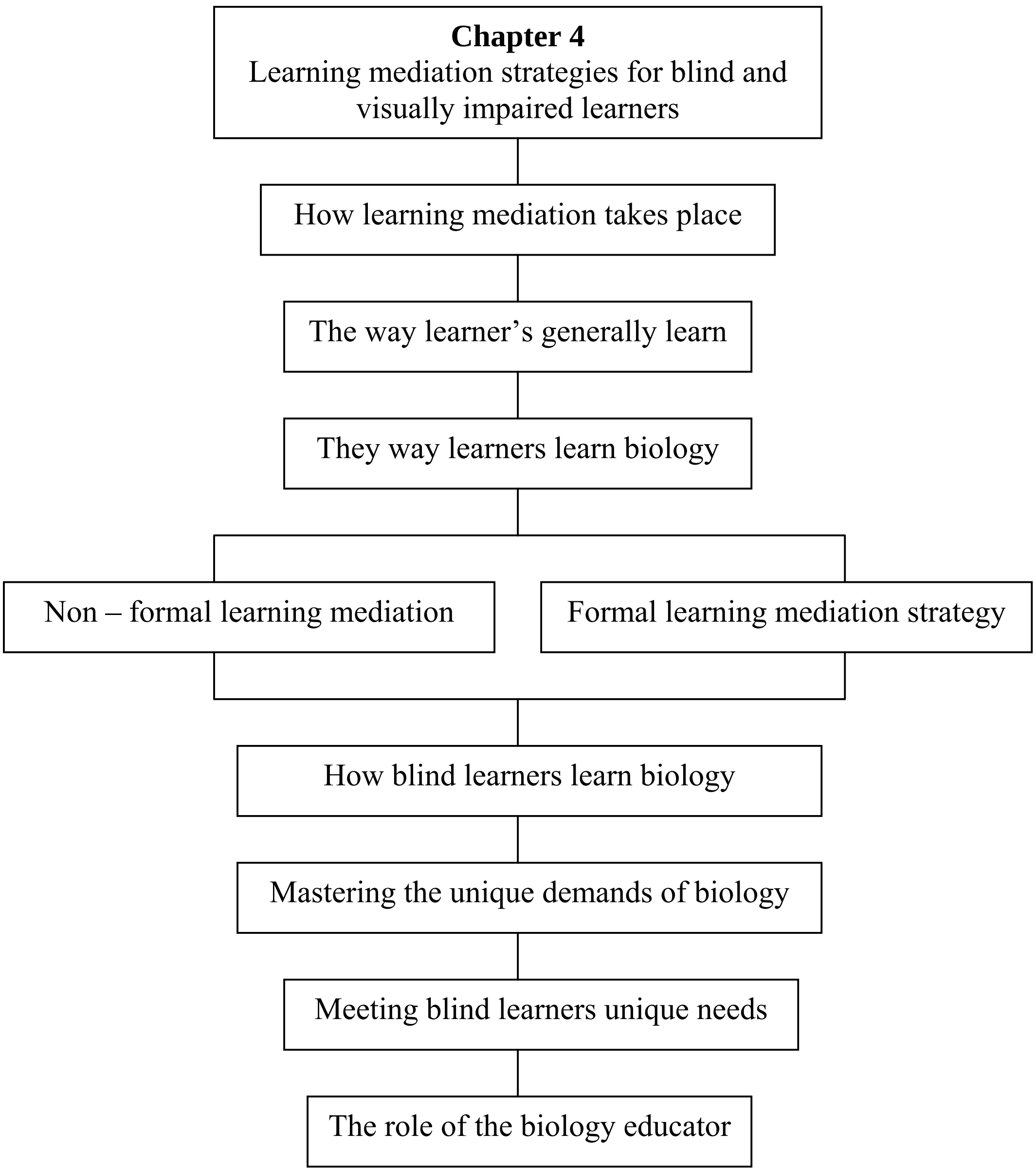
Van Der Horst and McDonald (1997:124) defined learning strategies as "... a broad plan of action for teaching activities with a view to achieving an aim." On the other hand, Pauw (1990b:31) regarded learning mediation strategies as processes through which an individual develops or acquires knowledge, skills or attitudes.

The researcher prefers Reigebuth's (1987:2) definition that strategies "… may be individual strategy components, the elementary building blocks from which methods are created. Or they may be models of instruction: sets of strategy components that have been combined to optimise the quality of instruction."

However, the researcher should bring to light the fact that there are no specific learning mediation strategies for blind learners, especially in the facilitation/learning mediation of biology and other subjects. Blind learners in an Outcomes-based Education learning environment make use of ordinary learning mediation strategies with modifications here and there to suit their learning mediation needs. A relatively limited amount of literature is dedicated to the subject of biology and the blind learner. It is incumbent upon the biology educator to modify or adapt common facilitation/learning mediation strategies and combine them with guidelines for the learning mediation of science to blind learners, in order to accommodate these learners in both special schools and inclusive settings.

The researcher further believes that if the specific learning mediation needs of the learner who is blind are not identified, s/he will perform poorly in inclusive education and the learning mediation of biology in an Outcomes-based Education learning environment will not be effective. The identification of the blind learners' needs therefore forms the basis for proper mediation. Strategies can be applied and should be effective if the way the blind learner learns, how s/he perceives and conceptualises, is taken into consideration. All these crucial issues should be addressed in advance. Learning mediation support material and the facilitation/learning mediation aids should be prepared before any actual learning mediation takes place.

FIGURE 4.1: THE OUTLINE OF THE ISSUES DEALT WITH IN CHAPTER 4.



4.2 HOW LEARNING MEDIATION TAKES PLACE

The following questions will guide us in our endeavour to understand how learning mediation takes place.

- How do learners learn in general terms?
- How do learners learn biology?
- How do blind and visually impaired learners learn?
- How would blind and visually impaired learners learn biology in particular?
- What are the blind and visually impaired biology learners' learning mediation difficulties and how do these learning mediation difficulties impact on the learning mediation?

4.2.1 THE WAY LEARNERS GENERALLY LEARN

Aspects raised under 3.5-3.7 are also applicable here as far as general learning is concerned. According to Kokot, Du Toit, Van Standen and Van Zyl (1997:26), learning implies "… the outcome or results achieved by means of a completed process." This further implies that when learners learn, they engage in learning processes, whether formal or informal, that influence changes in their behaviours, situations and practices. All people, in one way or the other, learn spontaneously. When they come into physical and cognitive contact with situations (through perception), they start to attach meaning to these and thus learn. The environment provides learners with lots of experiences. It is through these experiences that they acquire various life skills, which will be used later in life.

According to Reigebuth (1987:13), learners learn when their educators use the "Gagne-Briggs theory of instruction", comprising three major sets of prescriptions:

- Prescription of different methods of instruction for each of five categories of learned capabilities;
- Identification of nine events of instruction, "… which should usually comprise the instruction intended to develop any desired capability: and it prescribes a way to sequence instruction based on intellectual skills."

Gagne described five categories of human learned capabilities, each of which requires different instructional prescriptions. They comprise:

- Verbal instruction: This category focuses on the development of the following skills: recalling, writing, typing, stating, reciting information such as names, labels, sentences, arguments, single prepositions, etc.
- Intellectual skills, with five sub-categories: discrimination, concrete concepts, defined concepts, rules and higher rules (problem-solving). These skills can be realised when learners show competence, or interact with the environment using symbols or language. Learners know how "… to do something of an intellectual sort" (Reigebuth 1987:14).
- Cognitive strategies: Reigebuth stated that this strategy can be realised when learners have "… developed ways to improve the effectiveness and efficiency of their own intellectual and learning processes; when they can learn independently; when they can propose and solve original problems."

- Attitudes: These are very complex mental states of human beings that affect and influence their choices of personal action towards people, things and events.
- Motor skills: Learners who have developed motor skills are able to perform physical tasks, utilising equipment or materials according to a routinised procedure.

The researcher believes that all people, young and old, able-bodied or disabled, intelligent or less gifted, learn and build self-concepts if they are actively and meaningfully involved in learning mediation. In this kind of learning environment, learners are more likely to work towards the level of their potential and gain more insights into themselves. Furthermore, learners learn if they are exposed to or have good access to a particular subject or to a challenging and informative subject.

Holdstock (1987:41) on the other hand contended that learners learn if their education "…(t)ries to encompass everything about the person in relation to all other living organisms. Even our relatedness to inanimate matter and time is considered. It strives to complete that which is incomplete, to pay attention to those aspects of our humanness which have not received their proper or fair share of attention." This is what is called holistic learning. Holistic education is an endeavour to actualise the unique potential of the individual in both interaction and harmony with the larger universe of people and things in their entirety.

Holdstock (1987:42) further regards the task of the holistic educator as being that of effecting a fluid alternation between those aspects of experience and behaviour which stand out in awareness and those which are in the background, so that the neglected aspects have a chance to come to the fore.

According to the researcher, learning depends largely on the learner's attitude. Learners with a positive learning attitude grow and blossom socially, ethically, religiously, emotionally and mentally, while learners with a pessimistic learning attitude wilt and in the long run die. In addition, learners with a positive learning attitude are eager to find their special talents and better ways to develop them. Learning mediation takes place when learners realise their self-esteem because this enhances their growth and general development.

A positive learning mediation attitude enhances learners' effectiveness while a negative attitude makes learners ineffective. A positive learning mediation attitude inculcates values and norms into learners as well as stressing the importance of taking responsibility for their own learning. Such learners know, understand and appreciate their learning.

According to Higgins and Ballard (2000:168), its educators' management attitude and leadership style are crucial to a school's philosophy and value orientation. They argue that when educators and management believe that all learners, including learners with disabilities, belong to the school, then the stage is set for successful learning mediation to occur. For all learners to learn properly, school principals should model an accepting and welcoming attitude towards all learners in the school, so that each person in the school community can be valued for their uniqueness.

In addition, Holdstock (1987:107) contended that "…(t)he appropriate attitude on the part of the educator is necessary for the establishment of a climate in which learning can take place, … having the right attitude is not enough to ensure that this will come about. The teacher requires communication skills in order to establish an effective relationship with students. In addition to the characteristics of genuineness (openness, transparency, honesty), respect (caring, regard, prizing) and empathy (understanding) postulated by Carl Rogers as being essential for all good human relationships, Gordon adds separateness and mutual meeting of needs."

In support of the view that positive attitudes stemming from the educator and learner population in general towards disabled learners also encourage positive learning by disabled learners, Clark (1982:57) noted that "(r)egardless of the disability, personal and professional acceptance of the disabled … is the ultimate key to success." The author further argued that learners learn if educators develop positive actions rather than reactions.

As noted by Trief and Feeney (2003:137), all learners learn if they have acquired study and note taking skills, know how to properly handle the stress of classes, thoroughly prepare for tests, are able to manage time, and utilise library resources.

Reigebuth (1987:16) argued that learners learn when:

- They are given the necessary attention and introduced to rapid stimulus change;
- They are informed of lesson objectives;
- Their prior learning and recall is stimulated;
- They are presented with stimulus material with distinctive features;
- They are provided with learning guidance;
- Their performance is elicited;
- They are provided with informative feedback;
- Their performance is assessed; and
- Retention and transfer is enhanced.

The researcher further believes that proper learning mediation takes place when people are exposed to the widest possible learning mediation opportunities from an informal or a formal point of view. That exposure can be understood as comprising expository or discovery methods. All people learn when they are mentally empowered to formulate strong foundations of knowledge and know exactly where, when, why and how to apply the newly acquired knowledge. Fraser *et al.,* (1996:38) are of the view that learners learn when one or more stimuli are reinforced by social interactions and linked to one or more responses (relations). In addition, learners learn best when they regard learning mediation as the formation of associations between physical stimuli and observable reactions. In support of the previous argument, Arentz and Sterkenburg (2002:1) noted that "(t)he most important part of learning ... is observation."

As argued by Holdstock (1987:72-85), learners learn when educators realise that there is more to intelligence than the vulnerable intelligence quotient. This is also called multiple intelligences. Therefore, multiple intelligences including conventional intelligences (verbal, mathematical and spatial) and the non-conventional (musical ability, bodily skills and sensitivity to bodily sensations, adroitness in dealing with others, and self-understanding) have to be nurtured during learning mediation. Holdstock (1987:73) pointed out that "(f)ar from being a unitary power of mind, intelligence for Gardner thus consists of a set of mental abilities which not only manifest independently, but probably spring from different areas of the brain."

Mwamwenda (1990:13) believes that the law of effect, readiness and exercise should govern all people's learning mediation. He contends that the law of effect clearly states that a satisfying state of affairs leads to repetition of a given behaviour, while an annoying state of affairs weakens a response. What this means is that all learners learn by making appropriate connections or unmaking connections on the basis of or subsequent result.

The law of readiness (behaviour approach) possesses three components. As pointed out by Mwamwenda (1990:136), the initial step is to thoroughly get learners ready and prepared to engage in a certain behaviour, and provided with an opportunity to engage in the behaviour for which they are prepared. Secondly, instances where learners are denied the opportunity to engage in a behaviour for which they are prepared will lead to frustration and annoyance. Thirdly, when learners are not ready to engage in certain behaviour, yet they are compelled to do so, "…(t)he end result will be annoying".

The law of exercise enhances the bond between a stimuli and a response as a result of practice. Reigebuth (1987:47) argued that, a central requirement in classical behavior theory is learner practice (that is, practicing newly acquired skills or body of information) followed by reinforcement. Learners must practice the very performance that they are expected to learn. According to the above-stated author, (1987:47) "(i)f they are to operate the microscope, they must practice operating one. If they are to choose from among lenses the one that will magnify an object the most, they must practice making such choices." According to the researcher, the more all learners practise skills or a body of information, the more the knowledge and skill becomes mastered, perfected, applied and retained. Learners constantly have to use the acquired knowledge, so that it cannot become disused. All learners who are capable of using acquired knowledge are able to make connections between stimuli and responses by doing and thinking.

The researcher believes it is the duty of both the special school and the inclusive biology educator to help and motivate all learners to regard learning mediation as the association between physical stimuli and observable reactions. The biology educator should stimulate learners' interest so that they can be actively involved in the facilitation/learning mediation. Fraser *et al.,* (1996:39) pointed out that "(a)ctivity as didactic principle is … a prerequisite for effective instruction and learning." Furthermore, learners learn when they actively participate in investigative activities. When learning, learners should endeavour to fully and appropriately master the characteristics and concepts of learning areas.

Learners should also engage themselves in what Fraser *et al.,* (1996:40, 48) call "programmed learning", which permits learners to complete learning tasks at their own pace and according to their own ability. This is an acknowledgement of individualisation, differentiated teaching or target learning. All learners should be equipped with proper learning mediation skills, which should enable them to differentiate between "realistic learning" and "unrealistic learning".

Learning as pointed out by Fraser *et al*., (1996:48) involves intellectual ability, which will make it possible for learners to link new concepts to relevant concepts "…(t)hat are already part of his frame of reference".

When learning mediation takes place, metalearning (the ability of the learner to plan, execute, monitor and evaluate his or her own learning and develop an awareness of mental processes) and metateaching (the ability of all educators to effectively apply and implement mental learning strategies in practice) should also take place. According to Slabbert (1991b:71 and 1992c:113), "(m)etalearning entails the higher order learning activities or control activities of learning such as planning, executing, monitoring and evaluating one's own learning. Since competences should be the focus of teaching and learning, the attainment of a competence has to be accompanied with the ability to have control over that competence in order to act effectively in any given situation. This means that the learner will be able to identify the competence necessary to complete the learning task, execute it, monitor the process and evaluate the product in view of the competence executed."

To Slabbert (1991b:72) it seems quite obvious that metalearning should also be the focus in educator training and that educator training should be done through metalearning. According to this author, educators should actually be taught in a manner in which they are expected to facilitate or mediate learning.

The same author (1991b:72) stated that "(w)hen teachers are engaged in teaching students to metalearn, and they themselves are effective metalearners, they will plan, execute, monitor and evaluate their own teaching continuously in order to induce metalearning in their pupils. These actions of a teacher can then in fact be called metateaching."

According to Fraser *et al.,* (1996:50) learners should be made conscious of all demands relating to their tasks, and this implies knowing exactly what is expected of them as learners. Therefore, in this regard, their duty is to "…(d)ecide whether learning would take place and how it will be achieved."

Learners who are metacompetent (metalearned), as pointed out by (Slabbert 1992c: 113 and Fraser *et al.*, 1996:50), are set to:

- Allow themselves to be better equipped to compete effectively for jobs and recognition;
- Make themselves better citizens;
- Improve their psychological well being;

Form an integral part of a workforce composed of autonomous learners, people who are capable of mastering new technology as it develops, become entrepreneurs who have developed critical thinking, because economic prosperity will increasingly depend on a country's capacity to develop and exploit new opportunities, products and services.

The researcher views intellectual competence as instrumental in guiding and directing the learning mediation processes. He believes that all learners who are able to implement mental learning can become effective, productive, competent, independent lifelong learners.

Biology learning mediation takes place when it is perceptualised in such a way that the details to be observed and perceived by the learner are converted into the concrete facts of reality. Furthermore, learners learn effectively when they know their weaknesses and are also able to know where their strengths lie. Learners learn by acquiring proper skills for observation, classification, identification, interpretation, validation, discussion, writing, listing, labelling, analysing, mentioning, differentiating, evaluating, assessing, comparing and contrasting. For all learners to achieve all these, both special schools and inclusive biology educators should provide learners with a conducive environment for applying the appropriate mental learning aspects.

According to Fraser *et al.*, (1996:51) these educators' immense contributions should:

- Motivate learners to become aware of their own, existing way of learning.
- Assist and encourage learners to develop a deep approach to learning.
- Encourage learners to develop skills with which to exploit their existing knowledge in order to solve future problems.
- Make all experiences, with specific reference to the learning experiences, content related.
- Encourage cooperative learning in the classroom, "…(t)o give learners the opportunity to reflect their own learning and that of others".

These authors added that learners will learn biology only if "…(r)epresentative facts of reality are placed within the reach of the learner." This must, however, be done in such a way that details to be observed and perceived by the learners are converted into concrete facts of reality.

Learners learn by being exposed to various ways of knowing. Such ways include creativity (imagination) and innovation (initiation of things or improvement of existing ones). Holdstock (1987:65) is of the view that "…(o)ur normal waking consciousness, rational consciousness as we call it, is but one special type of consciousness, whilst all about it, parted from it by the flimsiest of screens, there lie potential forms of consciousness entirely different." Therefore, learners will learn more effectively if they are trained to be both creative and innovative. Just as intelligence is enhanced, creativity can be increased. Time should be allotted for creativity or innovation purposes during mediation.

Learners learn better if more help is given to them. It should be borne in mind that their emotional distress, a feeling of insecurity, psychological, educational and social barriers, interfere with mediation of learning and therefore require educators who are capable of noticing these factors. Holdstock (1987:108) advised that not only must educators be able to recognise learners' problems but that they must also be able to respond to them. Listening is one of the most effective and reliable techniques an educator can adopt in order to help the learner cope with a problem. This facilitates the release of feelings, fosters the exploration into more basic feelings, conveys the willingness of the educator to be a helper, and communicates acceptance of the learner as a person.

The researcher is of the view that because learners are unique, there is no one best way of learning everything. However, both non-formal and formal ways of learning mediation should supplement each other, depending largely on the learning mediation situation and learning mediation environment. Feuerstein (2001:1) supports the previous statement when he asserts that human learning, in fact, is fulfilled not only by direct experiences but it is also fulfilled by many requirements including and not limited to cultural transmission and mediate learning experiences (MLE).

All learners learn better when Mediate Learning Experiences are made available to them. Mediate Learning Experiences enable and encourage learners to be fully conscious about their own cognitive processes, and are crucial for enabling and further encouraging those learners to elaborate, by themselves, inputs coming from experiences. Feuerstein (2001:1) held that the "(p)resence or lack of MLE, ... is the most important cause of an individual's flexibility or plasticity ..."

A learner's potential depends on and is influenced by social mediation or interaction. For effective learning mediation to take place, learners have to be exposed to both direct stimuli and mediate learning. Mediate Learning Experiences should be goal or outcome centred. Educators should promote positive and meaningful interaction between learners, through the continuous dialogue that learners establish and maintain by belonging to their society and culture and, in particular, gain from Mediate Learning Experiences. Cultural transmission in learners encourages and allows, to a great extent, links between past and future experiences. Above all, cultural transmission allows and transcends direct experience.

Trief and Feeney (2003:138) have identified three types of social skills or interaction which are crucial for interaction purposes, namely: assertiveness training, interactional skills, and skills in physical communication. According to these authors (2003:139), "(t)he teaching and infusion of these skills should be part of any recreational … plan."

Feuerstein (2001:4) argued that learners will enjoy and benefit from learning if educators intentionally take care of them during Learning Mediation Experiences. Educators should help and also encourage learners, in their own right, to acquire behaviours, learning and adequate operative structures that allow them to gain the greatest benefits from direct exposure to Mediate Learning Experiences. If all learners' personal and social conditions are equal, in fact, "... individuals will realize differently their learning attitudes in order of the quality and quantity of the mediation they received."

In the researcher's view, learning mediation takes place and becomes effective when learners have background knowledge of the subject. Furthermore, learners learn in an environment comprising intentionality and reciprocity, transcendence and meaning.

As far as intentionality and reciprocity is concerned, the educator should make any stimulus functional for the individual who is learning. As a result, the learner modifies himself/herself to find better and more effective ways and means of coming into relation with the other, and involving his/her individual learning process.

Transcendence describes the features of mediation that go beyond the mediate objectives of the task and of the interaction. Mediate Learning Experiences stimulate participation through action and the transcendence of the present.

Meaning should better be understood as mediation meaning. It links the first two components. Meaning stresses the importance of concentrating on the subject experience, relations, important concepts of the learning process, and, on the other hand, stimulation (for the learner of any subject) to accord a wider personal meaning to what the learner is learning. The learner learns when and if the mediator endeavours to identify things that have a clear meaning for the learner and leads all learners to auto-motivation in autonomous research into the true meaning of objects, happenings, and learners' existence.

According to Feuerstein (2001) all learners should possess and be exposed to the following characteristics of Mediate Learning Experiences, in order to learn:

- Intentionality and reciprocity;
- Transcendence;
- Mediation of meaning;
- Mediation of a feeling of competence;
- Mediation of regulation and control of behaviour;
- Mediation of sharing;
- Mediation of psychic individualisation and differentiation;
- Mediation of choice, research, achievement of one's objective(s);
- Mediation of challenge and research attitude;
- Mediation of preference for optimistic choices;
- Mediation of a feeling of belonging.

In the researcher's opinion, all learners are capable of learning, performing activities or carrying out instructions. Learners should receive both training and learning mediation in order to learn. Learners should be confident and competent when learning. They should employ all the possible communication methods, including verbal, gestures, audiovisual, print, electronic, illustrations, et cetera, to gain meaning and to deliver meaning to others.

4.2.2 HOW LEARNERS LEARN BIOLOGY

Practically and pragmatically speaking, learners will learn biology if educators possess the competences discussed at great length in chapter three and if educators also make an attempt to expose them to a Mediate Learning Experiences situation in which all learners are to be educated. In such instances, problems according to a biological theme, or that are fundamentally biologically related, should be emphasised. Furthermore, learners will learn biology if references are made to the nature and structure of biology as a science.

Secondly, the material and its intrinsic norms, attitudes and values should be discussed and learned in the contexts of educational subject mediation or learning mediation. Learners will learn biology if an attempt to set up its subject didactics as an educational science is made. Educators should strive to point out: "...(h)ow this science can contribute to the effective subject teaching or learning which helps towards man's physical survival" (Degenaar 1989:3-4; Researcher's translation).

Learners will learn biology if biology as a part discipline is carefully structured and those learners are also guided to become educated and knowledgeable adults, through purposeful learning mediation, comprising more than a mere growth and development of knowledge of biology. Effective subject learning mediation leads to a total "...(d)evelopment of the adult to be, as the subject content proceeds to shape, and through the meaningful experience thereof, becomes educational subject teaching and learning, or subject didactics" (Degenaar 1989:11; Researcher's own translation).

The learner in his/her biology learning mediation should be thoroughly and suitably prepared by the biology educator in order to enable this learner to deal with contemporary environmental and biological problems during learning mediation. Degenaar (1989:11; Researcher's translation) held that "(t)his concerns the shaping of a positive life attitude and a specific view on the biotic part of reality."

NON-FORMAL BIOLOGY LEARNING MEDIATION

It would indeed, be a serious mistake to highly value formal biology learning mediation in secondary schools in terms of biological and ecological education but, on the other hand, to view biology learning mediation as the only strategy to access biology education. People should also understand that "(a)lthough developing countries are characterized by a rapid increase in the school population, not all learners of school age are taken immediately up in the school system. There are, therefore, many young adults who are literally too late for formal education. A shortage of suitable trained educators, lack of appropriate biology resources and inadequate as well as unsuitable learning mediation facilities is still a serious impediment in the development of education" (Degenaar 1989:11; Researcher's translation).

In the researcher's view, at the present moment South Africa finds itself in a situation of educational development and transformation. It is especially during this period of accelerated change that non-formal learning mediation could successfully and meaningfully fulfil this function. The (supplementary and complementary) functions of both non-formal and informal education in biologically related sciences, environment and health aspects offer an essential contribution to the development of this important aspect of total education. This kind of education should never be considered as of secondary importance, or as inferior. Non-formal biology learning mediation has the advantage that it is not restricted by rigid prescribed curricula. It is obviously the best method for the short and midterm haul.

FORMAL BIOLOGY LEARNING MEDIATION

Learners also learn biology in a formal way. In the secondary school or Further Education and Training Band, the educator is the subject or learning area educator and keeps himself/herself busy, for most of the day, with the facilitation of learning. In formal biology education, learners are made aware of and are also exposed to carefully selected and regulated biology contents. They are, furthermore, exposed to acquirable and learnable formative biology contents without losing or compromising the particular content and conceptual structures and the unique nature and character of biology as a part discipline.

Degenaar (1989:12; Researcher's translation) asserted, "(t)he intrinsic value of biology as a science must assist in the specific education and development in which biology has a role to play." The study of biology, the learning mediation thereof, must supply a wide spectrum of education to a variety of professions and should be viewed by all as an essential component of general formative learning mediation.

According to Carin and Sund (1989 [s.p.]); Van Aswegen *et al.,* (1993 [s.p.]); Wellington (1994 [s.p.]) and Collette (1989 [s.p.]), learners learn biology through enquiry, observation, experimentation, self and guided discovery, investigation, exploration, gathering of scientific evidence, application of scientific and technological ideas, the examination of the power and limitation of science, distinguishing between claims and arguments based on scientific considerations, and so on.

4.2.3 HOW BLIND LEARNERS LEARN BIOLOGY

Blind learners are disadvantaged because lack of visual ability deprives them of the joy and benefits of the learning mediation environment characterised by immediate and Mediate Learning Experiences in their life world, which is the apposite basis for future Mediate Learning Experiences. Their perceptual impediments fail blind learners in their quest to appropriately link the principle of perception and the principle of the so-called primary environment. Lack of perception poses to blind learners the disadvantage of not perceiving learning mediation to be as meaningful and effective as that of sighted learners because, in most instances, the biology examples which the special school and inclusive biology educator presents during biology learning mediation do not link "…(u)p with the learner's previous similar experiences" (Fraser *et al.,* 1996:68). Furthermore, the primary environment of the blind learner does not serve as a condition for effective learning. However, regardless of these challenges and frustrations that blind learners may encounter during the mediation of biology, both special schools and inclusive biology educators should strive to make facets of reality known to the blind learner.

Kirk and Gallagher (1989:356) also asserted that "(l)ack of vision, then, is both a primary handicap and a condition that can hamper cognitive development because it limits the integrating experiences and the understanding of those experiences that the visual sense brings naturally to sighted children …"

Contrary to the above sentiments, Erwin *et al.,* (2001:338) declared that "(y)ou don't need to be sighted to be a scientist do you? No. Absolutely not. Everything you've done today and last week is science, and you have done it, right?"

Kumagai (1995:82) further argued, "(a)t its heart, science is about observation: looking at things, measuring them, analysing their properties, figuring out how they work. How then does one proceed when nature's most basic and powerful tool for observing - that of sight - is missing? To be sure, the blind are not without tools of their own. Speech synthesizers interfaced to personal computers can read text aloud; a blind person can send and read e-mail and access the internet with nearly the same ease as a sighted person. And then there's Braille, the tactile alphabet developed in the 1800s by Louis Braille, in which each letter is represented by a pattern of raised dots."

Kumagai (1995:83-84) is of the view that the theoretical part of science is not that much harder for someone who is blind or visually impaired, because these learners mostly deal with symbols that could be "…(e)asily handled with the right computer. As for experimentation, where there may be a lot of apparatus to be manipulated, that can typically be done by working in groups. In studying and doing science", "…(t)he primary hurdles that a blind person faces are the attitudes of others. Changing those attitudes will be made easier when blind students are less reliant on sighted people …". Statements like these comfort and encourage blind learners that, despite their lack of vision, they can still make it in science.

When facilitating or mediating learning to blind and visually impaired learners, the starting point should be that these individuals cannot see. This reality should actually appeal to any facilitator to do something positive, so that these learners can learn and benefit from this help. Facilitators or mediators of learning should know and understand that, to blind learners, perception and sensory awareness are requirements for effective biology learning mediation. As argued in chapter one under the aim and objectives of this study, Erwin *et al.,* (2001:339) emphasised that teaching science to students with visual impairments must be firmly grounded in a multi-sensory approach if students are to receive positive benefits, such as activities related to tactile and auditory interactions, and therefore ample opportunity to manipulate and explore equipment and materials must be provided.

Blind learners learn biology through all the possible means discussed above. The only difference is that education should be delivered in a way that suits and meets their learning mediation needs. Higgins and Ballard (2000:172) support this argument by stating that when teachers teach these students with similar expectations to those held for others of their age, teach them with recognition and responsiveness to their particular communication and related needs, blind students construct blindness as part of ordinary human experience. Such a conceptualisation by blind learners seems to be a key element of inclusive practices.

Clark (1982:61) echoed the same sentiment when he noted that "(r)ecognizing that disabled people are not different, but just have different kinds of needs is, perhaps, the first and the biggest step to take in adapting programs to accommodate these needs." For the needs of blind and visually impaired learners to be met, this author (1982:58) advised that educators should "…(a)llow the blind person to make whatever arrangements he or she feels would be helpful. Remember blind persons … are the best consultants for their own learning needs."

For optimal learning to occur, the educator should allow and encourage sighted learners and blind learners to work collectively and cooperatively during biology activities. By so doing, learners will be applying a cooperative learning strategy. Erwin *et al.,* (2001:338), in support of cooperation between able-bodied and blind learners, commented: "…(an observer who is blind) isn't sighted. If I become a scientist, maybe we … can work together. You … can be the assistant scientist." According to *Learning by Doing Together A Bartim`eus - ICEVI (2002:1) Publication on Functional Curricula for Children and Youth with Multiple*

Impairments (2002:1), "Learning by Doing Together", which is cooperative learning, is one of the best ways to help blind and visually impaired learners to develop abilities that are central to family and community life, so that they become able participants in their homes and wider social environments.

Male (1997:13) emphasised, "(l)earning together is a cooperative strategy that illustrates the use of the essential components of cooperative learning." If this does not work, the blind learner should be provided with an aide who would help during experiments. The educator should, also, allow and promote equal opportunities to take place during activities. Kirk and Gallagher (1989:378) noted that "(f)rom a very early age we have to teach them not to be afraid of new experiences or injury. Sighted children skin their knees, bump their chins, fall from trees, and step in holes. Blind children must have the same 'privileges' if they are going to learn …"

On the other hand, Erwin *et al.,* (2001:344) state that "(c)hildren who are visually impaired are sometimes discouraged or protected from taking risks at home or in schools. Risk taking involves taking a chance, particularly when there is a threat of not achieving one's desired goal or there is a real perceived danger."

When blind learners learn biology in inclusive settings, the special educator (an educator who is qualified and is an expert in the education of the blind) should play a vital role in the learning mediation. The regular biology educator and the special educator could be instrumental in making the overall classroom atmosphere pleasant for learning mediation. The classroom climate is influenced by the attitudes of the educators and learners towards individual differences. Therefore, the special educator could promote and inculcate the understanding of learners' strong points and weak points.

The special school/inclusive biology educator knows that blind learners learn effectively where there are co-operation, competitiveness, safe learning mediation environments, positive and well supported interaction between educators, able-bodied and disabled learners, respect and trust from both sides (educators and learners), acceptance, and so forth.

A conducive environment, according to Arentz (2002:1), promotes learning. In supporting the previous statement he maintains that "(a) visual impairment leads to being more dependent." But people want to be independent, even though they have problems in visual functioning. Except for a low vision aid and learning to walk with a white stick there are many environmental adjustments that can contribute to being more independent.

Adjustments can be made in:

- Environment
- Personal interaction

One can feel more independent when the environment is familiar. So, it's important to make things predictable and to make the visually impaired person feel safe.

Blind learners learn and benefit from learning mediation if there is constant communication (a simple dialogue based on a theory of inquiry teaching) between them and educators, as they will always be kept abreast of biology developments. According to Van Kraayenoord (2001), interaction could take place in many forms. First, blind learners learn by interacting with other learners, family members, community members, and so on. As this author noted, communication should be seen as one of the essential skills in today's society. On a community front, in the home context, in employment, and at school there is a recognition that communication is fundamental to life and that it colours what it means to be human. Recent conceptualisations of the term communication are viewed in terms of print, oral, and multimedia communication. Therefore, engagement with these forms of communication equals interaction since that engagement involves acquiring and utilising all the processes of reading, writing, speaking, listening and viewing.

According to Reigebuth (1987:56), dialogue based on a theory of inquiry teaching encompasses the following two goals:

- First, the teaching of a deeper understanding of a particular domain so that "…(s)tudents can make novel predictions about the domain. The other is to teach students to be good scientists so that they can learn to construct general rules and theories on their own, and be able to test them out."
- Secondly, reading and writing is another form of interaction. According to the researcher the process of reading and writing entails how it is taught and how the reader attaches meaning to various written texts. When one reads and writes at school, one is, in actual fact, engaged in an instructional activity. Thus, reading and writing demonstrates the improvement and literacy levels learners have reached, due to the power, nature and positive influence of books. So, blind learners also interact using these ways and means as they learn.

Educators should play a significant role in involving blind learners in biology activities as well as facilitating perception in the following ways, as suggested by Fraser *et al.,* (1996:72):

Educators should direct blind learners to the aims and objectives of the lesson during the introduction of the lesson unit.

Educators should apply learning mediation strategies and the learning media that link to the existing frame of reference of the blind learner. This further implies that the strategies, which the special school or inclusive biology educator decides upon, should bridge the distance between the cognitive experiences of the blind learner and new content or skills to be taught.

Educators should stimulate as many senses as possible simultaneously. Blind learners should be accorded opportunities to feel, hear, smell and touch objects. Fraser *et al.,* (1996:72) stated: "…(o)ne really experiences what flying is all about when you touch the aircraft, feel the vibration of the engines, experience the thrust of the gravity at take-off, go into a roll and smell the aviation fuel and exhaust fumes."

Therefore, based on the previous suggestions, for positive and productive interaction to take place, there should be safe environments. These enhance blind learners' physical and social independence. Safe environments allow and encourage blind learners to move about, independently locating objects and places as well as orientating themselves to new physical and social situations. However, for blind learners to feel safe, they have to be equipped with proper orientation and mobility skills and techniques.

In addition, all environments, including but not limited to psychosocial, physical and classroom environments, have to be accommodating of and conducive for learning mediation. An adapted biology curriculum and materials should be made available for blind learners. As a prerequisite, the biology classroom needs to possess the materials and equipment which are relevant to the learning needs of blind learners.

Trief and Feeney (2003:143) declared that "(w)ith a proper curriculum in place, students can, in a short time, learn, embellish, and sharpen their skills …" Blind learners enjoy and also benefit to a great extent from individualised mediation. This may be effective in activities such as experiments.

The previously mentioned authors (2003:139-143) identified the following crucial aspects impacting on the way blind and visually impaired learners learn: communication skills; independent travel skills; library and research skills; notetaking skills; organisational skills; study skills; time management skills and use of adaptive technology. These authors further advised that all blind and visually impaired learners should learn keyboarding skills as well as how to effectively use a computer, read, write and do maths continuously throughout their entire education.

Blind learners will learn biology if educators state clearly defined objectives about what learners should achieve as outcomes. They learn better if they are constantly guided about what to look for and expect during learning mediation. Guidance is crucial in helping these learners to focus on the essential biology information. Blind learners will learn and benefit from biology if the educators assess and evaluate biology results and progress in order to see if the learning mediation strategies have helped blind learners meet the educators' facilitation/learning mediation objectives. Educators must themselves ascertain that blind learners have the necessary biology prerequisite skills (basic and advanced science process skills) to benefit from biology learning mediation.

Friend and Bursuck (1999:160) argued that blind learners learn better if educators take into account the learner's overall ability level, use of other learning mediation strategies and other learning mediation skills, attentional and motivational levels (an application of the ARCS model of motivational design), et cetera. Higgins and Ballard (2000:173) are also of the view that educators should have an adequate knowledge of the alternative methods which blind learners employ when reading, writing and taking notes. According to them, if educators are not aware of the methods employed by blind learners during learning mediation, they may treat blind learners unfairly. Both special schools and inclusive biology educators should encourage blind learners to perceive things tactually or experience perception more kineaesthetically during biology learning mediation. Fraser *et al.,* (1996:70) advised that educators should therefore not use media only to stimulate verbal, symbolic and cognitive learning. Educators should also afford blind learners the "…(o)pportunity to handle, touch, smell and, where possible, even to taste examples."

On the other hand, Siekierska *et al.,* (2003) and Kirk and Gallagher (1989:380) argued that blind learners should be provided with modern and tactile maps, representing spatial relationships that learners can master through their sense of touch. However, Kirk and Gallagher (1989:380) cautioned that "(j)ust as there must be readiness activities to prepare for the teaching of reading, there must be readiness activities prior to the teaching of map reading."

The researcher is of the opinion that sensory experiences help blind learners in remembering or retaining information. Therefore, it should be the primary responsibility of both the special school and inclusive biology educator to combine different learning mediation activities that will increase blind learners' learning and participation. Fraser *et al.,* (1996:70) maintained that: "(s)omething heard and seen by the learner, or even repeated and performed physically, will increase learning and retention drastically." Sensory experiences should be supplemented by strategies and mechanisms to compensate for blind and visually impaired learners' limitations. *Learning by Doing Together: A Bartim`eus - ICEVI (2002:1) Publication on Functional Curricula for Children and Youth with multiple Impairments* advised that blind and visually impaired learners need a suitcase full of strategies to attack this complex world, full of mechanisms for compensating their limitations, and stressing their abilities.

On the other hand, Pierce (2001:13) noted that "(t)hose who are blind know the world through sound, through scent, and through taste. But much of what we know comes through touch. Very often our hands are the instruments for gaining knowledge as well as devices for teaching others or the tools for implementing changes." What is touched should however, not be full of small details. Please see appendix B tactile Hydra sketch illustrating the difficulty blind and visually impaired learners encounter when exploring a too detailed sketch.

Special schools or inclusive biology educators should work very hard to present colour, intensity, depth, three-dimensionality, contrast, change, and movement to their blind learners. All of these should be incorporated during biology learning mediation where applicable.

Blind learners learn if and when their special skills (such as reading, writing, tactually investigating, etc) are well developed.

Educators should not only recognise that blind learners require a modified curriculum but should also develop blind learners in terms of:

- Concepts and skills that require more practice by those who are blind; for example teaching the concept of shapes.
- Concepts and skills that are specific to the needs of those who are blind; for example reading by listening (using audio material such as tapes, CD-ROMs, Braille, et cetera.)
- Concepts that sighted children learn through incidental visual observation, for example, walking down the street, using public transport, purchasing items from a shop, and so on.

Educators should always involve blind learners during learning mediation. Blind learners should be encouraged to count, measure with assistive devices, list, compute, weigh data and objects, "… during an investigative exercise" (Fraser *et al.,* 1996:72). Special schools or inclusive biology educators should use spoken language instead of gestures. It makes it easier for blind learners to follow lessons if spoken language is used.

Educators should motivate learners to be committed during biology learning mediation. Educators should always take into account the age and experience of blind learners because this influences the nature and quality of the perceived reality. The age and experience of blind learners enable them to understand, decode, analyse, interpret, assess and evaluate the various stimuli. According to Fraser *et al.,* (1996:72) these activities are essential for meaningful conceptualisation. Blind learners learn if educators endeavour to know, understand and facilitate a learning mediation of biology which is "…(c)onsistent with the individual's unique strengths, resources, priorities, abilities, capabilities and interests."

Interest motivates one to be committed. Learners' curiosity has to be aroused in order for them to develop an interest in what they are learning. Situations must be relevant in order to cause them to be highly motivated. If what they learn is relevant, they will never question the importance of receiving instruction in their lives. Relevant instruction boosts one's confidence level. Increased interest, motivation and confidence lead to more learning expectations and greater satisfaction.

Higgins and Ballard (2000:173) are of the opinion that blind learners learn better when educators do not feel that having "…(a) blind student in the class was a bloody nuisance … ." Blind learners learn better if they are just perceived as students. They really wish to go as far as they can academically. They deserve to be taught by educators who will take time and put their whole energy into doing so.

Blind learners learn better when they read or write in Braille. Kirk and Gallagher (1989:373) mentioned that "(p)eople who are visually handicapped must develop a series of special communication skills. For children who are blind, learning to use braille is a key skill for communicating with the sighted world."

Blind learners learn better when they have access to technology. In the past, and at the present moment, technology is significant as it impacts positively on the education of blind learners. Technology possesses the potential to expand both the intellectual and physical worlds of blind learners by giving them unrestricted access to information and knowledge. Kgame (2004:1) argued that "(b)eyond these meanings of the term 'learning', lies the reality of what the fast-moving world of technology offers us in the learning enterprise. Computers, the Internet, television and radio all offer unique opportunities to foster the learning process. For the fast-growing convergence between the media is turning the world into a multimedia age of information technology – anytime, anywhere."

Wareham (1999:16) pointed out that "(a)s we move into the 21st century, technology is setting the stage for making a quantum difference … for people who are blind, visually impaired and deafblind. It is vital that people who cannot see well have the necessary technical skills to compete effectively in today's job market as well as an equal opportunity to find meaningful employment."

Blind learners learn if their educators are conscious of the fact that their beliefs in those learners' abilities have a profound impact on their learners' performance. Erwin *et al.,* (2001:349) cautioned that "(s)ometimes teachers may not be aware of their powerful influence on students."

4.2.4 BLIND LEARNERS ADDITIONAL LEARNING MEDIATION CHALLENGES

The following challenges, if not taken seriously by educators during the facilitation of learning, may have a negative impact on blind and visually impaired learners mastering life sciences/biology. According to the researcher, lack of visual ability seems to be the major challenge that blind and visually impaired learners have to grapple with in any learning mediation situation. In addition to the challenge of not perceiving things visually, blind learners experience other difficulties such as differentiation, reading and spelling problems, social-emotional development, physical development and blindness itself, which impacts negatively on the learning mediation of life sciences (biology) by the blind learner.

Each of these difficulties will briefly be discussed:

Differentiation

Differentiation implies that the degrees of blindness, mental disabilities, health conditions and other physical, mental and sensory complications vary. Therefore, the special or inclusive school has to make effective provision and furnish the necessary accommodation for all these learners, "…(a)nd this applies also as well as to blind … children who manifest neurally oriented learning and behavioural problems" (Pauw 1991c:128).

Reading and spelling problems

Reading and spelling problems comprise basic skills, including reading, spelling, mathematics, oral and written language. This implies firstly that the blind learner with a severe reading problem is likely to encounter problems in learning mediation areas that require reading and writing and in any projects/assignments with written directions or instructions. Pauw (1991c:128) argued that blind learners have these problems because of their poorer spatial orientation and various other perceptual defects.

A second aspect of their reading and spelling problems is caused by lack of cognition and ineffective learning mediation strategies. These strategies include memorisation, textbook reading, note taking, test taking, and general problem solving. Lack of these skills negatively affects the learner's independency, required for adult life. According to Friend and Bursuck (1999:111), if the blind learner is not good at these skills, s/he will not cope in inclusive schools because s/he will have to memorise, not be able to take notes from tapes, et cetera. Learners, who lack these skills, normally fall behind in classes. For blind learners to survive they have to attend school regularly, always be organised, set themselves attainable school goals, complete tasks in and out of school, if possible be continually independent, take an interest in school and all school activities, never pile up schoolwork, display positive interpersonal skills, be cooperative, and so on.

Social-emotional development

Many blind learners do have social-emotional development problems. They may have negative classroom conduct, stemming from and leading to both poor interpersonal skills and personal/psychological adjustment. Classroom conduct might be characterised by aggressive or disruptive behaviour, that is, beating, fighting, teasing, hyperactive yelling, refusing to comply with requests, crying, bullying other children, swearing at other children and disruptiveness in general. Friend and Bursuck (1999:111) commented, "(a)lthough most of these behaviours may be exhibited by all children at one time or another, students with special needs may engage in them more frequently and with greater intensity."

Conduct problems certainly impact negatively on a learner's learning. Learners who tend to be disruptive in a class are less likely to learn academic skills and content because their outbursts may also be resented by their classmates and will most likely lead to peer rejection, social isolation, and a poor self-image. Personal psychological adjustment involves the key motivational areas of self-image, frustration tolerance, proactive learning, and the like. Should the blind learner at a special school or in inclusive education possess a poor self-image and relatively low tolerance for frustration, that learner might perform poorly in written tasks. On the other hand, blind learners who are inactive will most probably have difficulty pursuing an independent biology project.

Physical development

Friend and Bursuck (1999:112) maintained that "(p)hysical development includes vision and hearing levels, motor skills, and neurological functioning." As a result of their lack of proper physical development, "(s)tudents with vision problems will need adapted education materials" because physical development does influence learning.

Blindness itself

Blindness itself causes the learner to lack the positive role of vision, crucial in intersensory learning mediation, which is of cardinal importance to both the scope and quality of cognition since the senses not only stimulate but also complement each other.

Educators in inclusive or special schools settings should be familiar with these learning problems, as these problems do affect, in one way or another, their learners. Educators should possess background information about learning problems in blind learners in order to give appropriate attention to learners, and should, furthermore, use their experience to identify blind learners with these difficulties. These educators should also then be able to help blind learners to find appropriate sources of assistance for their day-to-day predicaments. Educators should constantly be aware of the symptoms of learning disabilities. Ignoring symptoms will exaggerate the problems.

Educators should, on a regular basis, check the potential areas of a learner's success. This could be done through the analysis of a blind learner's strengths and weaknesses based on the learning mediation demands, on all the activities and tasks the learner could do successfully and well. Success always positively enhances a learner's self-image and motivation.

Educators should accommodate a blind learner's learning difficulties by carefully reviewing the learner's needs within a particular learning mediation context. This simply means that the learning mediation needs of blind learners should be reviewed from time to time within such a context. Mistakes, learning mediation difficulties, and additional learning mediation needs should be identified and the needs of such learners catered for, their problems addressed amicably, depending on their importance and relevance to the blind learner.

After learning difficulties, needs and new demands have been identified, educators should take tentative decisions and use the information gathered to identify possible ways to eliminate or minimise the effects of those issues. Adaptations in certain instances could, as Friend and Bursuck (1999) view them, include bypassing a learner's learning needs by allowing or giving the learner room to employ compensatory learning mediation strategies, making a modification in classroom learning mediation or organisation, and instructing a learner in basic or independent learning skills.

4.2.5 HOW BLIND AND VISUALLY IMPAIRED LEARNERS COULD MASTER THE UNIQUE DEMANDS OF BIOLOGY AS A SUBJECT

Blind learners, in the researcher's view, could master the unique demands of biology as a subject if both human and material resources are made readily available for them. Furthermore, all environments pertaining to their learning mediation have to be conducive. Educators need to possess the right qualities in order to provide such learners with information as well as to guide them on their educational path. Their learning mediation support material has to be produced in Braille or other accessible formats, including tactile and electronic formats and audiotapes. There should be assistive devices to access this material, e.g. tape recorders and computers.

Blind learners should be encouraged and trained to use laptops and personal computers. Braille display equipment is instrumental for mastering the unique demands of biology as a subject because it allows blind learners to access electronic files and can also convert files into Braille format or have them read by the voice function. Burke (2001:66) advised that blind learners should "(l)earn it and use it. Even if your Braille-reading speed isn't great at the outset, it will improve with practice."

Blind learners also master the unique demands of biology as a subject through readers (sighted people who normally read print material to the blind) and classroom assistants. Through these people, blind learners can succeed in accessing print. Burke (2001:66) aptly stated: "(b)ooks on tape can fill a lot of your access needs, but not all, so learning to manage print with a reader is a critical tool for many types of material."

Books on tapes or CD ROMs enable blind learners to master the unique demands of biology as a subject. Blind learners can always borrow or purchase books on tapes or CD ROMs on literature, science, arts, politics, law, commerce, history, et cetera. Books on tapes and CD ROMs are useful because readers and classroom assistants, even if willing, will not be able to cope with reading everything to blind learners.

Burke (2001:68) pointed out that "(n)ot all books are on tape either, and not all subject matter renders well in a recorded format."

Blind learners could master the unique demands of biology as a subject through graphic learning mediation, which accords blind learners the joy and benefit of having tactual views of maps, mathematics and complicated diagrams and graphs. Inclusive or special schools biology educators should expose blind learners to graphics, because according to Burke (2001:68), "(i)f you have access to such technology or materials your competitive equality is literally at your fingertips."

Blind learners could also master biology as a subject through using screen-reading software to access computers. This converts what is displayed on the screen into synthesised speech using the sound card or Braille on a Braille display. These software packages are basically components that function within one's operating environment. Blind learners acquire valuable information, crucial for mastering biology, because screen readers afford them all the capabilities of reading, writing and editing. Through screen readers, blind learners can for example access spreadsheets, databases and web browsers.

"Scan and read" packages enhance blind learners' mastery of biology as a subject. These packages do excellent work in converting print into readable electronic texts, thus enabling blind learners to access, acquire, read or edit information independently and with competence. Blind learners can access library books, class handouts, and test and exam papers. Scanning and reading packages give to blind learners tremendous flexibility and greater independence as well as a sense of self-worth. In some instances, blind learners could use the Web, as it is a powerful source of information. Male (1997:76) in this regard pointed out that: "(a)ccess to internet provides the means for getting and sending needed information constantly, without having to leave one's home. Electronic mail enables those with a variety of needs and disabilities to communicate without interference or stigma of wheelchairs, sign language, and so forth - electronic quality for all."

Blind learners could enjoy some websites as they provide formatted electronic files, which can be read with a Braille display or a Braille notetaker. Burke (2001:70) argued that for mathematics and science courses such as chemistry and physics there are an increasing number of audible graphic calculators. Some calculators are portable, hand-held models, and there is at least one software-based calculator as well.

4.3 THE IMPORTANCE OF MEETING BLIND AND VISUALLY IMPAIRED LEARNERS NEEDS

According to the Department of Education (1999:3), blind learners experience learning difficulties and fail to learn effectively in inclusive education. This also applies to the facilitation/learning mediation of biology in an Outcomes-based Education classroom, because a broad range of learning needs exists among the learner population at any point in time, and that, where these are not met, learners fail to learn effectively or are excluded from the learning system. Therefore, to ensure their proper inclusion, blind learners need full educational support from the local to the national levels. They must be provided with Braille learning support material, writing equipment, reading equipment, and so on.

4.4 THE ORIGIN OF LEARNING MEDIATION NEEDS FOR BLIND AND VISUALLY IMPAIRED BIOLOGY LEARNERS

According to the Department of Education (1999:3), "(d)ifferent learning needs arise from a range of factors including physical, mental, sensory, neurological and developmental impairments, psychosocial disturbance, cognitive differences, particular life experiences or socio-economical deprivation."

In addition, the Department argues that different learning mediation needs also arise because of negative attitudes to and stereotyping of difference, an inflexible curriculum, inappropriate languages or medium of learning, inappropriate communication, inaccessible and unsafe built environments, inappropriate and inadequate or non-existent support services, inadequate policies and legislation, the non-recognition and the non-involvement of parents/guardians and professionals, organisations of and for the disabled, and, above all, inadequately and inappropriately trained education managers and educators.

4.5 THE IMPORTANCE OF LEARNING MEDIATION STRATEGIES FOR BLIND AND VISUALLY IMPAIRED LEARNERS

The researcher views learning mediation strategies for blind learners as being of primary importance. Learning mediation strategies for blind learners at special schools or in inclusive education settings and, in particular, the facilitation of biology or any other subject (learning area) are essential in:

Ensuring that each and every learner enjoys the fundamental right of education and is also able to access it. In other words, learning mediation strategies guarantee to blind and visually impaired children and youth the same rights and access to educational services as are guaranteed to all children and youth without disabilities. The South African National Council for the Blind (1997:9) argued that the Education Authorities have to allow and enhance equal access to all aspects of the education services provided to other learners. This further implies that through suitable learning mediation strategies, educators should acknowledge that blind learners have unique or particular needs in terms of the basic equipment, appropriate facilitation/learning mediation aids and learning mediation material, which have to be provided to them in order to ensure that they receive relevant and effective education and training. It admits that the modification of facilitation and learning mediation strategies for the adequate provision of blind learners' needs might cost more than providing for similar needs of sighted learners, "...(b)ut it should not be used as a reason not to provide."

The authorities must ensure that the education blind learners receive, whether at special institutions earmarked for them or at inclusive schools, is at least similar, but preferably equal in all respects, to that received by sighted learners in terms of quality and end results. Relevant learning mediation strategies therefore have to provide special attention to the education and literacy needs of blind learners. Such strategies should not only deal with the modification of subjects such as mathematics, geography, physical science, biology, music, or art and craft, but also **be focused on addressing the unique needs of blind learners such as:**

- Sensory and cognitive development;
- Facilitation/learning mediation of writing and reading Braille;
- Orientation and mobility;
- Skills of daily living;
- Ensuring the personal, academic and professional development and enhancement of the potential of learners.
- Ensuring that all learners know how to effectively use and recognise their potential.

Dreyer (1994:69) maintained that all children have potential, but very few ever utilise their potential. According to him, "(t)o ensure the better utilisation of potential, three requirements have to be met:

- Children must recognise their potential.
- Children have to be motivated to use their potential.
- Children have to know how to use their potential."
- Guidance and effective learning mediation strategies are, therefore, of vital importance in unlocking this potential. Educators through suitable learning mediation strategies are "...(b)est suited to promote the potential of children." (Söhnge 1994:69).

Finally, learning mediation strategies for blind learners require that the special or inclusive school environment be accommodating and accessible in terms of the:

- Physical environment;
- Curriculum (and additional curriculum);
- Attitudes of all concerned (parents, educators, other staff members, professionals and paraprofessionals, learners and departmental officials);
- Accessible medical and other specialised forms of support;
- The provision of a variety of settings, placement options and learners' services;
- Both a relevant and an effective continuous support system at blind learners' homes and at school.

4.6 THE ROLE OF THE BIOLOGY EDUCATOR DURING LEARNING MEDIATION PROCESSES

What is the special or inclusive biology educator's role during learning mediation processes? According to Dreyer (1994:69), "(a)ll children have potential, that is so to say latent, innate talents or abilities which, if fully utilized, can equip them to reach a particular degree of development and achievements." This is to say, any educator who employs the right learning mediation strategies should also be in a position to enable learners who are blind to utilise their potential, learn, develop and grow mentally.

Dreyer (1994:70) added, "(t)he degree and type of potential that each child has, differ remarkably from highly gifted children to extremely retarded children." As noted above, the same author further asserted that despite the particular degree of potential all children possess, none or very few ever utilise or develop their full potential. This could be the case at special schools or in inclusive education situations where educators are not conversant with appropriate skills to facilitate or mediate learning to learners who are blind.

According to (Olivier 1998:4 and Norms and Standards of Educators 2000:30-33) the following are additional roles of the biology educator:

- To impart knowledge which is inaccessible, or knowledge that needs to be explained to learners;
- To provide guidance on how and where education could be received, skills to be acquired and processes to be followed when learning or acquiring skills;
- To demonstrate whatever needs to be demonstrated;
- To direct all learners to capitalise on acquired knowledge, skills and processes to construct outcomes;
- To intervene on a continuous basis with all learners to confirm their progress and direction, based on the performance indicators;
- To mentor, assist, facilitate and guide;
- To reconcile learning styles with contexts of learning;
- To guarantee and provide learning relevant to the world of work;
- To propagate creativity, initiativity and innovation;
- He/she should be a competent curriculum designer and an effective assessor;
- He/she should be able to embark upon processes for the recognition of prior knowledge;
- He/she should be able to apply and integrate learning mediation competences.

The researcher contends that biology educators should always endeavour to assist and educationally support blind learners, so that those learners become aware of and also develop their potential, intellectually, physically and spiritually. If inappropriate and ineffective learning mediation strategies are employed, there is a danger that these may possibly lead to the curtailment of blind learners' personal growth. This could, furthermore, result in learners being hindered from contributing substantially to the development of the country and the society as a whole.

4.7 REQUIREMENTS TO ENSURE THE UTILISATION OF BLIND AND VISUALLY IMPAIRED LEARNERS' POTENTIAL

All educators are required to ensure that blind learners utilise their talents. They could achieve this if they motivate individual blind learners to:

- Recognise their traits and talents (potential).
- Use their potential.
- Know exactly how to use their potential.

In the researcher's opinion, these requirements are the cornerstones for effective learning mediation. Therefore, any learning mediation strategy that does not take those requirements into consideration is doomed to failure. Educators should constantly know and understand that it takes exceptional energy, discipline, devotion, diligence and persistence to develop and promote the full utilisation of blind learners' talents. Learning mediation strategies should in every possible way challenge and stimulate blind learners' potential.

4.8 CHARACTERISTICS OF THE BIOLOGY EDUCATOR USING PROPER AND EFFECTIVE LEARNING MEDIATION STRATEGIES

In addition to the relevant skills and techniques expected from all educators in terms of being competent in the execution of their day-to-day classroom duties, any biology educator, in order to be successful and effective during learning mediation, should possess the following competences and qualities in addition to those discussed in chapter three.

The ability to recognise potential

According to Dreyer (1994:73), if the educator is able to recognise potential, s/he will know when, where, how and why to use certain strategies during various activities. S/he will know what adaptations or accommodations to make in order to include and develop the potential of learners who are blind. Norms and Standards of Educators Department of Education (2000:30) made mention of the fact that the educator should do everything in his/her power to promote the accessibility of learning mediation programmes and also to provide adequate support to learners. One of the ways to do this could be in the form of assessments or through checking the knowledge of learners in other ways, in order to inform the development of learning mediation programmes.

Be able to motivate

Not all learners are always comfortable with some learning mediation strategies, in the sense that they may fail to understand what is expected of them. Because of this, some learners may lose heart. Hence, motivation by the educator is crucial. All learners should therefore, as a matter of fact, realise that, as indicated in chapter one, it is not a humiliation to fall, but it is a humiliation to fall and not stand up.

Have the ability to guide

Dreyer (1994:73) supports the importance of this ability as follows: "(l)ike guides, we walk at times ahead of our students, at times beside them, and at times we follow their lead. In sensing to walk lies our art. For as we support them towards their best, and cast light on the path ahead, we do so in the name of our respect for their potential and our care for their growth."

The researcher holds that biology educators should be trained to be aware of their responsibilities and need to be equipped with the necessary skills to successfully accomplish this. The effective biology educator should be a specialist who, according to Norms and Standards of Educators Department of Education (2000:30), is able to know and understand biology concepts and theories, and also possesses procedural and strategic knowledge (the knowing how, why, when, where and who).

4.9 GUIDELINES FOR BIOLOGY EDUCATORS TO EFFECTIVELY MEDIATE LEARNING TO BLIND AND VISUALLY IMPAIRED LEARNERS IN AN OUTCOMES-BASED EDUCATION CLASSROOM

In the researcher's view, all learning mediation strategies, no matter how relevant and effective they may seem, may not be realised in practice, if not used in conjunction with the following guidelines. The modification and adaptation of learning mediation strategies depend largely on, and their effectiveness and value is vastly influenced by, the following guidelines:

4.9.1 CONSULTATIVE PROCESS

It is noted by Ball and Keller (1994:16) that by the time educators encounter students with disabilities in the junior science high school biology class, many of them will have had years of experience in adapting situations to meet their needs. "(s)o the best source of information is the student. Especially if the disabling condition results from a congenital source, the student has had 12-14 years of practice in modifying his or her surroundings."

Nonetheless, this is not applicable to learners who have become blind later in their lives. The severity of the blindness will to a large extent determine the necessary and appropriate adjustments that are to be put in place. According to Ball and Keller (1994:16) "(t)he focus should always be on what can be done, not what the limitations may be."

According to the researcher's observations, blind learners have over the years proved that they are excellent problem solvers, as long as they are granted opportunities to come up with tentative proposals and solutions. They also learn to think critically and creatively and in addition, they might from time to time, like anybody else, arrive at solutions to situations that under normal circumstances would not be problematic to individuals who do not have disabilities. It is essential that the biology educator consults and collaborates on a regular basis with the blind learner to acquire this valuable information. They possess clarifications, explanations and tremendous insights which will be constructive in and functional for the biology educator's questions, doubts, problems, and in particular, learning mediation processes.

4.9.2 IMPORTANT ASPECTS FOR CONSIDERATION REGARDING ACCOMMODATION PURPOSES

Van Wagner (1994:81) emphasised the following as important aspects, which are helpful for the inclusive educator of blind learners during science or biology classes: The first is to review aspects of visual impairments in order to prepare himself/herself with a positive and optimistic attitude.

In order for the educator to achieve this, s/he should always endeavour to remember that all learners, if given the necessary support, could succeed in science and, in particular, biology, and also that:

- Blind learners could benefit from participating in science or biology classes.
- Serving their needs is much simpler than one might expect.
- Blind learners could be an asset to the class and make cooperative learning meaningful.
- There is no substitute for a positive attitude and a helpful, inspiring educator's mentoring role.
- Blind learners could enter and succeed in many different careers in science.

Biology educators should do everything to the best of their ability to make biology learnable. As remarked above, educators at special schools or in inclusive settings should familiarise themselves with each learner's unique needs as well as his/her progress. Van Wagner (1994:82-83) and Wareham (1999:58) advised that, in order for this to materialise, educators should plan informal meetings with learners to develop, foster, promote and sustain a sound learner-educator relationship and learn in advance what blind learners' particular needs will be. Informal consultative meetings are best at establishing and promoting educator-learner friendships, since all the participants can participate freely without any tension, mistrust, fear and formality. The educator should inquire from blind learners about the factors that are essential to, and over the years have proved to have been effective for and useful to, their education and learning mediation.

The educator should, on a regular basis, orientate the blind learner to the total barrier free classroom or laboratory environment, furniture, materials, sinks, hoods, open spaces and safety equipment. Van Wagner (1994:81) aptly stated that "(i)f the room arrangement changes during the semester, be sure to inform the student so as to allow reorientation." The educator should not feel ashamed and embarrassed to employ and utilise the expertise and valuable knowledge of an orientation and mobility instructor or that of a rehabilitation educator to assist with orientation in the classroom.

4.9.3 GUIDELINES FOR THE PROVISION OF REASONABLE LEARNING MEDIATION ACCOMMODATION

Friend and Bursuck (1999:113) provided the following as guidelines to help educators in their quest to provide reasonable accommodation during learning mediation:

- Educators should employ an adaptation only when a mismatch occurs. That is, the educator should make relevant changes only when it is an opportune time to do so.
- Before they make any adaptations, Educators should determine whether they are dealing with an "I can't" or "I won't" problem. Some of these learners might need a bypass or behaviour management strategy.
- Educators should keep changes as uncomplicated as possible. As a general rule, educators should use the intervention that will require the least time and effort on the educator's part, but that is likely to, most positively and meaningfully, affect the learner.
- Educators should make tentative decisions on which accommodations to implement. This implies that, as soon as both the educator and the learner have brainstormed, the educator should implement

the adaptations agreed upon, which might entail the selection of strategies to try on a number of occasions, to come up with those that suit the learner's needs best.

Adaptations should be based on:

(i) Age-appropriateness;

(ii) Being simple, easy and implementable;

(iii) Accommodations agreed upon by the educator and learner;

(iv) Accommodations with demonstrated effectiveness;

(v) Accommodations that have the potential to enhance the learner's progress. Friend and Bursuck (1999:115) stated, "…(t)his information will let you know whether to continue, to change, or to discontinue an intervention."

Biology educators should strive at discussing, in detail, the biology classroom safety rules and emergency procedures, including the emergency evacuation routes. According to Gettys and Jacobsen (2000:1104), one of the golden rules in the laboratory is to "(n)ever taste or eat anything in the laboratory. Use caution in noting odours or touching chemicals." Blind learners should be made aware of such rules. Blind learners should be encouraged to put on safety goggles while carrying out specific experiments. These authors advise, "(s)plash-proof goggles should be warn at all times in the laboratory." Safety goggles are important in protecting one's eyes from coming into contact with hazardous chemicals and exacting lights. Van Wagner (1994:81) asserted that "(e)ven totally blind students need to protect their eyes, especially if they have glaucoma."

Academic planning coupled with the development and utilisation of effective learning mediation ideas is vital before classes commence. To achieve that goal (academic planning), all stakeholders should be involved. Mani (2000a:18) argued that ideal inclusive education programmes strongly insist on the importance of stakeholders' involvement in education. This is why discussions prior to the commencement of lessons are important, so that all can come up with suggestions and assess them.

Decisions should also be arrived at regarding what, as an alternative to printed materials, might be required in the form of Braille, disc or tape.

Van Wagner (1994:81) pointed out that advance warning and lead-time is needed to produce these media, including handouts and exam papers, throughout the semester. The educator (facilitator in Outcomes-based Education's terms) should know where and how to obtain for example, converted text materials. In some instances, they are free or can be obtained at minimal or subsidised costs. These materials may include loans or recordings or computerised books in disc format, that provide access through Braille or speech output to visually impaired persons.

An in-depth discussion on the adaptive equipment the learner who is blind or visually impaired will need, or will bring to class during biology classes, should be held. It should furthermore, be established which equipment will be stored in the media centre, if the school has one. Such equipment might include but not be limited to: Braille writing machines, tape recorders, computerised reading equipment, speech output computers, optacon (a device to read ordinary print tactually), talking calculators, Dictaphones, record players, Versa Braille (tactile), Kurzweil or Arkenstone systems (with synthesised speech), and the like.

The educator should receive a rigorous training on how to use this equipment because some items are sophisticated and difficult to operate. Hence, s/he could be of tremendous help to blind learners in training and assisting them to know how to effectively operate such equipment to their academic benefit.

It should be the primary duty of biology educators to inquire about computers with output in Braille or synthesised speech, biology or Science videotapes, if possible with descriptive features and elements, or any other new technology on the market that offers blind viewers or listeners an auditory description of portions of a film. In developed countries, DVS (descriptive video service), which is a relatively new state of the art technology, makes television user-friendly in the sense that the television becomes accessible to blind audiences.

In instances where the services of itinerant educators (special educators travelling from place to place offering assistance, support and guidance to regular educators in special fields) or specialists are available, the biology educator should consult and collaborate with them when deciding what additional assistive devices might need to be borrowed or purchased, for example Braille or talking thermometers, light probes, liquid-level indicators, voltmeters with audible readout, talking balances, Braille labellers, and so forth. Some of these items are available from the South African National Council for the Blind or, if not available, the South African National Council for the Blind could obtain them on behalf of schools in need of assistive devices, from other international manufacturers or organisations for and of the blind.

As an obligation or priority, biology educators should label all glassware, chemicals, equipment, et cetera, in Braille. Van Wagner's (1994:81-84) system of labelling, whereby sandpaper is used to label hazardous chemicals, could be adopted. The special school or inclusive biology educator could also devise other methods of labelling, but should make sure that s/he discusses with the blind learners what those methods imply and should, further, specify their clear intentions. They may include using different types, shapes, sizes, and textures of containers or bottles to store chemicals. The way certain lids are shaped or can be opened might be another simple method to know and differentiate between chemicals.

The researcher argues strongly that no matter how challenging, strenuous and demanding it is to do adaptations and accommodations, biology educators should at all times be creative, innovative, dutiful, enthusiastic and industrious in their quest to help blind learners learn biology.

Biology educators should always make certain that they give their best when aiding and stimulating positive hands-on biology lessons during cooperative learning mediation activities. A classroom peer or aide has an instrumental role to play in this instance. S/he should keep a watchful eye and offer guidance to ensure that blind learners are always on track as far as the activity is concerned. The researcher regards the buddy system as being of strategic importance during the performance of experiments. The role of the buddy is to help carry out experiments on behalf of the learner who is blind. In support of the buddy system, Mani

(2000a:19) noted, "(i)nclusive settings should tap the child-to-child learning strategy effectively to improve the achievement of all children including that of disabled children."

However, this does not mean that blind learners should rest on their laurels during experiments. They should be encouraged to fully participate and contribute as much as possible. Their knowledge and contribution, however little it might appear, is vital. Van Wagner (1994:82) wrote, "(d)irect experiment involvement may not be possible in some instances but the visual-impaired student can develop leadership skills by doing the thinking and directing the experiment."

As cited above, the buddy or aide should perform the actual manipulation, but the blind learner's role should be to use the learning mediation opportunity by both directing the experiment and thereafter, on his/her own, interpreting the data collected. Other popular forms of accommodation include speaking clearly, avoiding pointing at things and using gestures to communicate and very important, reading loudly what one puts on the overhead projector or chalkboard. According to the researcher, no matter how hard it is to do, inclusive or special school biology educators should always strive to be specific with content and if possible, avoid speaking in generalities.

It would be of great advantage to both special and inclusive schools to have what is called "a model room or tactile gallery". This is where tactile objects are habitually stored and made available to blind learners. This will put biology educators in the desirable position of having objects at their disposal to show blind learners stuffed animals, dried insects and plant materials. They should make use of real objects whenever possible so that the learner who is blind can touch and feel them as well. According to Pauw (1984a:70) facilitation/learning mediation should be concrete and practical and include much self-activity. He states that "(b)igger children find the study of human physiology fascinating. For a blind child his own body is his field of reference …" This author further argued that there are also suitable body and internal organs available that blind learners could use during learning mediation. In the absence of real objects, the educators should make use of professional or handmade models because according to Van Wagner (1994:82-83) they are the next best thing to the real objects.

In addition, Pauw (1984a:70) asserted that "(i)n the general study of the environment, nature study lends itself admirably to practical and concrete teaching: the child can feel both live and stuffed birds and animals; he can listen to the sound of nature, a walk through the garden brings flowers, shrubs, insects, etc., to his attention, numerous subjects for study crop up naturally because of the changing seasons, procreation can be discussed spontaneously if someone has a hen with chickens or an animal with its young at home, or if a baby arrives in one of the families."

Concreteness has its limitations, though. The researcher would like to point out that the blind learner cannot observe many things, like experiments referred to in chapter 3, or bacteria, viruses and other tiny entities such as Amoeba and Hydra with the help of the microscope. Insects like flies, mosquitoes, fleas, and so on, for the blind to tactually explore them, have to be squashed and as a result, will be disfigured or deformed. In instances where these organisms are made accessible tactually, their size is then exaggerated (appendix A). Some of the pictures are so detailed (appendix B) that the blind learner cannot get sense or meaning out of them. (Please refer to the pictures in the appendices.) Some of the living animals are aggressive. Hence, the blind learner cannot tactually feel them. Good examples might be the lion, leopard, certain snakes, and the like. Some animals, like the elephant, cannot all be felt at once. Another problem is that African elephants are not tame. Nonetheless, the educator's perceptiveness and creativity should enable the blind learner studying biology to become familiar with biological aspects.

In spite of the insightfulness and creativity of either the special school or the inclusive biology educator, in order to familiarise the blind learner with biology, many people still have serious doubts and strong reservations pertaining to this.

They often pose questions like:

- How can the blind learners at either a special school or inclusive setting benefit from the study of biology, physics or chemistry?
- Of what importance are the said subjects to the blind learner?
- Is it really worthwhile for either the special school or inclusive biology educator to make concerted efforts to make biology adaptations in order to accommodate the blind learner?

According to Pauw (1984a:71) a relatively straightforward answer to these questions is that: "(e)ducation should not have utility value only, it should be aimed at the widening of one's mental horizon and at the improvement of the quality of life. No sphere of knowledge should be closed to the blind mainly because they are blind. Man's entire existence is affected by physics and chemistry, they are part of a child's culture, they are the topics of many conversations, and they are discussed in magazines and radio programmes. There is no reason why the blind child must be shut off from them."

Educators at special schools or in inclusive education settings, and in particular the mediation of biology to blind learners in an Outcomes-based Education classroom, should know that facilitation/learning mediation in these subjects poses many challenges. Biology educators should obtain a Braille code for the exposition of problems, theses and formulas. According to the researcher, it is an indisputable truth that some sections of the biology syllabus are not theoretical and are therefore extremely hard to demonstrate, explain or interpret to blind learners. Despite all such difficulties, (Pauw 1984a:71-72 and Kumagai 1995:83) urge all educators to be courageous, initiative and dedicated in their quest to take care of blind learners and demonstrate, explain or interpret experiments when possible, in such a way that learners will understand their meaning, intentions and use.

The educator should try very hard not to point at things. As much as possible, and time permitting, the educator should transform the abstract into a somewhat concrete tactile learning mode. As a ground rule, the educator should be creative, innovative and apply initiative in constructing simple tactile models, with for example, clay, yarn, card box, beads, wire, macaroni, timber, sponge, cloth or sand paper. Raised line drawings could be made using card stock paper and tracing wheels available in fabric stores.

It is both fair and apposite that when apparatus is to be set up, blind learners be allowed to examine it tactually. During chemical experiments blind learners could acquire valuable information through the sense of hearing. They could hear, for example, the bubbling sounds of the chemical reaction and also feel the heat that is emitted. They could also employ the sense of smell to distinguish certain chemicals from others. However, this should be done with extra caution, as not all chemicals can be smelled. Having said all this, the researcher believes it is not practical, sensible and realistic to undermine, discard or shun the use of the educator's own eye, as it remains the primary sensory organ in observing biology experiments. What one hears, sees and touches is more effectively recorded in the brain than what is felt, heard or smelt.

Without exaggeration, the sighted educator should give a careful description of everything, which only s/he is able to observe visually. However, it is of pivotal importance that the safety measures must be both strictly and automatically observed. Blind learners should be accorded opportunities to enjoy the use of instruments with Braille signs during biology lessons, namely: thermometers, barometers, balances, measuring instruments, and so on.

Van Wagner (1994:85) suggested that untouchable objects and microscopic specimens could be made visual with etchings in a pan of clay or by making a raised line drawing. Volunteer readers and teacher aides should always be encouraged to verbally describe graphic information that might be extremely difficult to obtain without vision, e.g. information on the computer screen. The blind learner's progress in biology should be monitored on a daily basis. Competent educators in inclusive and special school settings, and in particular the facilitation/learning mediation of biology in an Outcomes-based Education classroom, should foster the learner's success and not failure.

Biology educators should be aware of the fact that linear measurements are important in many active learning mediation experiences of mathematics and science. Blind learners do, however, encounter from time to time numerous difficulties with measurement. As one of the solutions, adapted tactile measuring instruments can be provided. It is advisable to use a metre stick with raised dots or lines representing centimetres and millimetres, depending on the space and size of raised dots and lines. Braille sign A may stand for millimetres while Braille sign L may represent centimetres. This system would enable blind learners to measure by counting those raised dots or lines. The educator's role in the measuring activity should be to help blind learners practise measuring by measuring common objects, like furniture, models, science apparatus, and so on. To measure circumference and irregular shapes, "...(u)se a piece of string. Measure the object with a string, and then place it on the tactile meter stick" (Van Wagner 1994:87).

To enable blind learners to learn to their full potential, some of them might simply require more individualised attention or lengthened task time. According to Van Wagner (1994:87), a further group might just need instructions that are more precise, simple or repetitive. Another group might need modified equipment or revised activity sheets for recording information.

4.10 LEARNING MEDIATION STRATEGIES FOR BLIND AND VISUALLY IMPAIRED LEARNERS

As indicated in chapter one under definitions of terms and concepts, Van Der Horst and McDonald (1997:123-124) regard learning mediation strategies as "...(a) broad plan of action for teaching activities with a view to achieving an aim." Such a strategy is a plan of attack. It outlines the approach one intends to take in order to achieve learning outcomes. One has to be clear about one's lesson objectives, learning outcomes and the main content of one's lesson before one can decide on a broad learning mediation strategy.

While all biology educators should become used to the guidelines proposed above in 4.1.4 and 4.8.1-4.8.3 they also have to consider certain factors when applying learning mediation strategies to blind learners. According to the researcher, one needs to realise that no education programme or learning mediation strategy will be effective, adequate and meaningful if the following factors are not taken into consideration.

A number of communication methods could be employed in the education of blind learners and these include touch, feel, taste and smell. In addition, other equally necessary methods include: aural/oral (auditory/speech), Braille learning material, reading and writing machines and talking books.

All strategies have their advantages and limitations. In most cases their limitations also limit the learning mediation of learners who are blind and visually impaired.

As argued earlier, the researcher contends that in order to achieve the envisaged aim, effective facilitation/learning mediation should take place in an environment modified and organised for individuals' needs. Gee, Alwell, Graham and Goetz (1994:13) remarked, "(t)he primary focus, therefore, of the educational team planning the instruction of the student ... must be determining the means by which the student will receive information, how instructional techniques will be adapted to the learner, and how the learner will be allowed to demonstrate knowledge and participate in the instructional and social activities which take place at school and in class."

Effective facilitation/learning mediation would normally take place in an environment modified, organised and adapted to individuals' needs. Therefore, blind learners also need this kind of learning mediation environment to fully benefit from and utilise the educational opportunities offered by a school. Learning mediation is an interactive activity where the learner is constantly involved with both the text and any other learning mediation activities, including but not limited to debates, excursions, experiments, reading texts, videos (which to the blind learners should be descriptive), talking books, et cetra.

In this regard Pearse (1996:46) stresses the importance of reading as a learning mediation activity when she states that "(w)hen reading, one is totally involved: one's general as well as subject-specific knowledge; one's reading, educational and life experiences, cultural background, beliefs and values; one's interests and feeling - all help to construct the meaning of reading."

4.10.1 READING TECHNIQUES

During learning mediation, blind and visually impaired learners should be able to link the newly acquired information to what they have learnt in the past. In order to learn effectively, the following reading techniques can be employed:

Reading with understanding

When one reads with understanding, one reads attentively and analytically. This technique is useful for most learners, as they will remember and recall things they have read about. Remembering and recalling is an important part of learning mediation.

The strategy employs methods such as:

- Surveying the headings;
- Connecting and constructing meaning from headings, sub-headings, chapters, and so forth;
- Reading the text with the aim of outlining key points;
- Revising what one has read, in order to find information that might have been omitted unintentionally as well as to check and verify the accuracy of major ideas and details written down;
- Previewing the text;
- Asking questions for clarification;
- Reading with the purpose of summarising;
- Knowing and understanding the aim of the lesson or text;
- Indicating/identifying the problem;
- Solving the particular problem;
- Predicting the outcome;
- Organising the gathered data;
- Searching for more information; and
- Evaluating and assessing information gathered.

Note-taking strategies

Taking notes simply involves the ability to identify and construct meaning from the main ideas, in the form of writing, so that an individual will be able to know and understand what the text is all about. By taking notes, learners acquire new insights, which are useful in learning mediation situations. Notes enable one to critically analyse the topic and ideas, determining whether they are related to matters s/he should study or learn.

Blind learners have unique ways of taking notes. Some use note-taking devices or tape recorders. In addition to those ways and means of taking notes, blind learners should be taught and encouraged to take notes by employing the Five Rs Note-taking Technique; **that is:**

- Recording main ideas;
- Reducing the information to being short and precise;

- Reciting key points;
- Reflecting on one's notes and if necessary adding other missing ideas, and
- Finally, the researcher suggests that one should review all the key information in one's notes.

To succeed in using this learning mediation strategy, the learner should be able to identify main ideas and details. If need be, the educator should give learners direct instruction on this learning mediation skill. When learners come to class, they should be well prepared. They could do this by reading in advance. Learners who attend and listen very well and show a keen interest in their educators and learning mediation. In general educators should not find it difficult to state the topics, state the source where they obtained their information, identify key words and ideas, and note and give the meaning in their own words.

Writing strategies

Learners who are conversant with writing strategies are competent and effective in planning, organising, writing, editing and revising what they wrote. They are able to express themselves in writing by describing what they like and dislike, asking questions and giving suggestions. They can plan the overall appearance of their papers, and use correct punctuation and spelling. They can show references, list points, put ideas logically and sequentially, summarise and conclude papers. In addition, they can examine and decide on what to include and exclude, form hypotheses, expose hidden meanings, note key elements, drive points home and also search for debatable points and details that are meaningless or irrelevant.

Scanning strategy

This means paying attention to the particular item one is looking for. This technique is, mostly, used when one wants to find a specific item of information such as a name, a date, a fact, a word in the dictionary, a picture, a symbol, or the like.

Study reading

This is intensive reading, which expects the learner to read carefully and attentively, analytically and thoughtfully. It is slow but ensures much comprehension of the things studied or learnt. It is effective in helping learners to understand and also to remember what they have read.

Other methods

Learners could also learn through group projects, assignments, demonstrations geared towards finding things practically, and so on.

4.10.2 STRATEGIES FOR MANAGING TIME AND RESOURCES

Learning mediation depends on and can only succeed when time and resources are utilised effectively and productively. Biology, as a part discipline of Science, needs concerted effort and time to gather information, test the data, carry out and interpret experiments, observe, inquire, et cetera.

Therefore, educators should empower all learners with skills which are adequate and appropriate to:

(a) Differentiate between short-term and long-term assignments. Short-term assignments are tasks or activities which could be completed or successfully carried out within a short space of time and may take one or two steps to finish, such as reading a chapter in biology and giving responses to questions posed at the end of the chapter. On the other hand, long-term assignments take more time than short-term assignments to complete. This kind of assignment usually involves more than two steps to complete. Good examples of this may be writing biology reports, or conducting experiments and research. Therefore, learners should be taught both short-term and long-term assignments and how to correctly approach them. This could be one of the best learning mediation strategies which blind and visually impaired learners might enjoy using in their quest to acquire new knowledge.

(b) Learners should be taught to analyse long-term tasks or activities by simply breaking them into small components. Learners should be in a position to estimate the amount of time it would take to perform each subtask. Having gone through this possibly tedious but necessary analysis, learners should schedule time to complete those subtasks in their schedule books. The educator's role should be to model the task analysis process.

Educators should demonstrate to learners how to record information in their schedule books by entering the fixed activities or activities they perform every week, entering occasional activities, activities that will be different from week to week, entering due dates for assignments, prioritising assignments, scheduling time to work on them, monitoring their completion, including rescheduling or adding time to work on assignments. Time management and resource strategies ensure that learners know their responsibilities in learning mediation. Additional learning strategies include the following:

Direct facilitation/learning mediation

This strategy is one of the easiest and is relatively complication free. It uses methods or tools such as asking specific questions and handling answers during lessons. The strategy is learner friendly because even learners who are blind can benefit and effectively participate during lessons, since responding to questions is not a difficult thing to do. However, in order to give relevant answers, one has to fully understand what the question requires of him or her. The researcher strongly recommends the use of this strategy during biology classes.

Questions that a biology educator could employ during direct facilitation/learning mediation might include:

(a) What is this activity all about?

(b) What is its significance?

(c) What do you know and understand about the topic?

(d) Do you as the learner know the reason why these questions are asked?

(e) What did you gain from the lesson so far and what do you expect to gain at the end of the lesson?

According to Pearse (1996:40), this strategy enables learners to "...(r)ecall work that was learned previously, observe similarities and make associations. Therefore the most important aspect of the new work can be placed within a definite and familiar framework." This helps greatly to systematise an activity to some extent so that it becomes more meaningful, more approachable and easier to understand.

Inductive and deductive strategies

Van Der Horst and McDonald (1997:124) pointed out, "(t)he deductive and inductive strategies have since ancient times been the dominant strategies of teaching." The one is the antithesis of the other. According to these authors, the principles underlying these two strategies are fundamental and they form the basis of all contemporary approaches in learning mediation.

The deductive strategy largely concerns itself with making deductions or arriving at conclusions. Educators making use of this strategy begin by giving their learners some general statements, rules, laws, theorems or principles, and continue to apply the various aspects to specific cases or instances. According to Van Der Horst and McDonald (1997:125), owing to this, "(t)he learner's active participation is confined to the application of the given statement, rule, etc., to numerous examples."

The significance of the deductive method is easily noticeable in mathematics and to a lesser extent, in other learning areas. (Pearse 1996:41)

The inductive strategy (an introduction of learners to a new educational environment, learning area or aspects of a lesson) is mainly useful in lessons where learners can make discoveries for themselves. It is not always possible for the blind learner to discover for herself during biology classes. Biology educators should always remember to encourage learners to use both low and high-tech equipment, if available and if it would be of great help during discovery activities. The educator could still use a classroom peer or aide if necessary. As noted earlier, the classroom peer or teacher aide should only help by doing the actual manipulation. The blind learner should direct the experiment and interpret the data collected. By so doing, the blind learner could, to an extent, discover for himself/herself.

If the educator allows and gives learners opportunities to make their own discoveries, their interest in biology will be stimulated. However, this needs a well-planned situation, initiated and carefully monitored by the educator. Its purpose is to develop and promote personal growth, creativity, originality and discovery. Here we distinguish two types of discoveries: guided and creative discoveries.

A Guided discovery

This implies that the educator leads the class along the right path, while at the same time rejecting all incorrect attempts, posing questions, and slowly but surely introducing key ideas where and when necessary.

B Creative discovery

The autor also commented, "(t)he purest type of creative discovery in a classroom situation occurs when the teacher presents a situation to a class and allows the learners to explore on their own, using only their intuition and past learning, with little or no guided direction." However, educators should be aware of the fact that this approach is best suited to the more gifted learners and provides the types of experience that are necessary for independent learning mediation.

The biology educator should always ascertain whether learners know and understand the steps or procedures of discovery. The first step is that of observation and experimentation. For the blind learner to be effective, s/he should be paired with somebody else. The next step is termed repetition. The blind learner should be encouraged to ask a peer or teacher aide to repeat the same experiment frequently, so that s/he can see if the same results are achieved after repetition of the experiment. The blind learner will then be able to postulate a hypothesis, which is merely a possible answer or solution.

Thereafter, together, the blind learner and his/her aide should perform further experiments to check the validity of their hypothesis, to suit the facts found as a result of these experiments. Finally, the blind learner should devise a theory. This is one way in which the deductive and inductive strategies could be adapted in order to accommodate the blind learner in special schools, inclusive education settings and during the facilitation/learning mediation of biology in an Outcomes-based Education classroom.

Cooperative strategy

In unsophisticated terms, this could be known as learner team learning. This strategy is defined by Drinkwater and Niewoudt (1999:37) as "…(a)n approach by the classroom that enables learners to work actively together and solve problems achieving common goals."

Slabbert (1991b:73 and 1992c:113) regards cooperative learning as a small group learning activity where members in the group help one another to learn or achieve. According to him, for cooperative learning to qualify as such and not to be mistaken for "traditional work" it has to comply with certain requirements, which will be discussed in this section.

He also argued that cooperative learning promotes metacompetence because certain methods of cooperative learning give "…(s)tudents more control over their own learning than other methods. But metacompetence will not be achieved through cooperative learning only."

The author further pointed out that cooperative learning supplies the instrument through which reflection on one's own competence attainment is obtained, but that the individual still has to internalise this in order to become an effective independent autonomous learner who:

- Is knowledgeable in many contexts and values knowledge;
- Is capable of high level thinking and sees learning as a lifelong process;
- Is a good decision maker;
- Is confident and psychologically healthy;
- Possesses multicultural knowledge and understanding;
- Possesses human relations skills for interacting with people different from himself/herself;
- Can view issues from many perspectives; and
- Can take responsibility for and exert control over his/her own learning.

According to Fraser *et al.* (1996:51), in cooperative learning, learners could either be categorised as field dependent or field independent. According to them (1996:52) field independent learners are achievers or performers who "(a)re highly competitive and individualised in their approach to learning." These groups of independent learners are characterised by depending on themselves.

On the other hand, a cooperative strategy involves and enhances positive and meaningful contributions which are characterised by the sharing of something, and anticipates seeking further ways and means to find and to continue sharing that common understanding. Fraser *et al.* (1996:52) maintained that in cooperative learning learners are "…(c)onstantly subjected to the influences and reflections of others."

A cooperative strategy as an approach requires of all learners, whether "field dependent" or "field independent", to utilise their potentials collectively. All learners should be exposed to a wide variety of activities and encouraged to work in groups with the "…(i)ntention of developing aspects such as positive interdependence, individual accountability, face-to-face interaction and cooperative skills" (Fraser *et al.,* 1996:52).

The following are aspects of a cooperative strategy, as proposed by Fraser *et al.*, (1996:52) and Slabbert (1991b:77):

The primary purpose of this strategy should be to create opportunities for cooperative learning experiences. It should strive to expose the learning content to the learners as well as emphasise their learning competence.

The authors further suggest that a cooperative strategy could be properly developed if:

(i) Cooperative skills such as communication, conflict management, decision making, leadership, recognition, respect and trust building are given special attention during learning mediation.

(ii) Members of the group collectively solve the problem and are all responsible and accountable for the performance of the group in general. The group should always maintain and enhance this sense of responsibility and realise that the survival of the group depends on its members' performance.
Group members should assess the performance of their group on a regular basis in order to identify activities that are beneficial to the group and those that are not.
Members should always be able to interact and work together in harmony. Because a group fosters the provision of a social support mechanism, Slabbert (1991b:77) maintains that learners should exchange ideas, ask questions freely, explain to one another, clarify ideas and concepts, help one another understand the ideas in a meaningful way and also mutually express feelings about their learning.
According to Fraser *et al.,* (1996:53) cooperative learning would in this sense be helpful for facilitating or mediating the learners regarding "… how to engage in helping, assisting, supporting and encouraging each other's efforts."

(iii) The size of the group should be composed of and also influenced by the type of the task and the method of cooperative learning.

Emphasis should be placed on the quality of learning experiences. A high quality could be achieved if there is sufficient opportunity for learners to interact with one another and when all members are given specific tasks.

Fraser *et al.,* (1996:53) are of the view that the success of cooperative learning, with specific reference to the objectives the educator has in mind in using the strategy, will to a large extent depend on the various methods that will be employed to enhance cooperative learning. These methods include cooperative cooperation, group investigations, learning together, the jigsaw approach, and team learning.

Furthermore, cooperative learning would be regarded as effective by Slabbert (1991b:76) if, among other things:

- Learners are able to challenge each other's ideas, which in turn improves the quality of learning;
- Learners experience different approaches to solving problems;
- When a learner's explanation of concepts to others becomes clearer and more meaningful to himself/herself;
- When the learner has acquired and perfected the art and skill of talking, listening, explaining, and, thinking with others;
- When the learner utilises the opportunity to both practise and refine the ability to grow in constructive communication within subject norms;
- When the learner utilises the opportunity to think constructively, is able to explain open-ended situations, makes conjectures and tests them; and
- When the learner is capable of successfully handling situations that are well beyond the capabilities of individuals at that developmental stage.

A cooperative strategy should be characterised by small groups which provide a forum in which all learners are at liberty to ask each other questions, discuss tentative ideas, commit errors in their process of learning, learn to listen to and accommodate others' ideas, offer positive, meaningful and constructive criticisms, summarise or paraphrase their discoveries in writing, mentor each other, share available resources, information and time, and so on. In cooperative learning, the role of the educator shifts from being the "… imparter of knowledge, maintainer of classroom control, and validator of thinking to help learners gain confidence in their own ability and the group's ability to work out problems, thus relying less upon the teacher as the only source of knowledge" (Drinkwater and Niewoudt 1999:37).

According to Fraser *et al.,* (1996:53); Slabbert (1991b and 1992c) and Gunter, Estes and Hasbrouck (1995:231-241) there are various types of cooperative strategies. The following constitute good examples of the methods of such strategies.

Jigsaw (II) cooperative strategy

The educator's role here is to assign heterogeneously grouped learners to study teams. In addition, the educator could assemble expert groups to mediate these study teams. The educator should critically evaluate and provide teams with due recognition. Cognisance should, however, be taken of the fact that the approach works perfectly only when learners are assigned narrative material to both read and learn. This method is crucial and effective in increasing learners' interdependency. Each team member is given a piece of information so that they can fit their individual pieces together as if they are working on a jigsaw puzzle. This approach encourages and guarantees the sharing of pieces of valuable information.

The team-games tournaments cooperative strategy

This approach is appropriate for mediating well-defined objectives with single right answers, such as mathematical computations and applications, language usage and mechanics, geography and map skills, and science concepts. When all learners have had an equal opportunity to study cooperatively, academic tournaments are staged in which learners compete for team points and recognition. The advantage of this approach is that "(t)ournaments offer a refreshing change of pace from normal class routines" (Gunter *et al.,* 1995:231).

The student-achievement division cooperative strategy

This approach is merely a substitution for the above-discussed strategy. In this approach, tournaments are replaced by quizzes and tests. This approach possesses the same components, advantages, form, objectives, et cetera as the previous strategy.

Team interview cooperative strategy

This approach is both useful and effective for what is known as getting-acquainted activities, such as a team-building activity, a method for checking reading comprehension, or a method of giving group reports.

For this method to be effective, the following steps should be followed Gunter *et al.,* (1995:231-241)

- Learners should be assigned to teams;
- Team members have to be instructed;
- The educator should conduct an interview;
- Continue interviews; and,
- Debrief.

Graffiti cooperative strategy

This approach requires learners to give written responses to questions posed by the educator. It is geared to checking the understanding of learners, to evaluating facilitation/learning mediation, or to doing an informal needs assessment.

The thinking pair, share cooperative strategy

This approach offers many benefits. It increases learners' participation and leads to a much improved retention of information. When using this method, "…(s)tudents learn from one another and try their idea in a non threatening context before making their ideas more public" (Gunter *et al.,* 1995:241). The learner's confidence improves significantly and all students, "…(r)ather than the few who usually volunteer, are given a way to participate in class".

The benefits for the educator include increased time being spent on tasks in the classroom and a greater quality in learners' positive contributions to class discussions. Learners and educators alike gain a much clearer understanding of the expectations regarding both attention and participation in the classroom discussions.

According to Van Der Horst and McDonald (1997:127), a cooperative strategy enables the learners to work "...(t)ogether in a group small enough that everyone can participate on a collective task that has been clearly defined, and without direct immediate supervision of a teacher." This strategy encompasses much more than group work. The cooperative tasks of this strategy determine and also enhance the active and full participation and real contribution of a learner, who is blind, to inclusive or special schools settings and the learning mediation of biology in an Outcomes-based Education classroom.

The strategy is also effective if it uses instructions such as "discuss, evaluate, mention, list, name, identify, analyse, explain". In order to ensure that this strategy is successful, the educators should create within their learning environments a true social system characterised by democratic procedures and scientific processes. In Van Der Horst and McDonald's (1997:128) view, the primary responsibility of educators making use of this strategy should be to engage learners in inquiry into important social and interpersonal problems.

According to Gunter *et al.*, (1995:231-241); Slabbert (1991b and 1992c); Van Der Horst and McDonald (1997:128) and Drinkwater and Niewoudt (1999 [s.p.]), the following are some of the advantages of a cooperative strategy:

1. It leads to more meaningful learning, and, more importantly, provides coping techniques for the educator, particularly one responsible for the large and crowded classes that are usual in the South African situation.
2. It encourages active involvement of learners in their learning mediation.
3. The spirit of sharing is enhanced and promoted.
4. All learners learn and develop confidence.
5. Learners are taught to accommodate others' differences.
6. The strategy maximises social interaction.
7. Learners provide academic help to one another.
8. The strategy encourages positive interdependence among the learner population.
9. The sharing and the development of leadership skills become the order of the day.
10. Learners develop and maintain accountability.
11. It improves communication skills.

The primary aim of cooperative learning is, therefore, "... an instructional design that stimulates peer interaction and learner to learner co-operation in the process of fostering successful learning by all" (Van Der Horst and McDonald 1997:128).

This strategy further aims at including and improving learners' understanding and skills in the various learning areas being taught, at helping learners to develop and be equipped with cooperative group skills, and at assisting them to gain from as well as to be aware of the different individuals and cultures prevalent in South African classrooms. According to Van Der Horst and McDonald (1997:128) the success of a cooperative learning strategy is determined and influenced by the following factors:

(a) Face-to-face interaction

It requires placing learners in close physical proximity to each other in order to complete the assigned task.

(b) A feeling of positive interdependence

This implies that learners should believe that each and every individual can achieve the particular learning outcome objective *only* if all the learners in a group achieve the same learning objective. In other words, if all are not successful, none of them is successful. Van Der Horst and McDonald (1997:128) described this factor as "...(s)wimming or sinking together."

Types of interdependence which an educator could strive to create include, but are not limited to: positive reward interdependence (a situation in which everyone is equally rewarded or no one is rewarded), positive resource interdependence (a situation in which all the members of a group have a specified task to accomplish), positive task interdependence (a situation in which a task is broken into a series of sub steps and is then completed in assembly-line fashion, with each group member completing only one section of the total task), positive role interdependence (the practice of assigning roles to individual group members, for example, a scribe, a presenter, a chairperson, and so on), positive identity interdependence (this is established by allowing the group to form its own identity by developing a group name, decorating a group folder or flag, developing a group motto, composing a mission statement or creating some other symbols in the form of a logo, coat of arms, colour, animal, plant, et cetera, that describes the group.

As far as these positive interdependence rewards are concerned, the blind learner may have a pivotal role to play. The blind learner might be given a task that suits his/her ability and might be in a position to complete it. He/she could report on, or chair, the group's meetings or collect specified information as long as it is available and accessible.

(c) Accountability

The feeling of each and every member of the group that s/he is both responsible and accountable for completing tasks individually, and cannot entirely depend on the efforts and contributions of the rest of the group, is called accountability. An accountable member always guards against fellow group members doing or completing tasks on his/her behalf. Van Der Horst and McDonald (1997:129) remarked that a "(f)eeling of individual accountability can be established in a variety of ways including assigning individual marks; giving individual tests, worksheets and quizzes; or structuring tasks so that they must be completed by the group while at the same time making it clear that the teacher will call on individual group members at random to ensure that each learner has attained the learning outcomes that were to be attained by completing the task." Educators should always value and appreciate learners' self-direction, which is one of the key points in cooperative learning.

The success and effectiveness of a cooperative learning strategy also depends on the learning mediation and acquisition of social skills by learners. Educators should make concentrated efforts to help and encourage learners develop the social skills which are necessary for them to function productively and effectively as accountable group members during cooperative learning activities.

In order for the group to effectively execute its tasks in a cooperative learning strategy, it should possess the following skills:

i. Forming skills (useful and crucial for getting groups up, accountable, running smoothly and effectively).

ii. Functioning skills (particularly aimed at controlling and monitoring the types of interactions that occur among group members).

iii. Formulating skills (composed of a set of behaviours which are instrumental for helping learners always to do their best as far as tasks are concerned, as well as to process materials mentally).

iv. Fermenting skills (constituted by a set of skills needed to resolve cognitive conflicts that arise within the group).

(d) Planning strategies

Pearse (1996:39) argued that learners with special education needs (LSEN) are often unable actively to plan how to solve problems themselves. More often, these learners tend to rely on a few familiar methods that they apply at random, or they simply guess. Therefore, it is advisable for educators to plan accordingly and make appropriate strategy adjustments to help them to be effective and successful. Together with the learners, they could decide on and adopt the most effective and successful strategies, during daily learning mediation activities.

(e) Thinking aloud

Blind learners would be comfortable with this strategy during biology classes. It would help them greatly in becoming aware of and realising the functioning of their own cognitive processes. This strategy improves, to a considerable extent, their problem-solving methods. Its effect may be evident when learners are grouped in pairs so that when one thinks aloud, the other checks for accuracy or correctness. It is effective in stimulating the ability to think positively and provides ample opportunities to find other solutions, rather than depending on one solution only. Pearse (1996:43) commented, "(t)he days when it was possible to hear a pin drop in the class have gone forever."

(f) Role-playing or modelling

When educators introduce the first step in a skill, they should try not to instruct learners about how to do it. They should rather demonstrate the step to them. By demonstrations, blind learners will gain a clearer picture of what the skill is all about. Demonstrations will help all learners to hear and better understand the procedures. If the learners fail to understand those steps to be followed or skills to be applied, the educator should perform them again and again. Learners should be taken through the various steps until they are competent and independent enough to do them on their own. When learners perform the skill, they should also verbalise it. When they have successfully completed the last step, they will have reached the stage where now they are ready to work independently.

(g) Learning mediation based on the objectives of the lesson

In this strategy, the educator should determine the scientific skill that learners are entitled to acquire and master. The educator could explain the skill, demonstrate it several times and then apply it in a way that gives appropriate practice for the particular skill. The beauty of this strategy is that it enables learners to transfer knowledge from one situation to the next. It is undoubtedly true that, by showing learners how new skills might be used, with different objectives, the educator promotes the learners' ability to apply the skills to different situations.

(h) The breaking up into phases of new work and concepts

This learning mediation strategy requires of all educators to determine the steps necessary for learning the given tasks. The determined steps might be taught individually. Pearse (1996:44) stated that "(m)ost learners, particularly LSEN, will learn more quickly and more thoroughly when they can absorb only small amounts at a time."

This strategy is useful in differentiating work in a class of learners with mixed abilities. It encourages and enables brighter learners to absorb material more quickly while, on the other hand, the slower learners are catered for in the sense that they are accommodated and are also more comfortable with small units and less difficult work. However, the educator should also ensure that learners understand the instructions and are both well prepared and ready to learn the following step/s. Moving too fast, before all learners have mastered the previous steps, impacts negatively on learners because they are unable to absorb new information, thus causing confusion and frustration on their part. Educators should always remember that this strategy is intended at helping learners to catch up with their class work.

Educators during learning mediation should integrate the previously learned steps with instruction concerning the new step. It is incumbent upon responsible educators constantly to make certain that the learners are fully aware of and understand the sequence of learning mediation. The advantage of doing this is that "(c)umulative reviews of mastered steps ensure the learners' retaining of those skills and understanding of their sequential relationship" (Pearse 1996:44).

(i) Reviewing strategy

This strategy is as important and effective as other strategies. This strategy encourages learners to take stock of and assess one another's ideas about the work being revised. Tools such as discussions, analysis and criticisms are employed. The strategy further encourages the learners to become active participants and good listeners, but most importantly, to stimulate and put to the test their own ideas. Blind learners would be comfortable with this strategy, as listening, to them, is one of the best ways to acquire new information.

A reviewing strategy should be supplemented by "feedback". Pearse (1996:44) states that "(b)y giving the learner the type of opportunity described above to explain what they have learned, you create a way of evaluating your teaching." Feedback allows the learners to emphasise to the educator the problems they have encountered during his/her learning mediation. The educator should allow and accept constructive criticisms and, as a result, the educator will hear about the problems which learners experienced in his/her presentation. This will enable the educator to obtain information on learners' specific problems and he/she will be able to modify the presentation of the learning mediation material in future.

4.11 ASSISTIVE DEVICES AND LEARNING MEDIATION AIDS FOR BLIND AND VISUALLY IMPAIRED LEARNERS

Blind learners use a wide variety of equipment or assistive devices to make learning mediation in inclusive settings easier, more accessible and more interesting. Assistive devices range from simple (low-tech) to complex (high-tech). Of late, blind learners use computers with speech synthesiser software packages together with a standard word processing programme, which make it possible for blind learners to type, read or edit their assignments exactly like their sighted peers. Learners, as well as students, who read Braille can print their assignments on Braille printers as well as standard printers so that both learners and educators can read them. Advanced computers have reading software and the blind learner can scan the text and thereafter read it independently.

Computers have several advantages for the blind learner. Laptops are good note taking equipment. Their only difficulty is keeping the battery charged. Some computer software allows electronic files to be converted into Braille.

Computers give blind learners access to print materials and enhance their competitive equality. Blind learner's access, acquire, read and edit materials independently and with competence. Most advantages have been discussed under 4.1.5.

Volunteer readers and class teacher aides are also useful in assisting blind learners to access and acquire information. Additional learning mediation assistive devices include, but are not limited to: Braille writers for producing Braille, slate and stylus (the oldest method for producing Braille), typewriters both manual and electronic, tape recorders, record players, science instruments, portable note-takers (a small device with a speech synthesiser, useful for taking notes or composing written information and printing it in Braille or print), specialised computers equipped with screen reading software and a speech synthesiser enabling the learner to listen to the information presented on the screen.

Assistive devices are useful and are very important in the learning mediation of learners who are blind. In instances where assistive devices are not available, educators should make use of other learning mediation aids so that blind learners can understand the lesson better. Pauw (1984a:61) maintained that "(s)ince the people are unable to see, the teacher must make abundant use of demonstrations and illustrations that involve the other senses."

Blind learners should continually, and as often as possible, be taken to the object/s of study so that they can touch the object/s, examine textures, shapes, sizes, patterns, and so forth. As a guideline for the proper use of assistive devices and learning mediation aids, the educator should discuss them with blind learners prior to and after the lesson with a view to "...(p)reparation and follow-up and rounding off" (Pauw 1984a:61). The use of assistive devices and learning mediation aids should be supplemented by oral and written work with the sole purpose of finding out whether blind learners have grasped the lesson or not.

Blind learners should not receive vague impressions but come into contact with new realities. It is advisable that all assistive devices and learning mediation aids used in classrooms and offices be demonstrated to blind learners by means of tactual examination. In other words, every new Mediate Learning Experience (MLE), which contains unfamiliar elements, should be accompanied by a proper introduction to these elements through the sense of touch. If it is appropriate and possible too, the other senses should also be stimulated and involved. Educators of blind learners often make good use of relief maps, embossed diagrams and scale models. To an extent, models to represent real objects could also be effectively used in order to give blind learners a better picture of what is being taught. However, models should be used with a degree of care.

Models never give to blind learners a satisfactory idea of the original. Their usefulness is limited. They compensate in a limited way for the fact that blind learners cannot make use of print pictures. They should only be used in instances where the real object/s is not available or is not easy to use. The disadvantage of model/s is that they only represent the form and proportions of the animal or plant but no other features such as character, nature, appearance and size. The major advantage of using models is that they give to blind learner's ample opportunities for observation, which lend reality value to their learning environment.

Perhaps as a solution, every special or inclusive education school should have a technical department for the design and manufacturing of models and other learning mediation aids for blind learners. Whether this is viable, remains to be seen. The biology educator should be responsible and accountable for constructive ideas, which might be derived from the actual requirements of orthodidactics for blind children. In schools' media centres there should be a room set aside to house models and other unique learning mediation aids and equipment for the education of blind learners.

4.12 THE IMPORTANCE OF EDUCATOR TRAINING IN ORDER TO EFFECTIVELY MEDIATE THE LEARNING OF BLIND LEARNERS

Learning mediation strategies for blind learners will be ineffective and meaningless if educators lack knowledge of the learners they are both responsible for and accountable to. Knowing and understanding blind learners, as learners with unique learning mediation needs, forms the basis of the success of any learning mediation encounter. Therefore, training, which does not impart the right learning mediation qualities for dealing with, and accommodating learners who are blind, will be directionless, unproductive and meaningless. Educators should be properly trained in order to work with learners who are blind and who happen to be demanding, so that these learners can be competent and productive, whether at special or at inclusive schools.

Bergh and Berkhout (1994:51) asserted that, "(t)here is a worldwide movement towards placing learners with special educational needs in the mainstream of education. In South Africa a large number of learners ... are experiencing learning problems, this necessitates that an ordinary teacher must deal with these problems in the mainstream classroom context."

As a matter of fact, many educators were not trained for this specific task. This is because of the fact that the education of handicapped learners was and still is regarded as being merely an extension of regular education, where a school manager or any member of the staff having the necessary experience, and/or specialised knowledge, might offer in-service training to those who had no training in special education. Therefore, according to Pauw (1984a:11), this practice compelled educators to "… rely mainly on their own intuition." The minority of educators who did receive appropriate training did not receive vigorous, intensive or adequate training.

Bergh and Berkhout (1994:51) argued that the curricula of the UK and USA were superior, compared to that of South Africa, and that to their dismay, the curriculum of South Africa for tertiary education as far as educator training for educators of learners with special education needs leaves much to be desired. In South Africa, as things are, educators in most instances are trained and prepared to guide learners when things go well, but not vice versa. In other words: when children are confronting problems they are not guided.

The major reason behind all these issues, is that educators were then not prepared, but are now still not prepared, during their training to deal with learners who have special education needs. As far back as 1976 efforts were made to emphasise the importance of educator-training for individuals who intended to educate learners with special educational needs: "... the South African authority laid down the following ordinance: 'Desired adaptations to training structures are made where these are deemed to be desirable, such as the inclusion of the subject orthopedagogics in all training courses in 1982 in order to enable teachers to identify learning problems among children'" (Booyse 1995:57).

Having skills to identify children with learning problems amounts to nothing if educators do not know how to accommodate them, adapt their learning mediation environment and effectively facilitate or mediate learning to them. A further suggestion is made by the researcher that relevant orthopedagogical aspects should also receive much attention in the Higher Diploma in Education as well as all other teacher training courses. It is argued by Booyse (1995:51) that strengthening and developing resources for special education in general should qualitatively transform the education of learners in the mainstream. This will create a greater capacity for the mainstreaming of individuals with special educational needs.

It is further argued that where mainstream education for people with special education needs is already taking place without the necessary recognition and support, urgent attention should be given to basic resources and support programmes. In South Africa, mainstream education is recognised and supported in theory. Basic resources and support programmes do not exist. Urgent attention should be given to special schools' problems, which could have an adverse effect on mainstream education, by our Government.

The educator training courses (certificates, diplomas and degrees) offered to educators should encompass and emphasise awareness of special education needs and promote an understanding of appropriate and effective learning mediation practices, which should be the cornerstone of all training programmes for South African educators. One major advantage of this kind of training is that it prepares and orientates student-educators towards the theoretical foundations of orthopedagogics and equips them with appropriate skills to identify, assist and accommodate learners with different kinds of problems.

In addition, such training should make educators knowledgeable in their fields. Furthermore, such educators should be both professionally and academically competent. These educators will therefore be in a strong position to know and understand both the historical background and the pedagogical principles on which the education of learners who are blind is based. Training indeed should make them aware of, and provide them with in-depth knowledge about, the psychological aspects of the development and education of learners who are blind. They should fully understand types of visual impairments and appropriate accommodations. They should be conversant with the implications of ophthalmological and medical treatment, the learning mediation process of the blind and specialised didactics, the importance of special apparatus and other appliances, the incidence, the nature and extent of the learning disability, the sociology of visual handicaps, learning mediation strategies, and so forth.

Other courses which would be of much significance for student-educators include psychology of education, didactics, subject didactics, assistive technology, Braille, orientation and mobility, strategies for mediating learning to blind learners, and the like. However, in South Africa, rehabilitation courses like O and M (Orientation and Mobility) , Braille, Independence Training, strategies for mediating learning to learners with a low incidence of disabilities, and so on, are not offered as part of educator training courses. As such, educators at either special or inclusive schools in certain instances do not know what to do in order to assist the blind learner. In addition, they never receive training in assistive technology for the blind. This is what makes special education as well as inclusion difficult; hence it does not deliver the goods expected of it.

Education for learners with special education needs is not esteemed highly because, according to Booyse (1995:57-58), "... the education of LSEN is a specialised form of education which is not compulsory for the subject teacher."

Specialised educator training would ensure that educators who will be involved with learners with special educational needs, such as the blind, are better qualified and better able to represent, develop and promote this specific branch of the learning mediation profession with much authority, improved and increased skills, and, above all, with confidence.

4.13 SUMMARY AND CONCLUSION

Learning mediation strategies for blind learners will only be effective and meaningful if educators are properly trained and are equipped with skills in assisting and mediating learning to blind learners at either special or inclusive schools. Educators should endeavour to follow the guidelines proposed in this chapter in order to make life sciences (biology) meaningful, realistic and worth learning by blind learners.

Educators should supplement learning mediation strategies with imagination, intelligent initiatives, dedication, devotion and determination in their quest to mediate learning to blind learners. Acknowledgement and approbation should here be given to Kent Cullers, a renowned blind physicist, who has achieved a distinguished career against all odds, and has given new hope and strong reasons to learn the sciences to blind learners following in his footsteps.

This physicist has been blind since birth and holds the position of a senior researcher at the Search for Extraterrestrial Intelligence Institute (SETI) in Mountain View, California. Some of his tasks include developing, evaluating and implementing complex algorithms that allow scientists to sift through radio signals originating from distant star systems. Furthermore, Cullers is also a great leader in the rarefied field of “envisioning” and “designing” advanced radio telescopes that scan wider and wider swathes of the skies. Cullers is the first blind student to earn a doctorate in physics in the United States of America.

Learning mediation strategies and the effective use of technology are capable of giving blind learners the opportunities and abilities to confront life sciences (biology) with much confidence. The *New York Times* [s.a.] [s.p.] argued that technology is one of the driving forces behind the advancement of greater independence for the blind. It further argued that even educators might not realise what greater things the technology could do, so it is not properly utilised yet. Blind learners have to be equipped with adapted learning resource material, specialised equipment and techniques to handle without fear graphics, illustrations, drawings, tables, computations, experiments, investigations, etc. Technology could undoubtedly help here. Biology educators and other education practitioners should inculcate into the minds of blind learners that both blindness and biology are small hurdles that can be overcome by effective planning, strategic, technical and intellectual leaps.

CHAPTER 5

SELECTION AND APPLICATION OF THE RESEARCH METHODOLOGY AND DATA COLLECTION STRATEGIES

5.1 INTRODUCTION

This chapter discusses the research methodology used during the collection of data. The chapter also describes the processes followed as a response to the specific aim and objectives of the study.

The collection of data for this investigation is based on qualitative data collection techniques and strategies. Emphasis is laid on the following aspects: the data collection techniques and strategies applied; content validation of inventories; the composition of the research sample and selection of the participants; data collection processes; the conducting of the individual and focus group interviews and the method of data analysis.

5.2 DATA COLLECTION TECHNIQUES AND STRATEGIES APPLIED

5.2.1 REASONS BEHIND THE CONDUCTING OF A QUALITATIVE INVESTIGATION

The researcher's intention to discover the opinions of blind learners and their educators prompted the selection of qualitative data collection techniques and strategies. The merit of this method of data collection is that it provides insight into the difficulties which blind learners experience during biology learning mediation. Qualitative data collection techniques and strategies are significant because they are interpretive and constructivist in nature and they shed much light on the learning mediation experiences of educators and learners. Quantitative methods would have shed less light than qualitative techniques, which have the capability of enhancing the researcher's tolerance of ambiguity, and his sensitivity, sound communication recording, empathy and listening skills.

The researcher distinguishes three distinct characteristics of qualitative data collection techniques and strategies which are significant in conducting research. They relate to the researcher as an instrument, as a data collector and as a data processor. Quantitative methods are not characterised by the features discussed above. Quantitative methods take positivist and traditional stances. Further, these methods are deductive and predictive in approach, thus causing them to rely on experimental designs and statistical correlations. Qualitative data collection techniques and strategies, however, are frequently inductive in their approach, implying that they are naturalistic and that their significance can be derived from in-depth study of very few cases.

Regarding quantitative methods, Smit (2001:56) argued that their assumptions about the world are based on a logical positivist philosophy. This implies that social evidence is a single objective reality which is separated from the feelings and beliefs of individuals. He added that qualitative research is based on a naturalistic phenomenological philosophy. It is assumed that realities are socially constructed by the individual and by society.

Quantitative investigation methods establish relationships that are important for explaining causes. These are what Smit refers to as "measured social facts". In contrast, the purpose of qualitative data collection techniques and strategies is to acquire an understanding of the social phenomenon from participants/ respondents themselves.

Through employing quantitative methods, the researcher tests hypotheses, while in qualitative data collection techniques and strategies, hypotheses are generated. Through quantitative methods, researchers search for causal determination, predictions and generalisations of anticipated findings. Qualitative researchers strive for enlightenment concerning, and a better understanding of, researched issues.

Quantitative data gathering methods and processes are uncompromising because there are set steps and procedures for guiding the researcher. The researcher has to abide by them. In qualitative data collection, techniques and strategies, processes, steps and procedures enjoy greater flexibility.

Quantitative data collection techniques and strategies detach the researcher from reality while qualitative data collection techniques and strategies encourage positive interaction between the researcher and participants. Qualitative data collection techniques and strategies are important for the development of context-bound generalisations, unlike quantitative data collection techniques and strategies, which are successful in the development of universal context-free generalisations. Pertaining to qualitative data collection techniques and strategies, the researcher's values and principles guide and shape his research conclusions. What makes this possible is the fact that the researcher himself or herself constructs the reality of the inquiry.

There are also two other reasons that should be listed: Blind and visually impaired learners would have found it very difficult to work through quantitative questionnaires independently without the help of an assistant. The limited number of teachers working in the field also made the use of quantitative techniques less significant.

Owing to these factors, the researcher decided primarily to use qualitative data collection techniques and strategies. Focus groups and interviews with educators and learners comprised the primary data collection strategy.

5.2.2 FOCUS GROUP INTERVIEWS

Cohen, Manion and Morrison (2001:267) define the term "interview" as "...(a)n interchange of views between two or more people on a topic of mutual interest, (which) sees the centrality of human interaction for knowledge production and emphasizes the social situatedness for research data."

By conducting focus group interviews, which are different from one-on-one interviews, the researcher sought to obtain an understanding of the problems experienced by educators and blind learners during the mediation of life science related subjects. The data collection technique or strategy is user-friendly. It allows the researcher to assess problems, concerns, new products, programmes or ideas by interviewing a purposefully sampled group of people rather than each person individually.

McMillan and Schumacher (2001:455) and Cohen, Manion and Morrison *(*2000:288), considered the following as advantages of focus group interviews:

- Interviews create a social environment in which group members are stimulated by the perceptions and ideas of each other;
- The perceptions and ideas of different people increase the quality and richness of data;
- The more the group interacts, the higher the quality of data and outcomes;
- The strength of the group lies in focusing on a particular issue, therefore yielding insight that might not have been available in a straightforward interview;
- Focus group interviews are economical as regards time because they produce a large amount of data in a short period of time.

The researcher used the semi-structured interview method at nine schools (four in Gauteng Province and five in Limpopo Province), discussed thoroughly later in this work (resulting in a total number of 17 educators and 104 learners interviewed). In total, the respondents (educators and learners) numbered 121. The researcher deduced that the largest group of learners was in the GET Band, followed by those in the FET Band.

Based on the advantages alluded to above, the researcher believes that the interview mode of data collection was ideal for this research because of the following factors:

- It is unrestrictive. Therefore, it allowed the researcher to make use of supplementary modes of data collection.
- Through it, one gains large amounts of information quickly.
- The researcher obtains a wide variety of information from a large number of subjects.
- It enables and enhances immediate follow-up questions and any necessary clarification.
- The researcher (interviewer) and participant (interviewee) always agree on follow-up interview sessions should the need arise.
- An interview that is supplemented by other modes of data collection (such as direct observation) allows the researcher to check and verify the descriptions given against other facts.
- It accords the researcher opportunities to describe and analyse the situation, event or process.

- Finally, the research methodology is successful because of its simple stages/phases of data collection, which comprise searching, collecting data, observing, interviewing and interpreting. It is flexible, thus enabling the researcher to adjust strategies as he hears or sees unexpected data, which he then wishes to use in future.

5.2.3 DIRECT OBSERVATION

The researcher also used direct observation (at one school in Gauteng Province and another in Limpopo Province) as another method for collecting data. Direct observation was important because it focused on the structure of the lesson and the determination of common and uncommon activities. Cohen, Manion and Morrison (2001:305) maintain that observational data are attractive because they afford the researcher the opportunity to gather "live" data from "live" situations. The researcher is further given the opportunity to look at what is taking place in situ, rather than relying on secondary resources. This enables the researcher to understand the context of the programmes, to be open-ended and inductive, to see things that may otherwise be unconsciously missed, to discover factors that participants may not freely talk about in interview situations, to move beyond perceptions-based data (e.g. opinions in interviews), and to access personal knowledge. The researcher used a sighted observer to observe on his behalf because he could not technically observe, owing to his blindness. He used her notes and verbal explanations to be in touch with what was happening during various activities.

Dyer (1979:158) argued that direct observations are ethically effective in situations where the researcher wishes to study specific aspects of human behaviour. In this instance, for example, the researcher wished to observe, know and understand the specific techniques and practices blind learners use during the learning mediation of biology and other life sciences subjects. Direct observations paid attention to the way educators explained certain things to learners, the techniques they used during learning mediation, how they created learning and observation opportunities for their blind learners, and so forth. It was decided to take photos because the main purpose was to reveal very effective techniques and practices where outcomes were being achieved, or unsuccessful techniques or practices where outcomes were not being achieved. The purpose of using the tape recorder and the videotape was to capture valuable "auditory and visual" information from educators, lessons and focus groups for analysis or synthesis of data. The interview schedule or inventory for educators and focus groups was based on the National Curriculum Statement and Science Process Skills and in particular on the learning outcomes and assessment standards for Grade 12.

5.2.4 FOLLOW-UP TELEPHONE INTERVIEWS

It was necessary for the researcher to conduct a follow-up interview to crosscheck respondents' responses and comments recorded during the individual and focus group interviews. Comments and responses were interpreted and taken into consideration when data was analysed. However there were still a number of issues that remained unclear to the researcher and needed crosschecking in terms of his interpretation of the observations against respondents' personal opinions.

5.2.5 THE USE OF QUESTIONNAIRES OR INVENTORIES IN THE COLLECTION OF DATA

Questionnaires and inventories are useful in collecting data since they mark "...(a) move away from seeing human subjects as simply manipulable and data as somehow external to individuals and towards regarding knowledge as generated between humans, often through conversations" (Cohen, Manion and Morrison 2001:267). Through questionnaires and inventories, people exchange views on a topic of mutual interest; therefore, their interaction enhances a sense of social situatedness. According to the researcher, social interaction is essential in any learning situation, but especially in a situation involving the blind because interaction will accord them opportunities to communicate and access information verbally. The purpose of using the semi-structured questionnaire in a qualitative research was to help the researcher as well as to protect him from deviating too much from issues investigated.

5.3 INTERVIEW SCHEDULES

5.3.1 SCHEDULING OF INTERVIEWS AND RELATED ACTIVITIES

Because the Department of Education granted the researcher only two months to conduct his research at schools for the blind, interviews took place during the period September and October 2003. Follow-up interviews with educators were conducted telephonically on 17 September 2004 to verify the researcher's observations and interpretations. Follow-up interviews focused specifically on questions listed under 5.3.2 (c). Educators and focus groups were free either to participate or not to participate.

Prior to the interviews, the researcher's role was that of:

- Preparing the interview schedule or inventory;
- Suggesting and scheduling dates for interviews;
- Notifying, in good time, participants (educators and focus groups) about interview dates;
- Confirming with principals the availability of participants during interview sessions;
- Furthermore, the researcher negotiated in advance with principals of targeted schools regarding suitable, quiet places for conducting interviews.

Before the commencement of the interview, the researcher:

- Checked the recording equipment so as to be aware of its current condition;
- Gave a short explanation of the purpose/aim of the project and some general guidelines for the interview process.

During the interview, the researcher:

- Facilitated interview sessions as a means to avoid lack of direction;
- Triggered responses by asking direct and follow-up questions;
- Monitored the sighted observer and the photographer to ensure that they met the objectives of the interviews and investigation;

- Finally, the researcher transcribed recorded information into Braille and compiled a report based on the participants' responses.

5.3.2 THE CONTENT VALIDATION OF THE INVENTORIES

Mouton (2001:108) maintained that "(d)ata come in different formats and have different properties: ..." Interview schedules or inventories, direct observations, notes, focus groups, educators, audiotapes, videotapes, questionnaires and photos were all not only methods but also techniques of triangulation. This was a way to verify or falsify the data collected. Furthermore, the research's trustworthiness lies in the fact that the researcher provided evidence that is reliable in terms of the resources in which the data were collected. The findings of this research provided a foundation to work from in the improvement of the facilitation/learning mediation of biology for blind learners in the Outcomes-based Education and Training classroom. Mohlala (1994:37) argued that qualitative inquiries should attempt to establish the "…(t)ruth value of the study, its applicability, its consistency, and its neutrality."

The research continued to search for the "truths" stated in the Department of Educations National Curriculum Statement Grade 10-12 (schools) Biology Life Sciences Draft (2002:3) that education has the ability to "(i)mprove the quality of life of all citizens and free the potential of each person." It further sought to establish whether everyone (blind learners included), actually has "…(t)he right to further education which the State through reasonable measures, must make progressively available and accessible"

White Paper 6 of the Department of Education (2001:30) argued that, "(c)entral to the accommodation of diversity in our schools, … is a flexible … assessment policy that is accessible to all learners, irrespective of the nature of their learning needs." White Paper 6 attributes the problem of possible inaccessibility to the fact that the curricula "…(c)reate the most significant barrier to learning and exclusion for many learners …."

Because the researcher is blind, he recognises that he might have been subjective when interpreting or analysing visual data explained to him by a sighted assistant and therefore might have biased the research. There is a possibility that certain questions might also have been biased by what the researcher wanted to find. What accords this work reliability, however, is that the participants themselves made some of the recommendations.

5.3.3 INTERVIEW SCHEDULE OR INVENTORY FOR EDUCATORS

Even though it does not appear to be a normal practice for researchers to explain and justify the content validation of any measuring instrument that is to be used in a qualitative investigation, the researcher, in this regard, is compelled by circumstances to explain and justify the content validation of the measuring instrument used. The researcher does so in order to give a good indication of the reasons why a number of questions were selected. The fact that the researcher did not follow the normal practice does not mean that the researcher is not aware of the fact that only measuring instruments used in quantitative investigations have to be content validated.

To justify why these questions were used in triggering responses from participants as well as acquiring valuable data, reasons and questions are listed in the following paragraphs.

Learning outcome 1: Scientific investigation

The first eight questions are based on learning outcome 1, where learners who have attained this outcome are able to confidently explore and investigate natural phenomena relevant to the life sciences by using an inquiry process, and communication skills. National Curriculum Statement Grade 10-12 (schools) Biology Life Science Draft, (2002:10) stated that, "(w)hile learners use process skills to investigate, reflect, analyse, synthesise and communicate, they study life, the environment and technology."

1. What type of simple tests and surveys do you do with your blind learners?
2. What do you do as an educator to give your blind learners an opportunity/opportunities to distinguish between similarities and differences?
3. Are you acquainted with science process skills?
4. Can you give me examples of how you go about applying the following science process skills in the mediation of biology to blind learners when they have to:
    i. Measure the distance from one object to another;
    ii. The mass;
    iii. Growth; and
    iv. Change in shape?
5. How do you create a capacity in learners in order for them to observe biology phenomena?
6. Can you explain to me what you do to give blind learners the opportunity to record data correctly?
7. What techniques and skills do you apply to make tabulation to blind learners possible?
8. What learning mediation strategies have you developed to achieve the science process skills discussed previously?

Learning outcome 2: Constructing science knowledge

Three questions (questions 9-11) are based on this learning outcome. Learners who have successfully attained this outcome are able to construct, interpret and apply scientific, technological and environmental concepts to explain natural phenomena relevant to life sciences. Life sciences further entails the construction of scientific knowledge from what learners already know, through collecting information and experiences from the world around them and linking this with their previous experiences (recognition of prior learning).

It is indicated in the Department of Educations National Curriculum Statement Grade 10-12 (schools) Biology Life Science Draft (2002:11) that collecting information and experiences involves using inquiry and the thinking process to interpret, apply and extend learners' understanding of concepts, principles, laws, theories and/or models. The same document further argued that when learners share experiences they reach

"... a common understanding, and the individual makes sense of how life, environmental and technological phenomena are bound together."

1. Which methods and sources do you use to access information in unfamiliar and complex settings?
2. What do you do to give blind learners an opportunity to describe and explain concepts, principles, laws, theories and models in unfamiliar and complex settings?
3. What are the strategies you apply in the classroom to give blind learners opportunities to accumulate information for investigation purposes?

Learning outcome 3: Science, society and environment

One question is based on this outcome. Learners who have attained this outcome are expected to demonstrate an understanding of products created from the interrelationship of science, technology, indigenous knowledge, the environment and society. Learners are further expected to identify the aforementioned links and comprehend what they accurately mean.

1. What do you do as an educator in learning mediation to give the learners the opportunity to predict outcomes of a certain intervention?

Learning outcome 4: Science, society, attitudes and values

Both the penultimate and the last questions are based on this learning outcome. According to this outcome, learners who have attained it are able to demonstrate an understanding of ethics, of biases and of the contested nature of changes in knowledge in the life sciences. This outcome further raises the learner's awareness of the existence of the different viewpoints of individuals in a multicultural society. The Mentioned National Curriculum Statement Grade 10-12 (schools) Biology Life Science Draft (2002:12) stated that learners, through this outcome, are equipped with skills to plan investigations, conduct, collect and manipulate data, analyse and synthesise data, explain patterns, etc.

1. Do you as an educator find blind learners being capable of easily designing and analyzing life science programmes?
2. What are the strategies and techniques you apply in the classroom to give blind learners the opportunity to express or reflect on the mediation in the science process skills?

5.3.4 INTERVIEW SCHEDULE OR INVENTORY FOR LEARNERS

All questions in this section were formulated based on the outcomes discussed in the previous section.

1. What type of simple tests and surveys do you conduct as blind learners?
2. Are you acquainted with science process skills?
3. Can you give me examples of how you go about?
   - i. Measuring the distance from one object to another;
   - ii. Measuring the mass;

iii. Measuring the growth;
iv. Measuring change in the shape.

4. Do you undertake scientific excursions or field trips?
5. Are opportunities created for you to observe biology phenomena?
6. Can you explain to me how you go about plotting and recording the data correctly?
7. What techniques and skills do you apply when you are required to make tabulations?
8. How do you go about interpreting the collected data?
9. Can you describe and explain concepts, principles, laws, theories and models in unfamiliar and complex settings?
10. How are you exposed to similarities and differences?
11. What are the strategies you apply in the classroom to create opportunities for yourselves to accumulate information for investigation purposes?
12. What does your educator do to create opportunities for you to predict outcomes of a certain intervention?
13. How simple or difficult is it for you as blind learners to analyse, synthesise, hypothesise, design, interpret and evaluate the life sciences programme?
14. What is correctly or incorrectly done during learning mediation in the classroom?
15. Which methods and sources do you use to access information in unfamiliar and complex settings?

5.3.5 FOLLOW-UP INTERVIEW

As a supplement to the initial questionnaire, the researcher conducted a follow-up telephone interview on 17 September 2004 to crosscheck educators' responses.

This verification was prompted by educators' responses and comments, recorded during the individual and focus group interviews, which were interpreted and taken into consideration when the data was analysed. However, a number of issues remained unclear to the researcher and he had to crosscheck his interpretation of the observations against respondents' personal opinions. The researcher interviewed the same number of respondents during follow-up interviews.

Below is the list of questions that he used to verify his observations.

- Drawing remains a problem to blind learners and in my investigation I discovered that learners are given "ready made drawings" and not taught how to draw. Is it therefore sensible for the blind learner to draw objects and observations, and if not what other activities are there to supplement a loss in drawing ability? How often do you use tactile diagrams and do learners have the capacity to draw and interpret tactile diagrams? Do you have equipment to produce tactile diagrams?

- My observation is that many educators engage their blind learners very seldom in practical work, field trips or related activities. This observation was supported by some educators and by some learners participating in the focus group interviews. What is your opinion regarding this statement or observation? If you would take your whole year's activities into consideration, what would you regard as the ratio between theoretical work and practical work in the teaching of the life sciences to blind learners?

- I got the impression when I looked at the practical activities blind learners were involved in, that the activities were limited to very simple and elementary exercises that called for very little minimal intellectual challenges or advanced problem solving skills. How would you respond to such an observation? Does it carry weight and if so, what would be the main reasons for such an observation?

- When I spoke to the learners I got the impression that very few of them had access to subject-related information, with specific reference to computers, encyclopedias and recent publications. However, when I spoke to the educators many of them indicated that such information systems were available to their learners at all times. Learners also complained that the information in Braille was outdated and limited. How would you respond to these observations? Do you actually facilitate the use of additional information technology systems or do you assume that the learners will access such systems independently?

- Many educators indicated that they adapt the traditional facilitation strategies (such as demonstrations) to enhance learning for the blind learners. The learners on the other hand indicated that many of the activities relied heavily on "tell and talk" activities. Could you please indicate to me through the use of good examples how you actually go about adapting the traditional strategies? If you would argue that it remains the main task of the educators to engage blind learners in "tell and talk" activities instead of engaging them through adapted strategies, please feel free in confirming or rejecting this observation.

- Do you know of any workshops or have you ever been invited to workshops where the development of adapted learning facilitation strategies was shared with educators?

- It was not clear to me whether at your school blind and partially sighted learners were sharing the same classroom. What is the situation at your school? How is it then possible for learners to follow a co-operative learning strategy when all learners are blind? How are responsibilities shared?

- I got the impression that not much is done by educators to stimulate and develop the senses of blind learners during the teaching of the life sciences. How would you respond to this observation?

5.4 THE COMPOSITION OF THE RESEARCH SAMPLE AND SELECTION OF PARTICIPANTS

5.4.1 TYPE OF SAMPLING

(a) SOUTH AFRICAN SCHOOLS FOR, OR WITH SECTIONS FOR, THE BLIND

There are 20 schools for/with sections for the blind in South Africa, as illustrated in the following table:

PROVINCE	NAME OF THE SCHOOL	NUMBER OF SCHOOLS PER PROVINCE
Eastern Cape	Efata School for the Blind & Deaf Zamokuhle Senior Secondary School Khanyisa School for the Blind	03
Western Cape	Athlone School for the Blind Pioneer School	02
Northern Cape	Re-Tlameleng School	01
KwaZulu-Natal	Arthur Blaxall School Ethembeni School	02
Free State	Thiboloha School for the Blind and Deaf Bartimea School for the Blind and Deaf	02
Gauteng	Filadelfia Secondary School Prinshof School Sebonile School S'Nethemba Learning Centre (former Katlehong school)	04
Limpopo	Bosele School for the Deaf & Blind Letaba School for the Handicapped Siloe School Setotolwane Secondary School Tshilidzini School for Special Education	05
Mpumalanga	Silindokuhle School	01

Before one decides on the type of sampling to be used, he/she has to be guided by what the appropriate sample size should be, depending on the purpose of the study, the nature of the study and the population under scrutiny, the number of variables researchers set out to investigate in their analysis and the types of statistical tests that they wish to carry out. All these factors, as stated by Cohen, Manion and Morrison (2001:93), should inform researchers' decisions about sampling sizes prior to the research undertaking.

For this study, the researcher chose convenience sampling, often called accidental or opportunity sampling. It involves the choosing of the nearest individuals to serve as respondents and continuing the process until the required size has been obtained. Cohen *et al.,* (2001:102) remarked, "(t)he researcher simply chooses the sample from those to whom she has easy access." Because of financial constraints and the long distances, which the researcher avoided covering when visiting schools for the blind, he chose nine schools in Gauteng and Limpopo provinces (four and five respectively) because he has easy access to them**.**

Furthermore, to supplement the criteria discussed above regarding sampling, the researcher used the criteria discussed below when choosing participants:

- Whether educators merely offered life science subjects or specialised in life science subjects.
- Whether learners followed the science stream at their respective school.
- In addition, learners were chosen according to their degree of blindness, which in this instance is defined as 100% blindness or light projection, meaning that vision does not play any significant role during the learning mediation of biology or elsewhere.
- Whether participants would be accessible to the researcher.

- Participants had to express some ideas about how to alleviate some of the educational problems of blind learners in South Africa.

5.4.2 POPULATION FROM WHICH THE SAMPLE WAS DRAWN

The population for this study was drawn from the following:

- Experienced interviewer/s;
- Nine focus groups totalling 104 learners; of these 104 learners 44 are from Gauteng and 60 from Limpopo.
- Of these 9 educators (4 Gauteng and 5 from Limpopo) Nine educators from nine schools for the blind (note: although the educators who were interviewed were 17 in number, the profiles included in this study are only of those who were directly involved with the mediation of science related subjects/learning areas. Hence, only nine profiles appear in this work. The profiles that have been omitted are of those educators who have merely shown interest and are not directly mediating biology to blind learners).

The following table illustrates the profiles of educators who participated in this study.

RESPONDENT	QUALIFICATION	GENDER
R1	B.Ed. and Diploma in Science and Mathematics	Male
R2	Senior Teachers Diploma	Female
R3	Primary Teachers Diploma	Female
R4	Senior Teachers Diploma	Male
R5	Primary Teachers Certificate	Male
R6	Primary Teachers Diploma	Male
R7	Primary Teachers Diploma	Female
R8	Senior Teachers Diploma	Male
R9	B.Ed.	Female

5.5 DATA COLLECTION PROCESSES AND THE APPLICATION OF THE FOCUS GROUP

Before one discusses the processes and procedures followed in the collection of data, the phrase "*focus group*" and its importance has to be clarified. McMillan and Schumacher (2001:455) defined a focus group as: "(a) … strategy for obtaining a better understanding of a problem or an assessment of a problem, concern, new product, program or idea by interviewing a purposefully sampled group of people rather than each person individually. By creating a social environment in which group members are stimulated by the perceptions and ideas of each other, one can increase the quality and richness of data through a more efficient strategy than a one-to-one interview."

The researcher intended to stimulate particular discussions on given themes or topics through facilitating interactions, so that these interactions could lead to the acquisition of valuable data and to effective outcomes. In addition, the researcher envisaged a strategy capable of yielding insights that might have not otherwise been available in a straightforward interview.

Written permission, with guidelines for conducting the research, was obtained from the National Department of Education. Letters of permission are contained in the appendix. The aims of the research were explained to the Department of Education. During each interview, the same aims were again explained to educators and learners (focus groups).

Though photos were taken during this exercise, the only intention was to reveal very successful techniques and practices where outcomes were being achieved, and also unsuccessful techniques and practices. The headmaster compiled a list of individual learners in order to seek permission from their parents to use their children's photographs in this work. No names of participants were mentioned in this research. Cohen *et al.,* (2001:61) argued that: "…(t)he obligation to protect the anonymity of research and to keep research data confidential is all-inclusive. It should be fulfilled at all costs unless arrangements to the contrary are made with the participants in advance. The essence of anonymity is that information provided by participants should in no way reveal their identity. Where this situation holds, participants' privacy is guaranteed, no matter how personal or sensitive the information is."

Audio and videotapes were destroyed after the analysis of the data. All developed photos and negatives were destroyed except for those that have been used in this work to strengthen its arguments. Participants' faces appearing on the photos used were blocked out to guarantee their anonymity.

During the process of accumulating information, the researcher was also concerned about how well informed the participants in this study were about what they were getting themselves into; that is, the mediation of biology to blind learners in an Outcomes-based Education and Training classroom. Secondly, he was concerned about their perceptions regarding the activities and goals of the research.

5.6 METHOD FOR ANALYSING DATA

Ary, Jacobs and Razavieh (2002:465) pointed out that: "(t)he final activities in qualitative inquiries are analyzing and interpreting the data collected and presenting the results. … data analysis is the heart of qualitative research and the process that most distinguishes qualitative from quantitative research." This is the most significant process for researchers. They systematically search, re-search, arrange and rearrange the data in order to comprehend the data clearly, so that they can present what they have learned to others. The process is intended to guarantee that field notes, interviews, transcripts, audiotapes, observer comments and other data are put into a readable form ready for analysis. To achieve the expected outcomes, notes, photos, audio and videotapes were analysed or interpreted. From the observations and findings, recommendations were made.

Data analysis involves coding, which authors such as Bogdan and Biklen (1992:166); McMillan and Schumacher (2001:467); and Ary *et al.,* (2002:466) refer to as coding, classifications, topics or categories. McMillan and Schumacher (2001:467) defined coding as "… the process of dividing into parts by a classification system."

According to McMillan and Schumacher (2001:467), researchers develop a classification system through the use of one of the following three strategies:

- Segmenting the data into units of content called topics (less than 25-30) and grouping the topics in larger clusters to form categories; or
- Starting with predetermined categories of no more than 4-6 and breaking each category into smaller subcategories; or
- Combining the strategies, using some predetermined categories and adding discovered new categories.

Ary *et al.*, (2002:466) maintained that coding enables the researcher to "…(p)hysically separate material bearing on a given topic from other material and is a crucial step in organizing the data." According to Bogdan and Biklen (1992:166), in order for the researcher to develop each coding category, he/she has to search through his/her data for the regularities, patterns and topics his/her data covers, and then write down words and phrases to represent the topics and patterns perceived. "These words and patterns are coding categories. They are a means of sorting the descriptive data … collected so that the material bearing on a given topic can be physically separated from other data."

The reason why the researcher, who is blind, decided to do the coding of the described information in the text and did not list it as a separate unit in the appendix is that it would have been very difficult for him to have worked across different documents (sections) and built his syntheses into a separate chapter.

In this study, the researcher has used the constant comparative method because it combines inductive category coding with simultaneous comparison of all units of meaning obtained. The researcher's role was to examine each new unit of meaning (topics or concepts) and to determine its distinctive features.

5.7 SUMMARY AND CONCLUSION

Aspects outlined at the beginning of the chapter were discussed. The researcher contends that qualitative data collection techniques and strategies are effective in facilitating and uncovering the intricate phenomena hidden in data, in an investigative way.

Qualitative data collection techniques and strategies enabled the researcher to describe educators' and focus groups' understanding and experiences of the learning mediation of biology. The researcher presented a logical argument as to why qualitative data collection techniques and strategies were the tools preferred over quantitative data collection techniques and strategies.

The researcher is positive that the data analysis proved to be a fundamental act of the research process because it made it possible for the researcher to make sense of the investigation, to interpret and theorise the acquired data. During the process itself, the researcher played an instrumental part in organising, describing and synthesising data, once he had read all the acquired data by means of careful Braille transcripts, divided data into meaningful and logical units, constructed and refined categories, and so on. The researcher strove to reflect respondents' perceptions. After the completion of the interviews, the researcher had in his possession approximately 9 hours of audio-taped information. The analysis was done to ensure that the significance of the data could be perceived.

The following chapter will provide a detailed report on and discuss the empirical investigation. Answers will be furnished to questions raised in some of the subsections of this chapter.

CHAPTER 6

DATA PRESENTATION AND RESULTS OF THE EMPIRICAL INVESTIGATION

6.1 INTRODUCTION

In the previous chapter, the author reviewed the data processing procedure and provided a description of the data techniques and strategies, which he used in data gathering. This chapter discusses the data analysis, based on learning outcomes as appearing on the Revised National Curriculum Statement (Grade 10-12 schools) for biology (life sciences), to consider whether they are achievable by blind learners or not.

The following aspects: descriptive data analysis; educators and learners' profile; interpretation of findings; and the interview questions are discussed.

The chapter deals with the significance of the analysis and its implications. **The chapter further provides important patterns regarding themes based on four biology-learning outcomes, as indicated in the previous chapter, namely:**

- Scientific investigation;
- Constructing science knowledge;
- Science, society and the environment; and
- Science, society, attitudes and values (these were all discussed in chapter 5).

In instances where the actual words of respondents are quoted, they are presented in italic type. Data analysis and interpretations regarding problems experienced by educators and learners in the learning mediation of biology are presented below. Sub-themes are discussed independently, though some questions are treated together in order to make them more significant, coherent and extensive.

6.2 THE LEARNING OUTCOMES PRESCRIBED FOR THE TEACHING OF BIOLOGY GRADE 10-12

The following is an illustration of themes and sub-themes in these outcomes:

SCIENTIFIC INVESTIGATION	CONSTRUCTING SCIENCE KNOWLEDGE	SCIENCE, SOCIETY AND THE ENVIRONMENT	SCIENCE, SOCIETY, ATTITUDES AND VALUES
The conduction of simple tests and surveys Opportunities for distinguishing similarities and differences Acquaintance with, awareness of and application of science process skills during mediation and/or observation Data recording processes and procedures Tabulation skills and techniques Learning mediation strategies	Acquisition of information Investigation strategies Strategies for describing and explaining biology phenomena	Prediction of outcomes Data analysis skills	Expressions and reflections

The main themes highlighted above are also pertinent as far as the focus groups are concerned. Therefore, they will not be mentioned to avoid repetition.

The sub themes for the focus groups are:

- The conduction of simple tests and surveys;
- Scientific educational trips/excursions;
- Acquaintance with, awareness of and application of science process skills during mediation and/or observation;
- Data recording processes and procedures;
- Tabulation skills and techniques;
- Data analysis skills;
- Opportunities for distinguishing similarities and differences;
- Information acquisition during investigation;
- Prediction of outcomes;
- Analysis of programmes;
- Correct and incorrect activities done by educators during learning mediation; and
- Methods and sources of accumulating data.

6.3 DESCRIPTIVE DATA ANALYSIS

6.3.1 BIOGRAPHICAL DATA ANALYSIS

Written permission was sought and granted by the national Department of Education (Inclusive Education Sub-directorate) to the researcher to carry out his empirical investigation at 12 schools for the blind or with sections for the blind (grades 7-12). This permitted the researcher to visit four schools in Gauteng Province, five in Limpopo Province, and one school in each of the Free State, Kwazulu-Natal and Western Cape provinces. Empirical investigation was actually only conducted at nine schools (four in Gauteng Province and five in Limpopo Province) due to the financial constraints the researcher experienced. Two schools offer grades 1-12, two offer grades 8-12, one school offers grades 1-9, while four offer grades 1-7.

6.3.2 EDUCATORS AND LEARNERS' PROFILES

It was indicated in the previous chapter that 17 educators were interviewed because they offered life sciences or they showed an interest in the research itself. One educator refused to be interviewed on the basis that his/her principal did not inform him/her and colleagues in time about the expected date for the interview and that the objectives of the research were unclear. Of 17 educators interviewed, nine were females while eight were males.

104 learners from nine schools were interviewed. Equal numbers of both boys and girls were interviewed.

6.4 DISCUSSION BASED ON INTERVIEW SESSIONS

This section comprises responses given by respondents (educators and focus groups), and relates the findings arrived at as a result of the interviews. The researcher will comment on the quality of the evidence gathered. The implications of these findings will be further explored and relevant recommendations made for further research and development, or for a clear science policy that would address the needs of blind learners.

6.4.1 FEEDBACK AND REPORT ON THE INTERVIEWS

Prior to the conducting of interviews, respondents' fears (educators and learners) were allayed by spelling out the intentions of the study. It was made clear to all respondents that the study was not intended either to assess the quality of education or to find out how much learners knew. The study was designed to look at what they would like to see put in place, at their concerns and at how their needs would be met in future. Learners were advised and requested not to use their real names but rather the grades they represented.

Educators and learners were interviewed separately. Therefore, the first section below will pay attention to educators' responses and the latter part to learners' responses in order to avoid confusion.

6.4.2 FEEDBACK AND REPORT ON THE INTERVIEWS WITH EDUCATORS

This section attempted to establish educators' views on the concerns and challenges regarding the mediation of life sciences to blind learners. The researcher made use of the interview technique because the population interviewed was small and because of the additional reasons given in chapter five. He heeded Rambuda's advice (2002:196-197) that the face-to-face interview is the most effective way of enlisting the cooperation of the participants in a survey because rapport can be easily established. Furthermore, one is able to clarify the meaning of the questions to the respondent and follow up on unclear and incomplete answers. In the interviews, the researcher could pursue all the matters of interest.

Learning outcome 1: SCIENTIFIC INVESTIGATION
The first six questions are based on learning outcome 1: scientific investigation.

<u>The conduction of simple tests and surveys</u>

The first question considered the types of simple tests and surveys, which educators carry out with their blind learners. There is good evidence (both positive and negative) from transcripts, data sources such as photos, and triangulation suggesting that at a few schools simple experiments and surveys were conducted while at the rest of the schools such tests and experiments were not carried out. Please see photo 1.

Photo 1: Apparatus used for the sweet/sour taste experiment.

Photo 1 illustrates the different apparatus used by respondent 1 during the day of the visit to illustrate how a simple experiment could be conducted by blind and partially sighted learners in the biology classroom. This is a classical experiment that could be classified as a 'simple experiment' based on the fact that the experiment is reasonably simple to conduct and also holds very few dangers or hazards to the learners.

The purpose of this experiment was to give learners the opportunity to distinguish between the different taste areas located on the tongue. Harmless chemicals such as a sugar and salt solution, lemon juice and aloe sap were selected by the educator in the investigation. The worksheet used during the investigation is clearly visible on the first photo. On this worksheet the partially sighted learners had to report where the different taste areas were located on the tongue when touched by an ear bud dipped in one of the different solutions.

Photo 1: Apparatus used for the sweet/sour taste experiment

Good evidence supported the idea that certain educators lacked competences and skills to accommodate blind learners during the learning mediation of science. Those educators did not improvise. There is also solid evidence to suggest that blind learners relied on theory and not on good scientific practices only.

One respondent during the follow-up interview stated the following words, *"So the experiment like if they have to do an experiment of, of soil mixing it with water so that we can see types, the different types of soil. It is a very easy experiment but basically they won't be able to see it. Do you get the point, so I have to do an extra explanation that this soil have larger particles. So in a way try to teach them with the aim that they should also use their imagination you can take them to try and feel the soil the different types of soil but doing that experiment practically like I do it with the blind learners is not going to, is not going to help them. You understand, but the only thing that you can do you can take them to feel that soil, the different textures of soil if they … some of them are totally blind, they haven't seen, you understand the only thing that you can do you can take them and try to make them feel the texture of different kinds of soil."*

Another respondent in the same follow-up interview said the following, *"The practical observation? Yes, you see it I in fact a bit of a drawback for a blind learner say for instance we do linear programming like that they don't normally get the whole picture because it is very visual and there are certain things that I normally can't even try and I try to teach them the basic principles because is part of the art and the end of the matric exam so they must just be able to concentrate on certain things but it is really impossible for me to say for instance explain to them the different areas that we use to apply to a linear programming and the stuff like that. So I don't but do concentrate on certain basic principles that they gonna need to answer some of those questions but really ask them to get the whole picture and interpret … a specific problem is very difficult."*

Based on sound evidence, the author argues that, access to the learning mediation of biology including experimentation and exploration is limited. This supports the argument that the learning mediation of biology depends on one's visual ability, thus making it difficult for blind learners to access information through visual observation. The first Working Session on the National Working Group on Curriculum Adaptation (2003:16) stated that, "(o)bserving is a good means for gathering information. Traditionally 'observing' has meant that learners watch what the educator is doing and then copy or model the same. A learner-centred approach to observation would require that learners are expected to analyse their observation …"

Lack of visual ability deprives blind learners of the enjoyment and the advantage of observation. Borg (1987:157-158) indicated that observational processes are essential in enabling individuals to collect direct information. This means that blind learners are deprived of opportunities to study specific aspects because they cannot observe.

This deprivation causes blind learners to be less competitive during biology learning mediation. Blind learners will only be able to be competitive when they are fully exposed to all biology phenomena. Nagel and Stobbs (2003:47) argued that, "…(b)enchmarking against the regular curriculum is extremely important because we've got to foot it with this competitive world that we live in. Like it, or not. And if you want a job you have to compete, you have to be there, you have to develop skills and talents. Part of this is having the ability to know and to deal with others, and to live in the real world. You have to learn to take the knocks and have the ability to deal with prejudices."

The researcher argues that sciences have many advantages for blind learners: for example, their understanding is broadened; many career opportunities (including but not limited to physiotherapists, science educators, biologists, researchers, and the like) are also possible for blind learners. Evidence shows that even if blind learners are not able to observe experiments visually, they still benefit from explanations given by partially sighted classmates and educators. One respondent (R1) argued that, *"yes experiments are done (E.1). Specifically with practicals, because of their complexities and challenges (P.1) that they may pose to blind learners, we encourage teamwork between blind and partially sighted learners so that they could assist one another (T.1)."* All learners are involved in the recording of results as well as the interpretation thereof. For evidence of this, please see photo 2.

Photo 2: Co-operation between learners sharing information when conducting a common experiment.

Noticeable on the second photo (photo 2) is the sharing of information between learners who are visually impaired. Both learners were requested to perform the experiment by stimulating the taste buds with different solutions while the partially sighted learner had to record the information on the worksheet. This became common practice in most cases where partially sighted and blind learners shared the same workstation. The partially sighted learners posed the questions to the blind learners and the answers to the questions were then recorded by the partially sighted learners on the spaces provided on the work sheet.

Photo 2: Co-operation between learners sharing information when conducting a common experiment.

Some educators expressed frustrations regarding experiments since most of their learners need visual ability to perform and observe. Hence, educators resorted to the teamwork approach (pairing blind and partially sighted learners together) so that the partially sighted learners could supply blind learners with visual experiences. This practice is known as cooperative learning, teamwork, group work, collaborative learning, and the like. What complicates the matter is that some schools do not have equipment, such as beakers, cylinders, talking thermometers, barometers, voltmeters, talking liquid jugs, talking balances and other apparatus, to do experiments.

However, Luebbe 2002:52-53) considered observation to imply more than seeing with the naked eye. She noted, “ i have also recently encountered a teaching professional prepared to deny my entrance into a degree-completion program because I could not see. She concluded that I would be unable to complete the observation portion of the program. I questioned this instructor, pointing out that a sighted person might see something, but without the knowledge and intelligence to understand and interpret what was observed, the exercise would be worthless. On the other hand, the situation being observed could be described to someone with experience, knowledge, and intelligence; and that person could explain and assess it effectively. Observation is not just seeing; it is listening, asking questions, and understanding what is going on around you.”

The unavailability of adapted equipment impacts negatively on the experiences of learners because they only carry out activities theoretically. Some educators feel stretched to the limit because of the lack of equipment to perform experiments. High expectations placed on them (those of mediating learning in all circumstances) are challenging and difficult.

A respondent (R2) stated the following words in frustration: *“Oh! Well. Even if I would like to conduct experiments with my learners, my hands are tied because I do not have even basic equipment like beakers and so forth to do experiments (E.2).”*

Another respondent (R5), supporting the previous view, highlighted the following: *“Experiments in biology are very core (E.3). However, the problem with experiments is that, more often than not, we run short of equipment (E.2). When you deal with blind learners, experiments are even more problematic (E.4). For instance, when you ask blind learners to go and collect the earthworm, in order to know and understand its habitat, they cannot do it on their own (E.4.1). Unavailability or limited resources (E.2) lowers the standard of mediation or that of performing experiments (E.2.1).”*

Another educator (R3) expressed himself as follows: *“With the blind learners we do not do experiments (E.4.2) as we are supposed to do for instance if one needs to separate dissolved substances one has to boil the solution. Instead I give them the background because they will not be able to observe visually (MS.1)”*. This has become a serious problem experienced by many educators, namely the fact that blind learners find it difficult to observe the actual experiment or practical procedures and for these reasons are excluded from further participation. What is experienced here is a classical move away from the practical work to be done in life science education to the verbal explanation of procedures and activities.

One respondent during the follow-up interview stated, *"… physical science is difficult for me … what more about blind people."* Another respondent argued, *"Imm, … in my school … we have field trips with learners. And especially because I'm offering Maths and Science we do involve them a lot. Yes. … let say we are doing distances we have the meter wheels where they do measure their class… they do that. … in our case they do go to the kitchen if it is a practical lesson, …I would say theory is 60% and practical is 40%, ja, this my … observation …"*

Since the bulk of experiments have to be observed visually, respondents felt that they were not blind-friendly. Because of these and other frustrations, one realises that there is a noticeable lack of creative ideas and practices amongst educators of blind learners.

This lack could be attributed to the following factors:

- Educators lack skills to adapt experiments in such a manner that they will accommodate blind learners;
- Experienced educators conversant with the didactics of mediating learning to the blind are retired or occupy senior positions and, as such, do not share their experiences with the current educator generation;
- Educators no longer undergo training in order to be skilled or re-skilled;
- Some educators go to class unprepared and for the first time stumble across experiments and other aspects during the learning mediation activity;
- Some educators believe in technologically adapted learning mediation material/aids; hence they do not try their God-given talents of adapting them by hand, because they continually put the blame on poor resources or on the Government, which did not supply them with material.

Special Education Report (2001:5) argued that educators trying to assist blind learners were worried that the budget shortfall was hurting their mission of teaching and learning. Educators believed that what they did was a public service and, therefore, "…(d)on't believe it's appropriate to be treated in a different manner than other public schools."

The researcher also noticed that some educators had excellent ideas/plans but did not set themselves deadlines to allow those plans/ideas to materialise. Youth Information Guide (2003:74) advised that "(w)hen you have decided on an idea that suits you and that sounds good, you need to draw up a plan."

One also gained the impression that some educators who joined schools for the blind had never thought about the extra things they would have to execute due to the learners' barriers/challenges, calling for, at times, different mediation styles and techniques, accommodation strategies, materials, et cetera. When educators consider becoming part of the staff of a school for the blind, they "…(n)eed to think carefully."

They need to ask themselves sets of questions and must talk about these issues with friends or older persons they fully trust. It is suggested: "(a)sk yourself: What interests me? What are my skills and talents?"

The researcher believes that educators need to ask themselves how efficient they, and the services they and other service providers render to blind learners, are. They need to ask themselves what else is needed and to list all the things they have to put in place, as a priority, to improve the learning mediation situation. They need to ask themselves whether they are capable of producing, say in the absence of tactual learning mediation aids, substitutes that would be better and relevant. Finally, they need to ask themselves whether they will have sufficient energy and dedication should they be employed at schools for the blind.

Opportunities for distinguishing similarities and differences

The second question involves what educators do to give their blind learners opportunities to distinguish between similarities and differences. There is evidence from the data collected and analysed suggesting that blind learners in South African schools for the blind are given opportunities to distinguish between similarities and differences.

In supporting this argument, one respondent (R1) stated, *"When you work with blind learners, use concrete things (MS.2) to show them similarities and differences and avoid abstract things like light and darkness, black and white, beautiful and ugly (MS.3)."*

It is believed that "(p)ersons with visual impairments have been one of the most difficult populations to accommodate …" (Butler, Crudden, Sansing and LeJeune 2002:166). These authors then argued that for the trend to be reduced, it is "…(i)mperative that barriers … be resolved."

Another respondent (R2) stated that, *"Experience has taught me over the years that deep stuff does not work (MS.3) well with blind learners when you talk about similarities and differences. Say, you want to teach them about black and white, refer to the colour black to a coal and the colour white to an ice cube (MS.2)."*

Another respondent (R3) shared his views by indicating the following: *"We should create opportunities for learners to distinguish similarities and differences based on the background these learners come from (MS.4). It is obvious that learners who became blind at a later stage are more experienced when coming to the issue of similarities and differences. When educators expose blind learners to similarities and differences, they have to take their condition into consideration. Comparison and contrast in instances where one has to show them similarities and differences, are significant strategies that one should employ. Blind learners can understand if educators compare 'white' with snow, 'green' with green grass, 'blue' with the sky even if they will never see it visually (MS.2)."*

Basically, biology concepts indicating similarities and differences are used. For example, during an activity that the researcher observed, which concerned respiration and photosynthesis, the educator indicated similarities and differences there. What the educator did not forget was to inculcate in learners information about ordinary and exceptional features of parts, organisms, processes, etc.

The respondent (R4) explained as follows: *"Basically biology concepts (MS.5) indicating similarities and differences are used. For example when one is mediating learning about respiration and photosynthesis, there are similarities and differences there. What one should always bear in mind is to inculcate and introduce to learners ordinary (MS.5) and exceptional features (MS.6) of parts, organisms, processes, etc."*

In addition, educators relied on description and explanation of aspects to blind learners. To support this argument, one educator (R5) elaborated: *"When I describe and explain (MS.1) things to them, they see common and uncommon features. That is how I teach them similarities and differences (MS.1)."*

Description is one of the characteristics of the "telling and talking" method. It was emphasised by educators that one cannot avoid it. One respondent said: *"ahh, I'll say that, … we teachers use the tell and talk ehh, … you cannot avoid it of course …"*

Another respondent said: *"ja, although I don't fully agree with that statement, look the traditional approach was about the teacher giving all the information to the learner and the teacher being the only source of knowledge so we are seldom applying that somewhere somehow we do apply that maybe you find that they have got nothing no background they don't have any concept on that subject that you might be delivering but now we are approaching the outcomes-based one that one is where the teacher becomes the facilitator although we know that we all not doing that at the same level same degree but the approach is different altogether, the approach is like the learners can, I'm making an example with that one, you just give them an example … a topic and you let them to interact you trying to get from them how much they know about the problem, explore the concept with them when they come up without the understanding of what they know …"*

The researcher further discovered that most educators relied on concepts used in everyday life. Examples given above and the following argument bear testimony to this point. One respondent (R6) indicated: *"Concepts (MS.2) such as similarities and differences are used in everyday life (MS.7). What I do, I reinforce it by making use of both concrete (MS.2) and abstract examples (MS.8)."*

Another respondent (R7) added: *"When I teach them about these concepts, I try to be practical (P) than to be theoretical (T). Give blind objects, real things, etc. if it is possible (MS.2). The concepts will be well cemented in their brains."* The researcher supports this idea by emphasising the fact that by touching objects, materials and apparatus, the thought processes are stimulated and learning is enhanced.

Another respondent (R8) cautioned: *"Never underestimate blind learners' intelligence (I). Some understand these concepts far much better than sighted learners (LR.1). If that is the case, build on what they know and understand (MS.4). You will be surprised how they even explain abstract things to you (LR.2)."*

Certain advantages of creating opportunities for blind learners to distinguish between similarities and differences were mentioned. If similarities and differences can be observed tactually, learners have immediate access to information. In addition, learners' ability to describe and explain is enhanced.

However, there is also evidence contradicting the former argument. For example, although a lot of information can be tactually accessed, there are instances where vision plays a critical role. If you have to show learners that spiders have blue blood and not red blood, learners will just rely on theory and not on the reality.

Acquaintance with, awareness of and application of science process skills during mediation and/or observation

The third, fourth and fifth questions based on learning outcome 1 are jointly discussed since they relate to each other, and the information gained from them, for purposes of logic and relevance, should not be isolated. The third question involves whether educators were acquainted with science process skills and goes hand in hand with the fourth question, which asks where educators apply these process skills in the mediation of biology to blind learners, as well as how they create opportunities for blind learners to observe biology phenomena.

Before the researcher puts the views of respondents on paper, we should understand what science process skills comprise, as well as their importance. Halliday, Resnick and Walker (2001:2) maintained that "(p)hysics is based on measurement. We discover physics by learning how to measure the quantities that are involved in physics. Among these quantities are length, time, mass, temperature, pressure, and electric current. The unit is a unique name we assign to measures of that quantity - for example, meter (m) for the quantity length."

In addition, the Department of Physics Laboratory Manual (2003:4) maintained that "(e)very measurement of a physical quantity must be expressed in the applicable SI unit. The SI-system is based on the meter (m) as the unit of length, the kilogram (kg) as unit of mass and the second (s) as the unit of time. It then follows that although measurements in an experiment should be given in the units of the instrument, it is necessary to convert these units to SI units before they are used in calculations."

The data collected and analysed in this study supports the argument that educators are acquainted with science process skills. There is good evidence to suggest that some schools were well resourced with learning mediation aids, including talking thermometers, talking scales, metre sticks/wheels, and so on, while on the other hand other schools possessed virtually no learning mediation aids.

Regarding the issue of whether educators were acquainted with science process skills (SPS) one respondent's (R1) reaction was: *"Of course, I am acquainted with science process skills (SPS.1). Remember, I have 30 years teaching experience. I therefore, know what science process skills are. With regard to what one does when teaching blind learners to measure the distance, the mass, the growth and change in shapes, that is foundation phase work (SPS.2.1). Obviously, we cannot work in millimetres."*

Another respondent (R2) supported the argument as follows: *"I am acquainted with science process skills (SPS.1). Because I do not have equipment (E.2), one uses bottles and other containers if we measure liquids (E.5)."*

A viewpoint worth noting was given by another respondent (R3), who showed the importance of improvisation (E.6). S/he was of the opinion that: *"With shapes, as a teacher, one has to improvise (E.6). One can take a paper and cut it into different sizes and shapes that is, circles, squares, triangles, rectangles, etc. For instance, one can associate or compare a circle with money coins. A circle and a coin are both round. When measuring (SPS.3), of course blind learners cannot measure long distances (SPS.3.1). With short distances of course they can. They are encouraged to use rulers. Regrettably, here at our institution, we do not have adapted apparatuses which blind learners can make use of (E.7). Blind learners cannot observe visually (O.1). But, to compensate or complement what they cannot observe visually, through the sense of smell, touch, hear, feel (O2), prior to that, we prompt them as well as to give them background information (MS.1) so that they can come up with their own predictions, or analysis of the data. For instance, when I teach them about combustion, they know that some gases will be released. However, the intricacy lies in testing the released gases. As a solution to the problem, I encourage my learners to do group work (T). If the class comprises blind learners only, I bombard them with lot of information (MS.1). Clues and cues that I give them, help them in scrutinising the information (MS.1.1)"*.

The researcher gained the impression that where educators did not equip learners with those skills, the latter were given a lot of information to compensate for what they had missed practically. One respondent during the follow-up interview stated that, *"the 'tell and talk' method that you are referring to is the order of the day, …"* Other respondents put the blame on Outcomes-based Education and Training. In describing his predicament, one respondent (R4) stated: *"I am acquainted with science process skills (SPS.1). The advent of Outcomes-based Education has made matters worse (MS.9). It encourages learners to be active participants (MS.10). In the absence of adapted equipment (E.7), how can they measure or observe?"*

Smit (2001:114) argued that lack of resources, especially when the curriculum is changed, brings about desperation. Many teachers cannot keep up, and simply have little or no personal time left; in fact, there appears never to be enough time to implement something new in detail.

Empirical data revealed that in most instances, blind learners struggle with observations (O). One respondent (R5) alluded to this issue as follows: *"I am acquainted with science process skills (SPS.1) and I know that blind learners have to also be equipped with them. In biology for instance, I expect them to measure the presence of chlorophyll in the plant (SPS.3.2). However, lack of appropriate devices deprives them this opportunity (E.7). It is also difficult for my learners to observe (O.1). Observation entails seeing from the start till the process ends. For the blind, I give them a verbal explanation (MS.1) and surely, that is not observation."*

Because blind learners are not involved in observation, as indicated above, educators resorted to question-and-answer sessions supplemented by explanations. To support this argument, please see photo 3.

Photo 3: Blind and visually impaired learners participating in a classical 'question-and-answer' session

Photo 3 reflects the classical problem and strategy so often applied to the teaching of blind and visually impaired learners. In this specific classroom situation, learners are subjected to a number of questions and have to respond to the questions individually. As explained by one of the respondents who participated in the investigation, one has to bombard the learners with information and the only way to determine whether they understood the work, would be to pose questions to the different sections of the work dealt with by the educator. One of the problems with this approach is that it might restrict intellectual development especially when the focus is on the recall of information only.

The view that observation means practical or physical involvement is also shared by the writers of the Department of Physics Laboratory Manual (2003:1), when arguing that "(e)xperimental observations form the basis of physics. Thus an acquaintance with experimental work is essential."

Because of the difficult conditions and situations educators have to negotiate during observations and experiments, some lose their sense of achievement and accomplishment. Smit (2001:142) argued that lack of appropriate resources and lack of materials worsen the possibilities of sound implementation in the classroom. The researcher concurs with Smit's argument and believes in addition that a lack of resources, materials, creativity and innovativeness, jeopardises opportunities of reaching the desired effect/s in the learning mediation of biology, in terms of outcomes to be achieved. Therefore, something needs to be done to reverse these unfavourable learning mediation conditions and situations.

For the most part, the learning mediation of biology is prone to some debate, particularly concerning observation, mediation strategies, resources, creativeness, innovativeness, and the like. Consequently, if educators are not creative, they are defeating one of the objectives of Outcomes-based Education and Training, which is to eliminate rote learning and promote critical thinking and creative teaching.

Feelings of ineffectiveness, hopelessness, discouragement and/or incompetence in educators may bring about ineffectiveness in practical adaptations (e.g. of experiments). On the other hand, if educators find themselves in supportive work conditions, they gain a sense of achievement and accomplishment.

One respondent (R6), who was in this kind of position, emphasised this argument by stating: *"The availability of adapted learning mediation aids at our institution drastically reduces the need for dependence on both educators and partially sighted learners by blind learners and that these learning mediation aids solve problems encountered in the past caused by lack of resources (E.8). Furthermore, learning mediation aids give blind learners confidence and a sense of self-reliance (E.8.1). With these aids, blind learners can participate in learning mediation freely (E.8.2). Blind learners who have access to the learning mediation aids have an urge over those who do not have them at school. They comprehend things better and they become active during the learning mediation of science (E.8.3)."*

Another respondent (R7) added: *"Should our schools be resourced, blind learners will practically and theoretically be equipped with science process skills (E.2.2). In addition, observations will be possible and meaningful to them."*

This implies that educators can facilitate learning in a poor learning mediation environment. Please see photo 4.

Photo 4: Teaching in a poor learning environment

Photo 4 gives the reader a clear understanding of one of the concerns raised by many of the respondents who participated in this investigation. Many respondents argued that most of the schools were poorly resourced and that little trouble was taken by the educators to stimulate learners through the enrichment of the learning environment of the blind and partially sighted learners. Most classrooms experienced few or no tactile teaching media and in few of the classrooms visited, models, diagrammes or even photographs were used in support of classroom learning. This photo is further proof of the lack of sensory stimulation occurring in many of our classrooms.

Another respondent (R8) replied: *"We have limited resources (E.9). With the little we have, we try our best to make science process skills known to blind learners. Regarding observations, we are still behind from developed countries. I guess we should learn from them (O.3)."*

The unavailability of resources in the form of laboratory equipment, classroom equipment and library equipment obliges blind learners to depend on friends, educators, relatives, and others. Corn and

Rosenblum (2002:9) warned that the existence of such restrictions "…(t)acitly marks the beginning of what might be a dependency career."

Data recording processes and procedures

Relating to the fifth question, what educators do to give blind learners the opportunity to record data correctly, the evidence is encouraging.

The evidence of successful data recording becomes visible when educators inculcate in learners a sense of cooperation and assistance. One respondent (R1) argued: *"I as an educator, in instances where my class comprises totally blind and partially sighted learners, I encourage partially sighted learners to take the readings and blind learners to record those readings on their own (T.1). They then work out the readings and arrive at possible conclusions. Unfortunately, that is the only way to do this (E.6.1) as we do not have apparatuses to take the reading (E.7)s."*

Another respondent during a follow-up interview indicated that combining blind and partially sighted learners does have advantages. *"… those who are partially sighted can help those ones who are blind who cannot see and so they are doing that to help each other."*

The researcher also noticed that respondents used different strategies to encourage blind learners to record data.

The following strategies were listed during the interviews the researcher conducted with the different respondents:

- Telling blind learners the salient points; in turn they transcribe them into Braille using their Braille writers.
- Going all over the process again and checking mistakes in order to fill the information gaps.
- Dictating notes to them.
- Handing-out prepared Braille notes, and so on.

Stressing the point that blind learners can record data, another respondent (R4) argued that: *"Blind learners do not find it difficult to record data correctly (R.1). In order to encourage a proper recording of data, one has to combine blind learners with partially sighted learners (T.1). This is to say, during experiments the partially sighted learners will observe visually, describe all the proceedings to the blind learners and the blind learners would record the data in Braille and later, interpret it."*

The researcher is of the view that if team work is advantageous to blind learners as far as experiments and data recording are concerned, then the practice is appropriate. He therefore suggests that because teamwork is advantageous to blind learners during these situations, the practice should be pursued. This normally happened during the course of the research when the groups were small and the grouping per se had not been based on educational arguments. However, the researcher has also observed that in other special schools for the blind, the blind learners and the partially sighted learners are separated.

According to educators, allocating separate classrooms to blind and partially sighted learners has its advantages too. Supporting this statement, one respondent during a follow-up interview stated, *"… most of the blind ones are disadvantaged because … we write it on the board or some diagrams we do them on the chalkboard …"*

Another respondent said, *"Oh, the disadvantages obviously will be that they can be neglected sometimes especially when the partially sighted are demanding and you can't get time to present to them because for instance now say I've got a grade 10 mathematics class here then I've got only one blind but the others are sighted …."*

<u>Tabulation skills and techniques</u>

The sixth question relates to the techniques and skills educators apply to help or make it possible for blind learners to carry out tabulation on their own. Regarding tabulation skills, only a few respondents were enthusiastic, while the majority felt stressed and expressed their concerns about the difficulties they experience when trying to make such skills meaningful for and possible to blind learners. There is strong evidence supporting the argument that the making of tables is difficult for blind learners.

One respondent (R1) responded as follows: *"Drawings (MS.11) are an inherent part of mathematics and physics: whether the educator presents them to the learner or whether the blind learner has to make them. This poses a problem in mathematics and science even though such problems could be resolved by opting for the use of technology (T). Educators could employ the zytec method whereby diagrams and drawings are generated by a computer programme such as CorelDraw, printed and then photocopied onto Zytec micro-capsule paper (also called swell paper). It is then put through a "Zytec" machine', which raises the drawn lines. Some of the advantages of this method are: educators are able to create drawings for immediate use instead of having them done by producers in some centralised places; Braille characters could be included in graphic material (MS.12) for labelling, etc.*

"Disadvantages include: the Zytec copying machine and paper as they are imported, are very expensive (T.1.1). This technology makes it hard to have the graphic material included as part of the textbook. Braille produced on Zytec paper tends to smudge, making it more difficult to read. The technology does not enhance blind learners' independence when making graphs. Over the years, I have realised that an effective means of teaching blind learners to make their own drawings is to use the drawing set available from the Depot at the SA National Council for the Blind, designed to draw on Braille paper (MS.13).

"At our school for instance, in mathematics, blind learners are taught to plot the critical points, of which the co-ordinates were calculated previously, onto a pre-printed axis-page by means of pushpins. The pushpins are then connected by an elastic band and the elastic band followed with a pen or pencil. Then, the drawing is removed from the drawing board, entered into a Braillewriter and the co-ordinates then written in Braille onto the pages. With a little practice, blind learners are able to feel the rut (groove), which was made by the pen when the curve was drawn. However, certain sections for mathematics

concerning linear programming are very difficult since several straight lines could be necessary to complete the drawing.

"In physical science the main area where learners have to draw, concerns vector physics. As far as this is concerned, blind learners are taught how to use a Braille ruler, Braille protractor and triangle, and again how to use pushpins and elastic bands to produce straight lines. At a very young age as possible blind learners should have a good grounding which would be essential by the time they need to manipulate such tools."

Another respondent (R4) argued as follows: *"I don't expect blind learners to make tables on their own as they are complicated. I give my learners ready-made tables (MS.1.2) and ask questions based on the tables handed to learners (MS.15)."* This respondent believed it was difficult for blind learners to make tables. If possible, and time permitting, he made tables for them. The malfunctioning of their thermoform machine was letting him down because he could no longer give them ready-made tables. Since this problem had occurred, his learners' lives had become even more dejected.

Regarding the ability to make drawings by blind learners, one respondent during the follow-up interview said, *"Okay, right I'm gonna answer that one in two ways, the first well sometimes it does not make sense to actually engage them in drawings normally in some cases we all go for an alternative …"*

Another respondent said, *"Well, in case of drawing ja, … blind learners are not drawing … The challenge here is that there are no mechanisms that we can employ to draw; we do not have the equipments that we can use also."*

These observations and concerns of the researcher are supported in the literature. Kashmer, Gupta, Geiger and Weaver (1999:2) emphasised the fact that it is a challenge to mediate learning to blind learners in science, mathematics, engineering and technology. They argued that "(o)ne of the greatest challenges to the visually impaired student in science and mathematics disciplines is reading and writing complex mathematical equations or having convenient access to information based tools such as the World Wide Web ."

The above authors added that the lack of quality academic access for blind learners is particularly felt in the study of SMET (Science, Mathematics, Engineering and Technology) "…(b)ecause of the difficulty in rendering technical material accessible. Consequently, there is a strong need to provide quality to SMET subjects for students with visual impairment. Another concern is student-to-teacher communication since few of the SMET faculty know anything about Braille and other alternate media. Mathematics access must be two-way. The visually impaired student must be provided with quality tactile materials in a timely manner as well as produce correct print output for a sighted instructor."

In addition, one respondent (R7) argued that he/she was still new in the field of blindness (HR.1). Maybe he/she would discover ways and means to make blind learners do tables. He added that everything is possible if one tries hard.

Trying hard always should bring about equal educational experiences for blind learners and this is very important. In order for one to attempt one's best in ensuring quality education for blind learners. Charles and Yewpick Lee (2003:84) advised that "(a)s these children are devoid of visual experiences, the teachers and other personnel involved in serving them should understand the techniques of providing the best possible experiences to optimise their learning. It is in this context that efforts are needed at all levels to improve the capacity of teachers and other personnel working with children with visual impairment."

The fact that blind learners are not taught tabulation skills brings out an even more fundamental shortcoming. This particular shortcoming (lack of creativeness and innovativeness) depicts qualities that are missing in educators, such as those of being researchers, sources of knowledge, scholars, et cetera, because if they possessed these qualities, they could have seen, heard or read about ways of accommodating blind learners in mediating tabulation skills.

Learning mediation strategies for blind and visually impaired learners

The seventh question addresses the learning mediation strategies educators have developed to inculcate the science process skills. There is good evidence that some respondents have developed particular strategies which are necessary for the acquisition and application of science process skills. However, there is also anecdotal evidence that other respondents have not developed such strategies.

Comments to support the first point came from one respondent (R1), who shared positive sentiments as follows: *"The fact that blind learners are taught to plot critical points (LR.3) of which the co-ordinates were calculated previously, onto a pre-printed axis-page by means of pushpins which are then connected by an elastic band followed with a pen or pencil proves that there are strategies that some of us have developed. For instance, I cut the two-litre bottle into halves, quarters and eighths (E.5), which blind learners use to fill the uncut two litre, bottle up (LR.4.1). That gives the blind learners an idea or experience of how long it takes to fill a two-litre bottle with halves, quarters and eighth sizes (SPS.3.3)."*

As alluded to earlier, evidence of lack of creativeness and innovativeness amongst educators is visible in tangible results such as frustrations, incompetence with regard to adaptations, and the like. The problem is further complicated by the lack of communication, networking and support from other "sister schools" for the blind. Schools seem to solve learning mediation problems independently or in isolation.

Though some educators have not developed new strategies, they do improvise according to situations and conditions. The other group of respondents comprises those who lack particular skills and techniques to mediate learning to blind learners. They only improve what is already existing.

One gains the impression that respondents exhibit decreased productivity. Decreased or poor productivity can be attributed to one or more of the following factors: poor mediation quality, lack of creativeness and innovativeness, little care, and so forth. Statements coming from one respondent (R6) like: *"No! No! No. I have not developed any particular skills and techniques to teach blind learners"*, give one the impression that he is not prepared to walk the extra mile in accommodating blind learners (E.6.2). This is what Smit (2001) calls an "I am not going to do more than what I have to do, attitude."

This type of attitude is normally displayed by educators who do not want to embrace changes with vigour and a willingness to give such changes a chance to prove themselves and, if necessary, to modify them. Educators need to understand that "(h)andling involves the interaction and proactive response of … professionals. When change is occurring around you, look at the issues, examine their impact on others, and get involved. Even if you cannot prevent the adaptation of new ideas, you can affect your ability to use those changes as an opportunity to learn and grow" (Beedles and Robert 2003:52).

Other reasons why educators cannot improvise might be the fact that they do not attend workshops for special education, where new learning mediation techniques could be shared with them. During the follow-up interview, it was revealed that they are not invited to such activities. One respondent stated, *"Not invited at all, we have never been to any … most things we get are for the normal people only and not blind people."*

Another respondent added, *"Particularly, you mean for the blind learners, not necessarily but there are educators from our school who attend such workshops but they come back and share that with us."*

Most educators receive specialised training at the South African National Council for the Blind. Such training initiatives are made possible by donor funds, but such workshops are not conducted regularly because of financial problems. One respondent indicated that he attended one workshop as follows: *"Oh, well … you see we attended that one you were there as well last year at the blind conference and Mrs Viljoen went to Holland few years ago and she came back with a book on adaptations that can be made. … in my learning area I had to do everything on my own well you more or less sometimes develop a sense to know how to adapt things for the blind.*"

LEARNING OUTCOME 2: CONSTRUCTING SCIENCE KNOWLEDGE.

<u>Acquisition of information during investigations</u>

Question eight concerns the methods and sources educators use to access information in unfamiliar and complex settings. Evidence gathered and analysed shows that respondents use a wide range of methods and sources to obtain information in such settings.

It is illustrated in the empirical data that textbooks, magazines, periodicals, co-workers, newspapers, radio, television and scientific videotapes, experts, the environment itself, the internet, computers with text-to-speech software, science conferences, symposia, and seminars comprise most of the respondents' sources of information.

One respondent (R4) indicated that he could log on to the Internet and acquire as much information as he needed (KA.1): *"Personally I use the computer with text-to-speech software. Therefore I can log on to the*

Internet (KA.1) and acquire as much information as I need. What I am appealing for is that blind learners should also have access to computers (TEC.1.2).”

He urges that blind learners should have unlimited access to computers, which are a valuable source of information. This problem is highlighted by the researcher’s personal experience when he discussed the issue with a fellow teacher working within one of these schools. This specific school possessed 15 computers but only one teacher used the computer/s for his personal needs. He was the only person who had access to these computers.

The argument is supported by another respondent (R5), who had the following to say regarding the use of computers in the teaching of the blind: *“Other than the books we use daily, we have been using the Internet (KA.1), although we have problems with it. Of late, it is not working (KA.2)."*

<u>Strategies for describing and explaining biology phenomena</u>

Question nine focuses on what educators do to give blind learners an opportunity to describe and explain concepts, principles, laws, theories and models in unfamiliar and complex settings. There is good evidence showing that blind learners can carry out such activities in these settings.

One respondent (R1) argued that: *“Blind learners are capable of describing and explaining (LR.3) depending on the situation they find themselves in. If you want them to describe or explain, first give them a real thing or, a model (MS.2). You will be stunned by how much knowledgeable they are. Remember, the key is to give them something tangible (MS.2).”*

Another respondent (R2) added: *“Often people conclude that blind learners are unable to describe or explain because the problem is that when experiments are done, they do not observe things visually (EP.1). However, if things are explained to them in great detail (MS.1.2), they comprehend and are therefore, capable of describing, explaining, analysing and interpreting concepts, laws, theories, principles, models and processes (LR.5).”*

Since blind learners are a heterogeneous group with different intellectual abilities, they at times explain matters far better than some of the people who are fully sighted. This is because the visual ability does not play a major role particularly in explanations. What is required here is intellectual capability. Blind learners with adequate mental capabilities can therefore manage such tasks very well.

The connotations of the word blindness, taken to mean “total darkness”, often give individuals wrong impressions. Luebbe (2002:48) posed a question and answered it as follows: “(w)hat do you think when you hear the word ‘blind’? If you are like most of society, you think of blindness as total darkness, and the dictionary will support that belief with its definition of ‘lack of discernment, lack of sight. Actually blindness has a range of meanings from total absence of light to the inability to see distinct features. Blindness means that you must use alternatives to sight to complete the activities of daily life.”

Is this process of finding alternatives not what educators should be doing during science process skills, observation, data recording, investigating, and so on? The attitude that educators should adopt is that at the beginning, their learners should learn necessary skills to negotiate the learning mediation of biology. Their mission should be to live by in terms of the barrier and educate others about it. This philosophy, according to Luebbe (2002:50-51), should be "…(b)ased on the premise that blindness doesn't have to be anything more than a personal characteristic. It is not a handicap, but merely means that … use alternative methods to complete the same tasks that sighted people do."

Investigation strategies

Question ten focuses on the strategies educators apply in their classrooms to give blind learners opportunities to accumulate information for investigation purposes. There is convincing evidence that educators encourage their learners to gather information for these purposes.

One respondent (R1) stated: *"I encourage learners to peruse their textbooks (MS.15), lend 'talking books' from Tape Aids for the Blind and Print Handicapped (MS.13.1), books from South African Library for the Blind on specific topics, Braille encyclopaedias, electronic and print media, etc. (MS.13.1)."*

However, another respondent (R3) cautioned as follows, that in order for blind learners to be engaged in investigation activities, *"The learning mediation field has to be level in order for blind learners to access information (MS.13.2). That is, before one recommends whatever format, one should ensure that it is indeed accessible."*

This respondent was actually saying that whatever is recommended for blind learners in order to enhance their "quality of learning" has to be available in the first place. It is of little value if recommendations are made but the media and resources are not available.

However, the fourth respondent (R4) had the following to say: *"How learners access information for investigation purposes is actually not the problem of the teacher (KA.3). The learner himself or herself should search for information, figure out the information, select the relevant information, analyse it and compile it (LR.6). Because our media centre is poor in terms of reference work and because newspapers and magazines are inaccessible (E.9.1), what I normally do, I go to the Internet (KA.1) and print it in an accessible format and give them to read (KA.1.1). By so doing, they will present their findings to me."*

This respondent makes the valid point that learners too have the responsibility of accessing information for investigation purposes. Learners could employ various strategies in acquiring information such as discussing things among themselves, consulting their books and educators, listening to both the radio and television, and the like. The learner himself/herself should search for information, figure out the information, select the relevant information, analyse it and compile it. Pierce (2001:31) argued that blind individuals should be engaged in activities and "… programs that will challenge the assumptions that others have about us and sometimes challenge those we have about ourselves."

She also argued that the blind should "…(e)ngage in adventure; … climb the highest peaks; … scale the ivory towers of academe; … apply inventive imagination to the everyday problems confronting us all. If we expect the blind to achieve in ways defined by the most exalting standards, we must demand excellence. Those who believe the blind have little capability expect little, … they get it." She added that if people expect productivity, productivity is what they get.

LEARNING OUTCOME 3: SCIENCE, SOCIETY AND ENVIRONMENT.

Prediction of outcomes

Question eleven discusses the things educators do in learning mediation to give blind learners the opportunity to predict the outcomes of a certain intervention. It became clear that, in order for blind learners to predict the outcomes of an intervention, educators have to give them the background knowledge which they mostly need before they can embark upon an experiment.

Supporting the previous argument, one respondent (R1) noted that: *"Prediction to an extent has to do with one's understanding and intellectual ability (SPS.4.1). Any learner with low intellectual ability would possibly find it difficult to predict outcomes of an intervention whereas someone with high intellectual ability would find it simple and easy to do predictions (I.1). The same applies to blind learners. However, one is tempted to say sighted learners' way of making predictions seems to be easily and comprehensively done because hearing and seeing what the educator say gives them an edge over blind learners."*

On the other hand, another respondent (R3) indicated that *"At times, when I give my learners all the relevant information, they are able to predict (SPS.4.2)."*

The researcher's impressions are that blind learners either can or cannot predict, depending on the type of intervention by the educator. If educators make every effort to explain to them the intention of an intervention, steps to be followed, etc., they may accurately predict the outcome. Predictions of outcomes are also influenced by their simplicity and complexity.

Another respondent (R8) argued that: *"At times predicting means making a wild guess (SPS.4.3). One could be right or wrong. Blind learners can do that."*

According to another respondent (R6) the nature of the prediction will once again be determined by the type of intervention conducted by the educator: *"Blind learners can or cannot predict depending on the type of intervention (SPS.4.4). If as an educator you explain to them the intention of an intervention, steps to be followed, etc., they may predict the outcome."*

Data analysis skills

Question twelve discusses how blind learners analyse collected data. The ability of blind learners to analyse data emerged prominently from the answers. Most respondents were of the view that blind learners are able to analyse data the way sighted learners analyse data.

In supporting this argument one respondent (R1) stated, *"Analysing data to an extent has to do with one's intelligence (SPS.5.1). Any person who does not experience an intellectual barrier, would find it easy to analyse data whereas, any person experiencing an intellectual barrier, would find it extremely hard to analyse collected data (I.2). The same applies to a blind learner. One is also tempted to say because blind learners are not disturbed or distracted by things during the learning mediation; they have an edge over sighted learners. Because they listen attentively, they absorb that information and understands it better (LR.7)."*

The researcher discovered that other responses pertaining to this question were not different from the previous answer. Another respondent (R2) noted: *"Some blind learners can analyse data while others cannot. That ability, is, influenced and depends on their levels of mental growth (SPS.5.1.1)."*

As was the case with predictions, where it was clearly indicated that blind learners need adequate information to predict the outcomes of an intervention, the same applies here. The moment educators explain different things to blind learners, they comprehend and are, therefore, capable of describing, analysing and interpreting concepts, laws, theories, principles, processes, and so on, at times better than some people who are fully sighted.

According to one respondent (R5), when blind learners are given models (MS.2), they are able to describe and explain them. They can also tell the differences between biology phenomena. Other respondents also echoed the same sentiments.

LEARNING OUTCOME 4: SCIENCE, SOCIETY, ATTITUDES AND VALUES

Opportunities for expressing and reflecting on the mediation of science process skills

Question thirteen is centred on the strategies educators apply in their classrooms to give blind learners the opportunity to express or reflect on the mediation of science process skills. There is persuasive evidence to suggest that blind learners are capable of doing so.

One respondent (R3) attributed this capability to the fact that Outcomes-based Education expects educators to play a more passive role and learners a more active role. Because he encouraged class discussions, blind learners interacted and shared knowledge. His role was only to facilitate and prompt correct responses.

The respondent (R3) emphatically stated, *"Remember, blind learners enjoy talking as it is one of the ways to express themselves (LR.8)."*

Another respondent (R5) advised, *"If you want to know how much the blind could express themselves or reflect on what you were teaching, employ strategies such as discussion, narrative, question and answer, etc. (MS.15.1)."*

From the sentiments echoed, one concludes that blind learners can express and reflect on things verbally and in writing.

When respondents were asked what they would love to see put in place, one respondent (R1) said: *"I would like to see a very simple laboratory with the essentials for example, a burette that is marked so that blind learners could feel it (E.9.2). Also, a laboratory tailored to the learning needs of the blind."* The respondent (R1) added, *"I would like to see that there are far more descriptive video services rendered to the blind (MS.13.1). Should all these things be put in place blind learners could benefit a lot."*

6.4.3 FEEDBACK AND REPORT ON THE FOCUS GROUP INTERVIEWS

The focus group interviews attempted to establish learners' views, concerns, challenges and needs during life sciences learning mediation.

<u>The conduction of simple tests and surveys</u>

There is solid evidence that some learners do conduct simple tests and surveys, while others do not.

To support the first argument, one respondent (Focus Group 1) stated, *"Yes, we do conduct simple tests and surveys (E.1.1). For instance, today's activity was about indicating areas on the tongue where different tastes take place. I guess that was a simple experiment. Wasn't it?"*

Another respondent (Focus Group 2) stated: *"Mainly with practicals, we are encouraged to work in groups comprising both blind and partially sighted learners (T.1). This arrangement is crucial in terms of assisting each other. We as learners, we are encouraged to take the readings together, but, we interpret them independently."*

Contrary to this, the majority of respondents (including Focus Group 4) indicated that they conducted no experiments (E.4.2). In support of this remark it was stated: *"No we do not do experiments because we do not see and, again, our school does not have a laboratory and equipment that blind learners can use."*

In addition to that, it was also argued by (a learner in Focus Group 5): *"Though we know the importance of tests and surveys which is to provide us with new insights and a better understanding, we do not do them (E.4.2)."*

Other respondents indicated that they do not do simple tests and surveys and suggested that this area urgently needs a solution.

If it is true that at some schools for the blind learners do not conduct experiments, this means that those learners do not enjoy or do not have the same rights to receive the education available to their sighted peers; that is, the right to equal opportunity in and equal access to all aspects of education, access to a visual world, access to information, access to curricula, access to knowledge, and access to human relationships.

One gains the impression that once again, educators and learners are not creative and that they, therefore, give excuses for not doing tests and surveys. Environments for excellence are not created. Educators doubt blind learners' ability and blind learners are also guilty of under-estimating their ability. Blind learners lack determination and the right spirit to conduct tests and surveys. They seldom try, seldom work and infrequently believe that they too, can make it and must contribute positively to the innovation of strategies to accommodate them.

The impression that the researcher also gained from responses is that lack of visual ability makes blind learners feel inadequate and inferior, and gives them low self-esteem so that in certain instances they may be depressed and could exhibit perceptions of unhappiness. Van Huijgevoort (2002:59) argued that people who have problems adjusting to their visual impairments may have responses such as "(I) feel that my visual impairment forms an obstacle to my development"; "(I) want to live independently, but I'm scared because I'm blind"; or "(I) want to go to a mainstream school, but I'm afraid my classmates won't accept me with my visual impairment."

He added that blind learners are justified in doubting their abilities because "(s)ociety appreciates a sound and perfect body, physical attractiveness, independence, and achievement. Since people with visual impairments cannot meet these values, society downgrades them to a lower position."

In addition, the researcher further gained the impression that the difficulty in conducting simple tests and surveys could be attributed to the fact that educators tend to expect blind learners to experience events in the same way as learners without visual impairments. Ferrell (2002:83) commented, "(b)ut it is false to think that children with visual impairments experience events in the same way as children without visual impairments. While the learning of children without visual disabilities is often reinforced by visual input, whether repetitious viewing of the act itself or the expression on an adult's face, children with visual impairment often miss out on both the visual feedback and the visual reinforcement. Learning occurs too often by chance, and it occurs in discrete, fleeting pieces that cannot easily be combined into concepts. Learning for … children with visual impairments has to be more deliberate: not a structured, stimulus-response approach, but a thoughtful and planned use of the time available to increase the chances for success by mediating an environment that cannot be experienced visually."

In addition, Erwin *et al.,* (2001:348) maintained that, "(i)n many ways, children who are visually impaired have limited access to opportunities for self-direction both within and outside the school."

As a solution to the problem highlighted above, it is advisable that educators seek blind learners' opinions in order to grant them full participation opportunities during classroom activities. Baxter (2003a:120) commented: "(c)hildren who are capable of forming views have a right to receive information, to give an opinion and to have that opinion taken into account in any matters affecting them."

Where there is creativity, determination, excellence and talent, nothing is impossible. Pierce (2001:32) enquired, "(h)ow can we foster creativity? Nobody knows for certain. However, some of the elements are obvious. We must believe in our talents, and we must demand first-class performance. We must not accept excuses, and we must never quit trying to be all that we can be.

"Most of us will never make it to the top of a mountain or to the winner's circle in the competition for the Nobel Prize. However, each one of us has a contribution to make. If we expect excellence in ourselves, we will create the environment for excellence in others. I am not talking here only of intellectual pursuits, though that is a part of it. If we believe in each other, support each other, dream of a brighter tomorrow, and work to bring it into being, we will ensure success for ourselves and those around us. Nobody, we are told, is indispensable. However, we need everybody with determination and the right spirit. We cannot change the past, but tomorrow is ours, for we will never stop trying, never stop working, never stop believing until it is."

Acquaintance with, awareness of and application of science process skills during mediation and/or observation

The second and third questions are dealt with simultaneously because of their close relationship. The second question determines whether learners are acquainted with science process skills while the third question requests examples where learners go about measuring distance, mass, growth and changes in shapes.

There is convincing evidence (contained in the focus groups' responses) suggesting that learners are acquainted with science process skills, but because of the subjects they are doing and a lack of resources, they rely on theory.

In support of this argument, one respondent (Focus Group 1) stated: *"We know and understand science process skills (SPS.6). However, in physiology, we do not use most of them (SPS.2). What the educator does, he gives detailed information including sizes, shapes, growth, etc., but we do not literally measure things (SPS.7)."*

While some respondents did not engage themselves practically in science process skills, it was encouraging to note that others acquired them and practised them to a limited extent. Those respondents (Focus Group 3) stated: "*We only measure the distance, mass, growth and changes in shapes to a limited extent (SPS.2.2). Our biggest problem is that, our school is poorly resourced (E.2). We do not have enough textbooks (MS.13.3), let alone instruments that blind learners can use in science process skills."*

The position that blind learners have limited access to subject-related material, such as data available on computers, recent publications and encyclopaedias, was strengthened by one respondent during the follow-up interview when he said: *"… we are getting there we are still struggling … computers … I think is of a tremendous help to them if they can get access to the internet and make use of that information from the internet. … Ja but at present we rely on the textbooks and the notes that we … try to convert … and try to make …"*

Another respondent said: *"And so far what I've discovered is that our computers for totally blind learners are not in a good number we have 1 or 2 which are talking which … all the total blind learners can use. But for partially sighted ones we have about 8 computers and they use them in the afternoon …"*

Photo 6: Sources of information

Photos 4 and 6 support the previous argument.

Photo 6: Sources of information.
This photo is a reflection of limited sources of information used by blind and visually impaired learners during learning mediation. Appearing on the photo are Braille textbooks, a Braille machine and a file. What is also clear, is that, the learner is writing with that machine.

The photo (photo 6) further supports the notion/observation of the researcher made during educator and Focus Group interviews that there is limited access to subject-related information with specific reference to computers, encyclopedias and recent publications.

One of the members of Focus Group 4 mentioned that because most of the lessons are based on theory (MS.14), they are not certain whether they are able or unable to conduct experiments practically. The respondent continued to argue that *"One will only be sure the day he is required to show his practical skills."*

Scientific educational Trips/excursions

The fourth question determines whether learners undertake field trips. There is good evidence, supported by information obtained from respondents, that scientific excursions are not habitually taken by learners. The fact that of nine respondent groups, only one group (Focus Group 7) undertook one scientific excursion to Pretoria Museum is indicative of the fact that field trips are not taken as often as possible.

One respondent representing Focus Group 2 indicated: *"We do not undertake scientific trips at all (MS.16.1). We would like to undertake them (LR.9) because we could acquire knowledge and information through them (MS.16)."*

Another member from Focus Group 3 said the following about the importance of scientific trips: *"We hardly undertake field trips* (MS.16.1). *They are extremely important because they are full of new knowledge and new discoveries (MS.16)."* Their educator indicated that they are rarely taken on such trips.

Focus Group 7 had the following to say about the scientific excursions: *"Scientific excursions are important because you always stumble across new information* (MS.16). *Nevertheless, we don't undertake such trips quite often* (MS.16.1).*"*

Opportunities for observing biology phenomena

The fifth question determines whether opportunities are created for learners to observe biology phenomena. From the researcher's observations, there are schools where opportunities are created and others where they are not created.

At two schools, learners experimented by tasting different things and felt a living dog respectively. At other schools learners were only given theory and not practice.

The Department of Physics Laboratory Manual (2003:1) argued that observation is essential for acquiring information, especially during experiments. Observations are important for encouraging learners to collect data and to learn effective procedures and practices for making relevant and accurate observations. It is further argued that when blind learners are not observing, they are deprived of the advantage of learning to order things logically and "… (p)resenting it concisely in a report."

It became clear that learners thought and felt that vision was important for observations. However, with the help of educators, they brought the situation under their control.

One respondent representing Focus Group 3 argued as follows: *"Most of the experiments are complex (E.4.3). They require one to have sight. As such, we are unable to observe them (O.1). However, our teacher compensate for that by giving us a detailed description and explanation (MS.1.2)."*
Also see photo 3. Blind and visually impaired learners participating in a classical "question-and-answer" session.

Other respondents from Focus Group 4 indicated that they use alternatives to circumvent their disability. "*Because we know we are unable to see most experiments (O.1), we also use other senses like listening, feeling, smelling (O.2), etc. Where that is not possible, we listen attentively (O.4) to our teacher's explanation."*

Burke argued that (2001:64) it makes sense to use any legitimate means you can to be as successful in school and later in your career as your natural talents allow.

Likewise, Luebbe (2002:56) maintained that, "(t)hese alternatives make … life every bit as good as those of sighted people."

There was an instance at one specific school where the teacher responsible for one of the subjects arranged a scientific field trip for the learners and requested that learners should contribute financially towards the trip. The learners refused to pay for the excursion, arguing that they were "Government's children", and that as the Government was subsidising special schools, their contribution to the excursion should also be subsidised.

Regarding this specific occurrence, one is of the opinion that some blind learners might be using the fact that they are blind as an excuse not to participate in certain activities.

Data recording processes and procedures

The sixth question concentrates on how blind learners plot and record data correctly. There is solid evidence that blind learners are able to plot and record data. In order for them to do so, they need to be given models and sketches. Their role is that of identifying parts and discussing them thoroughly. In instances where experiments are conducted, educators explain to them and they write down the most salient points during the explanation. By so doing, they record data. Burke (2001:67) noted that "(t)aking notes … is a good idea …"

There is also good evidence that recording data in tables with columns is difficult. One respondent from Focus Group 1 said that blind learners are often required to mention or list things in their chronological order.

The respondent added*: "If that is not possible and allowed (SPS.4.4), one could ask the assistance of the educator (T.2) to do it on one's behalf. However, we the learners, we are duty bound to furnish any assistant with relevant information (LR.5.1)."*

Another respondent from Focus Group 2 gave the following comment regarding the drawing of sketches: *"Most of us do not draw sketches at all (LR.10). We make use of sketches made by our educators (MS.11.1). Remember drawing is an art and it is never simple to blind learners. Even the sighted practise a lot to perfect this artistic skill. No wonder it is not simple to blind learners (LR.10)."* The fact that blind learners experience difficulties with drawing was supported by educators during follow-up interviews. They indicated that, thus far, they do not know how to teach blind learners how to draw.

Tabulation skills and techniques

Question seven discusses the techniques and skills blind learners apply when they are required to perform tabulations. Regarding this, respondents from only one group indicated that they use pushpins and elastic bands attached to pre-printed axis-pages. There is evidence that at other schools learners do not do tables on their own.

In showing the difficulty of executing this task one respondent from Focus Group 2 uttered the words:*"Tables are a difficult task to execute (SPS.4.5.1). As learners who are doing science, we are interested in doing everything that sighted learners do (LR.8)."*

On the other hand, another respondent from Focus Group 3 asserted: *"We do not make tables (SPS.4.2.2) because our educator is not Braille literate (ED1). Therefore, adapting tables is a problem."*

The conclusion at which one arrives is that, should schools be better resourced, some of the problems will disappear. Educators and blind learners will be able to make and convert complicated diagrams into a tactile format. Burke (2001:68) argued that, "(g)raphics printers are increasingly effective for rendering maps, math, and complicated diagrams and graphs. If you have access to such technology or materials, your competitive equality is literally at your fingertips."

A conflicting statement is, however, that an educator interviewed at one of the schools stated that she used last year's common task assessment graphs, which were already adapted. This remark may be linked to the observation by one of the learners from Focus Group 4, who stated that *"We only depend on what has been handed out to us by our teachers (LR.12)"*. Another respondent from Focus Group 6 mentioned that *"We are not taught how to make tables (SPS.4.5.3), however, we believe that with practice we can be perfect (LR.11.1)."*

Interpretation of data

Question eight addresses the way blind learners go about interpreting data, since interpretation of data requires the investigator to draw conclusions from the acquired data and/or results of calculations, and also that the investigator "…(m)ust be able to test the reliability of these conclusions" (Department of Physics Laboratory Manual 2003:1). There is good evidence that blind learners are able to interpret data, depending on the type of information that has been gathered.

Evidence from empirical data suggests that blind learners do not have problems in interpreting data.

One respondent (Focus Group 1) regarding this matter stated: *"We do not take the readings but we instead record them (R.2). Recording readings is a fairly simple thing to do."*

Similarly, another respondent from Focus Group 2 agreed that blind learners are able to interpret (R.3) the information because they can write statements on their own and according to their own understanding. According to that respondent, being able to do that surely indicates that blind learners do what interpretation requires and expects of everyone. In addition, as that respondent sees it, that is what interpretation means and entails.

A member of Focus Group 3 stated: *"As blind learners we can analyse (SPS.5) and interpret (SPS.8) information. As far as designing things is concerned, I think it would be a daunting task if not an impossible thing to do (SPS.9). Furthermore, the simplicity or the difficulty depends on different conditions and situations (LR.13) under which one has to do those things*".

One of the members of Focus Group 5 remarked that: *"Interpretation does not depend on the visual ability (SPS.8.1) but the intellectual ability (SPS.8.2). As blind learners, because there is nothing wrong with our intellect, we can interpret data."*

<u>Strategies for describing & explaining biology phenomena</u>

Question nine addresses blind learners' ability to explain concepts, principles, laws, theories and models in unfamiliar and complex settings. There is sound evidence to support the view that blind learners are capable of carrying out these tasks.

For instance, one respondent from Focus Group 1 stated that: *"The information in Braille is similar to that in print (MS.12.1). Hence, one uses the same information that sighted learners use in doing exactly that".*

In the same vein, Corn and Wall (2002:8) argued that access to developmental and educational services to blind learners should include "…(a)n assurance that instructional materials are available … in the appropriate media and at the same time as their sighted peers."

Another respondent from Focus Group 2 confidently said the following: *"Yes, we can (SPS.8). Remember, a description is all about the characteristics of something while an explanation is about giving as much information as possible to someone the way you understand it (LR.14)."*

Description and explanation depends mainly on one's understanding of different meanings and connotations and on one's being able to describe and explain without any difficulty. A description considers the features of something (specifics), while an explanation involves talking in great detail (generalities) about something.

In addition to the previous evidence, another respondent from Focus Group 4 stated: *"I prefer to be given models (MS.2) or taken to the real thing (MS.2.1) for me to describe or explain. With models in my hands, I can tell their differences as well as their similarities. This is to say, I like describing what I feel and thereafter, I can explain at length about what I felt."*

Opportunities for distinguishing similarities and differences

Question ten focuses on blind learners' exposure to similarities and differences. In this regard, there are conflicting arguments. Some respondents indicated that they are exposed to similarities and differences while others dispute this.

As evidence for the fact that blind learners are exposed to similarities and differences, a respondent from Focus Group 1 stated: *"We are indeed exposed to similarities and differences (SPS.11). Our educator uses comparisons and contrasts (MS.17). Models and shapes are also important to a blind person in knowing differences and similarities (SPS.11.1). Surely, a square and circle are shapes. However, they are different in that one is round and the other one has four equal sides. The same applies to a fish and a dog. They are all animals with a different body structure and a different habitat. Through those models, one can tell that they are different."*

Another respondent from Focus Group 2 added: *"We are able to tell similarities and differences because the process involves telling common and uncommon things as far as biology phenomena are concerned (SPS.11.2)."*

Contrary to the above evidence, other respondents from Focus Group 4 indicated that they were not exposed to similarities and differences. There is evidence to support this because one respondent argued that they were not exposed to similarities and differences (SPS.11.3). According to this respondent, *"If learners were exposed to similarities and differences, that was infrequently done (SPS.11)."* One is convinced that this response was given as a result of not understanding the "similarity and difference" concepts.

Information acquisition during investigation

Question eleven focuses on the strategies that blind learners apply in the classroom to create opportunities for themselves to accumulate information for investigation purposes. There is solid evidence that blind learners do everything possible in this regard.

One respondent from Focus Group 3 argued that opportunities could or could not be created (SPS.12), depending on particular situations and conditions, the environment, effort and dedication. The respondent went further, arguing that opportunities to accumulate information require one to consult experts (SPS.12.1), peruse one's prescribed and reference books (SPS.12.2), listen to radio and television news, browse the internet (SPS.12.3), borrow Braille books or talking books (MS.13.1) on a particular topic, and so on. However, the respondent indicated that the opportunity to accumulate information for investigation purposes was hampered by a grave shortage of Braille material (E.9.3). Please see photo 4 discussed previously.

Corn and Wall (2002:6) indicated that the present generation of learners is more advanced than those in the past. They stated, "(t)oday's students … use textbooks and instructional material that have little physical resemblance to the textbooks of years past, which were in black and white or had only a few coloured pictures and diagrams. Students may now receive electronic versions of textbooks, with moving pictures, and links to information not contained in the primary source book.' Classrooms are no longer limited to the use of textbooks and worksheets found in textbook storerooms and/or copied. Rather, information has few boundaries; when students use textbooks on CD-ROM, they may be asked to seek information through the Internet and to receive and develop their assignments as multimedia presentations."

These authors further (2002:10) suggested that blind learners be encouraged and allowed to access and use information by means of technology so that they can "…(u)nderstand the same information presented to sighted students in a … presentation. For example, screen readers and screen-magnification software provide access to information presented on computer screens."

Similarly, Pierce (2001:17) argued that "(i)f you are on the right side of the divide, meaning that you have access to technology and access to those who can teach you how to use the technology, your future as an individual, a community, and a country is bright."

For learners to be able to access information through technology, they have to become more technology literate. According to Neibaur, Day and Sebastian (2002:102) the creation of a community of learners using multiple connections and multiple ways of communicating creates the sense of a more personal education, as well as autonomy in learning.

Because most blind learners reside in hostels, it is difficult for them to use different methods to accumulate information though they know that the methods are extremely important. One respondent from Focus Group 2 pointed out that accumulating information involves reading books in the media centre (SPS.12.2), watching TV, listening to the radio (SPS.12.3), requesting information from friends (SPS.12.4), surfing the internet and undertaking science field trips. The phrase "watching TV", in the researcher's view, implies listening to it. The blind are accustomed to using ordinary terms or phrases like "watching TV", "I see" (implying "I understand") and many more phrases.

Another respondent from Focus Group 7 remarked that acquiring information for investigation purposes was rather difficult (SPS.12.5). Because they lacked books in Braille (E.9.3), they were depending on partially sighted learners (T.1). At times, partially sighted learners read to them (T.3). On other occasions, partially sighted learners refused to read to them (T.3.1) either because they were busy writing their classwork or because they felt it was not their duty to read to blind classmates. Wall and Corn (2002:60) argue that even if Braille books are available, this does not guarantee "…(t)hat students who use Braille will receive the appropriate quantity or quality of Braille necessary to access their educational curricula." Because blind learners do require accessible and appropriate Braille learning materials, it is imperative that all stakeholders in education do address the provision of these resources.

The same respondent from Focus Group 7 elaborated as follows: *"Furthermore, when one reads to you (T.3.1), it is totally different from reading on your own. If you read on your own, the advantage is that you have time to digest (MS.18.1) what you read, you could revise it and you are also sure about spellings."*

Respondents in the remaining focus groups also mentioned the same techniques as far as the accumulation of information is concerned.

Prediction of outcomes

Question twelve concerns the methods the learners' educators use when they create opportunities for the former to predict the outcomes of a certain intervention. There is in fact little evidence suggesting that opportunities are created for blind learners to predict in this way (SPS.4.4.1).

In support of this finding, one respondent from Focus Group 1 indicated: *"We are given background knowledge (MS.1) before we could do experiments".*

In contrast to what this particular respondent had stated, another respondent from the same Focus Group mentioned that because the learners themselves do not do experiments (E.4.2), they therefore cannot predict the outcomes of an intervention (SPS.4.4.2). What they think the educator should do is to verbally tell them all the steps involved in doing that experiment (MS.1.4). Perhaps they could then predict the outcome.

What emerged from the interview, particularly in answer to this question, is that blind learners could predict or could not predict the outcomes of an intervention, depending on the type of experiments conducted. If their educators explained to them the intentions of the experiment, the steps to be followed when conducting such experiments, and so on, they might be in a position to predict the outcomes of an intervention. However, if the environment is optimum, yet does not address differences in blind learners' learning styles, predictions will be difficult to make (Ferrell 2002:83).

There are, however, according to one respondent from Focus Group 5, instances where blind learners use common sense to predict the outcomes (SPS.4.1.1) of an intervention. If an intervention happens to be complex, common sense does not work. Therefore, blind learners will rely on the information furnished by the educator (MS.1). Other respondents were also of the same view.

Analysis of programmes

Question thirteen determines how simple or difficult it is for blind learners to analyse, synthesise, hypothesise, design, interpret and evaluate life sciences programmes.

There is sufficient evidence to demonstrate that blind learners are able to carry out these tasks. Furthermore, they do not do this differently from their sighted counterparts. However, for blind and visually impaired learners to interpret, analyse, et cetera, Erwin *et al.,* (2001:339) advised that it is necessary for educators "…(t)o provide access to new content within the environment, guide exploration and discovery, and encourage interpretation."

One respondent from Focus Group 4 maintained: *"Analysing data depends strictly on the type of information (SPS.5.1.2) one shall have gathered. Because most of the time we do not take the readings (SPS.13.1) but are required to record them, (SPS.13.2), that is a fairly simple thing to do."*

In addition to this, another respondent from Focus Group 5 maintained, s/he can interpret data as long as the information gathered, in whatever form, is adequate. However, other respondents considered the process of analysing, interpreting, et cetera, to be expressing one's opinions both verbally and in writing and according to one's own understanding (SPS.8.3). One respondent even stated, *"surely that is what interpreting means".* The researcher is of the view that the previous respondent lacks an adequate understanding of the activity of interpretation. Interpretation implies having the ability to analyse and give a sensible explanation of events, situations, aspects, et cetera.

Another respondent from Focus Group 8 also indicated that blind learners could analyse, interpret, evaluate and hypothesise. However he warned: *"… Designing things I reckon would be a daunting task if not an impossible thing to execute (SPS.9). Furthermore, the simplicity or complexity of things depend and is as well influenced by situations and conditions under which one has to execute the task."*

The perception that the researcher was left with is that if blind learners understand the information, then it is simple to analyse and evaluate collected information.

Correct and incorrect things done during the learning mediation

The fourteenth question concerns what is correctly or incorrectly done during learning mediation in the classroom. There is good evidence to demonstrate that there are a number of activities that are correctly or incorrectly performed.

One respondent from Focus Group 2 expressed the view that she thought models are not enough (MS.2.3). Some of the sketches are too detailed; hence (MS.11.2) she is unable to comprehend them (MS.11.2). According to her, blind learners have not yet found a way to make tabulations independently, although (SPS.4.5.1), as such, blind learners are fully aware of the important role they play in their education. This, in her opinion, should be explored.

Another respondent from Focus Group 9 argued as follows: *"What we think is correctly done, is Braille notes that our educator gives us (MS.1.5). You know, half a loaf is better than no bread. But, we would appreciate if we are supplied with our own books (MS.13.4) as this gives one independence as well as enhancing one's self-reliance (MS.1.3.5)."*

Another respondent from Focus Group 6 stated: *"Things that are correctly done include giving us notes in both Braille (MS.12.3) and enlarged learning mediation material (MS.19). In terms of things that are incorrectly done, I tend not to like it when our science educator write on the chalkboard and forget to tell me what is written. That style, makes me lose focus as there are also learning gaps in what I am learning. I would prefer that the educator either gives me notes or verbally tell me what he wants me to know (MS.1). Discussion of issues instead of writing is better for me as a blind learner (MS.20)."*

Photo 5: Educator writing on the chalkboard.

Photo 5: Educator writing on the chalkboard.
Photo 5 is an illustration of the science educator writing on the chalkboard. His back facing the learners is evident of his action (writing) phrases such as mixture and compound. Those phrases are visible on the photo. Some low vision learners are writing in their notebooks while blind learners are just sitted. This is a classical example of educators displaying their skill of writing at the expense of blind learners who cannot follow or make sense of what has been written. A learner in one of the focus group interviews vehemently opposed print since it is a nightmare to blind learners. According to that learner, meeting their needs of solving the "print nightmare" involved the provision of prepared Braille notes or dictating such notes so that they could independently record them with their braillers.

Methods and sources for accumulating data

The final question discusses the methods and sources blind learners use when accessing information in unfamiliar and complex settings. Blind learners use a wide variety of these. Such methods include Braille textbooks, talking books, sighted people, electronic media including internet, radio, television, Braille magazines, educators, objects, real objects, and so on. However, the socio-economic factor counts when it comes to the availability and accessibility of sources and methods. The previously disadvantaged institutions and learners are still disadvantaged; hence, their methods and sources will be fewer than those of previously advantaged schools.

6.5 GENERAL COMMENTS OF RESPONDENTS

Natural science, biology and physiology are subjects mediated to blind learners at various schools in the ways described by individuals and focus groups during interview sessions and observed by the researcher. There is a reasonable number of educators with extensive knowledge of science subjects. Some schools are better resourced, while others are under resourced. For example, one school in the vicinity of Pretoria has better facilities than those of the other eight schools studied, whether in townships or in rural areas.

The Education White Paper 6 of the Department of Education (2001:5 and 8) similarly argued that some schools were extremely resourced while others are systematically under-resourced. Schools which are extremely well resourced possessed the best human, physical and material resources.

The researcher was also informed by a member of staff at one of the schools that their institution offered physiology, mathematics and physics up to grade 12 level. Other schools where this research was conducted were not yet offering these subjects at this level: however, they showed interest in offering them. This implies that blind learners who are doing life science subjects up to grade 12 are in the minority, because there are three, or maybe four, schools offering life science subjects at this level in South Africa. In addition, career opportunities for blind individuals are limited. Therefore, this also implies that blind learners have only a few education streams from which to make their choices.

Learners who possess background knowledge in life science related subjects are likely to continue with them up to tertiary level because life sciences offer career opportunities and the learners are interested, and as such, they can cope with the demands and challenges of life sciences.

In addition, blind learners' understanding of, love for and interest in these subjects can be broadened. When asked whether blind learners should also take life sciences at school one respondent from Focus Group 8 said: *"Why not? Nobody should be discriminated against. After all, science is very useful."* Another respondent from Focus Group 7 supported the previous view by saying *"I love science."* As a further elaboration that respondent stated: *"The only thing that discourages me is the fact that here at our school, it is only offered up to grade 9. Why should one bother learning something useful, which will discontinue?"*

While all respondents agreed that science related subjects are useful, not all were pleased with their schools' situations. Displeasure was highlighted in the following ways: *"Science make sense when you have Braille books (MS.12.3), when you do experiments (E.1.2), when you undertake trips for investigation purposes (MS.16.2) and, when you have dedicated educators (ED.2)."*

Closely related to the former argument, another respondent from Focus Group 2 expressed his reservations in the following manner: *"We use old and worn out Braille books (E.8.4). It's high time that we also get recent publications."*

It was further revealed that blind learners use different methods in order to benefit from life sciences. Learners from better socio-economic backgrounds, or well-resourced schools, use computers with special software such as JAWS, Zoom text, Internet explorer, Duxbury translator, and the like. However, many of the respondents do benefit from Braille textbooks, educators, partially sighted classmates and adapted learning mediation aids.

Abner and Lahm (2002:98), in supporting the point that blind and visually impaired learners benefit or obtain information from various sources and technology, declared that "(o)ver the past decade, advances in technology have provided new opportunities for people who are visually impaired (that is, are blind or have low vision) to be independent at work, school, and home. These advances have allowed them to compete successfully with sighted people and to have equal access to printed information … Optical scanners; closed-circuit television systems (CCTVs); optical magnifiers; note-taking devices; and technologies that produce large print, Braille, or speech are examples of technologies that enable individuals who are visually impaired to write and edit papers, conduct research, gain access to information, and develop job skills."

One respondent from Focus Group 1, regarding this point, declared: *"I often ask my classmates, my friends or my relatives and I say … can't you read me information which is in print (T.3)."*

However, it seems Braille is the primary source of information for many blind people. According to Dr. Euclid Herie, the then president of the World Blind Union (2000:4), Braille plays an immense role in the life of a blind person. He noted, "(e)very life tells a story and for those of us who are blind, our stories are told in Braille." He further argued, "(t)ruly Braille equals equality. When Braille leads, literacy follows."

Dr. Rajinder Singh Sethi (2000:65), in the same publication, also stressed the importance of Braille in the following manner: "(a)sking what Braille means to me is akin to asking what fuel means to an automobile, what the binary digits mean to a computer, what water means to a fish, and what freedom means to a Nelson Mandela who was incarcerated for the better part of his life. It means freedom to me. It is platform of equality for me - equality with my sighted counterparts. It means oxygen for me. It is my life blood - my life support system. It makes no demands; it doesn't require electricity. I can read in a dark room as easily as in a crowded train. My thirst for information and sharing it with others would have remained unfulfilled had it not been for Braille."

Blind learners in South Africa could use other services to acquire information. Institutions like Tape Aids for the Blind and Print Handicapped could lend them talking books, while the South African Library for the Blind could lend them Braille books and talking books as well.

Some respondents had reservations about the services rendered by printing presses and other service providers offering a talking books service to the blind and print handicapped. They indicated that they received material from these services but sometimes it was of no use. Almost all the respondents preferred receiving information or documents in Braille because, according to them, data written in Braille showed the value of Braille to blind people. Data in Braille enhanced their independence and self-reliance. It is argued by Dr. Rajinder Singh Sethi in World Blind Union (2000:65) that modern technology has provided various gadgets that seek to help the visually handicapped, like tapes and speech synthesisers. But nothing can give blind people the kind of freedom that Braille has given them and will continue to give them. He added that "(m)odern technology is fast, functional and advantageous. With tapes and speech synthesizers, a blind person can collect lots of information, but listening is not the same as reading, and talking is not the same as writing."

The present study has also revealed that blind learners in South Africa are more excluded from doing biology in the Further Education and Training Band than their fellow sighted learners. When learners (in focus groups) were asked if they thought and felt that they were more excluded from doing biology or life sciences than their fellow sighted learners, their responses were as follows:
"We are really excluded" - Focus Group 2.
"It is absolutely correct" - Focus Group 4.
"Undoubtedly yes" - Focus Group 5.
"I definitely think so" - Focus Group 9.

The statements recorded above indicate that blind learners are not held "…(t)o the same academic standards as all students, …" (Special Education Report November 21 2001:5).

6.6 REASONS WHY BLIND LEARNERS THOUGHT AND FELT THEY WERE EXCLUDED FROM DOING BIOLOGY

These reasons include (the researcher's comments in brackets):

- Lack of accessible reading material. (The advent of Outcomes-based Education and training brought along with it problems as far as mediating learning to the blind is concerned. Material has become too visual. Books are now selected by cluster-schools, making it impossible for Braille printing presses to transcribe a few books into Braille, as this is not cost-effective for them. In addition, even if they are transcribed into Braille, such books are used only for a short period. Some small schools for the blind cannot cope with this practice (changing prescribed books after a short space of time) because of their small budgets.)

- Adapted equipment to conduct experiments. (Some schools do not have equipment such as computers, thermoform machines, tactile image enhancers and the like, that educators could use to adapt learning mediation material. On the other hand the unavailability of equipment such as: talking scales, meter sticks, volt meters and talking calculators make it difficult for blind learners to independently conduct experiments. This makes it even harder for the blind to do experiments practically when adapted equipment is not available. It is argued by Spungin (2003:15) that "(i)f these students do not receive appropriate instruction designed to develop competencies that meet the sensory deficits of blindness … critical learning opportunities will be lost, thus diminishing the potential for future accomplishments.")

- Inadequate laboratory facilities. (The fact that most schools lack adapted equipment is indicative of the fact that laboratories (if available) are ill equipped. Because of this, no blind learner could conduct experiments in a laboratory that does not cater for his/her laboratory needs.)

- Sketches that are always omitted from textbooks. (Sketches form an integral part of the mediation of learning to all learners. Because of a lack of experts, who can make sketches, at Braille printing presses, or because sketch-making into a tactile format is a time consuming process, they are in most instances omitted from Braille books. As a result, blind learners only depend on theory and not on practice. In addition, they do not possess any background regarding how such sketches are produced. This limits their education and skills, which implies that blind learners will not develop fully in education. It is argued in the first Working Session on the National Working Group on Curriculum Adaptation (2003:28) that "(s)kills development relates to areas whereby learners can gain new skills and/or practice, as well as to maintain, combine, refine, transfer or generalise existing skills. It might also involve reactivating skills that have been acquired previously." It should be borne in mind that people are often influenced by others' artistic work in order to develop artistic skill. So should the blind also be.)

- Lack of visual ability. (Vision complements and supplements hearing. Lack of vision causes blind learners to miss many things that are difficult to explain, for example intricate and dangerous experiments. Important visual events or images that people can see are ineffaceable from one's mind, unlike second-hand information. This is a problem when it comes to the blind because they depend on second-hand information during experiments and the mediation of biology. Dyer (1979:188) argued that experiments are critical because they yield "…(i)mportant and unique information.")

- Incompetent educators. (Some educators have not received specialised training in how to mediate learning to blind learners. They lack appropriate learning mediation strategies, strategies to accommodate learners in different learning mediation environments, proper subject knowledge, and so on. This impacts negatively on the education of learners. The Report of the National Commission on Special Needs in Education and Training (NCSNET) National Committee on Education Support Services (NCESS) (1997:19) stated that "(t)he development of educators, service providers and other human resources is often fragmented and unsustainable. The absent of on-going in-service training of educators, in particular, often leads to insecurity, uncertainty, low self-esteem and lack of innovative practices in the classroom. This may result in resistance and harmful attitudes towards those learners who experience learning breakdown or towards particular enabling mechanisms.")

- Lack of in-house machines to produce material that cannot be sent to external printing presses. (Not every type of learning mediation information that blind learners need, can be sent to printing presses. In order to make each and every little detail available to blind learners, since they do not have newspapers, periodicals, journals, and the like, the school should provide them with such information. There should be machines to produce or duplicate material, in what is called in-house production. Some schools do not possess them. This implies that blind learners miss out on the acquisition of information.)

- Inaccessible public libraries. (Most public libraries do not have accessible reading material and assistive devices that blind learners can use to access information. Because of this, blind learners do not find them useful.)

- Educators' perceptions that blind learners lack the mental capacity and skills to do and excel in science. (Some educators still believe that science-related subjects, because of complex experiments and other challenges including drawing, having to use microscopes, and other issues are not meant for the blind due to the fact that they lack visual ability. The Report on the National Commission on Special Needs in Education and Training (NCSNET) National Committee on Education Support Services (NCESS) (1997:15) argues that "(n)egative and harmful attitudes towards difference in our society remain a critical barrier to learning and development. Discriminatory attitudes resulting from prejudice against people on the basis of … disability … and other characteristics manifest themselves as barriers to learning when such attitudes are directed towards learners in the education system.")

- Rationalisation and redeployment. (Some schools have lost educators owing to redeployment and rationalisation processes; but those who replaced them do not necessarily possess the competences and skills to mediate learning to blind learners. One respondent (R2) remarked that *"Facilitating learning to blind learners is a tedious process (ED.3). One cannot use any visual learning mediation aids like, you know, screens to project pictures or word next to it, microscopes, certain acids, etc."* Furthermore, another respondent (R3) suggested that science is not supposed to be offered to blind learners, as it is just a waste of precious time. Insinuations like the ones stated above, further lessen blind learners' interest in and opportunities to do biology.)

- Inflexible curriculum. (Barriers to learning can also be attributed to different aspects of the curriculum, such as the actual content of the curriculum and how it is being taught. The Report on the National Commission on Special Needs in Education and Training (NCSNET) National Committee on Education Support Services (NCESS) (1997:16) noted that "(o)ne of the most serious barriers to learning and development can be found within the curriculum itself and relates primarily to the inflexible nature of the curriculum which prevents it from meeting diverse needs among learners. When learners are unable to access the curriculum, learning breakdown occurs. The nature of the curriculum at all phases of education involves a number of components, which are all critical in facilitating or undermining effective learning. Key components of the curriculum include the style and tempo of teaching and learning, what is taught, the way the classroom is managed and organised, as well as materials and equipment which are used in the learning and teaching process.")

Because of the reasons furnished above, blind learners are less likely to do biology. One respondent (R6) stated that: *"I think the majority of our blind learners do not enjoy the learning mediation of biology because of many problems of which lack of resources is the major stumbling block (E.9)."*

Resources will only be available to all children, including the blind, if they "…(o)btain equal education, and the state …strives towards giving all students - whether they are in suburban schools, township schools or farm schools - the same access to resources and to personnel, and the same opportunities to realise their fullest potential" (Wilmot 2001:14).

6.7 CODING AND CLASSIFICATION OF EDUCATOR AND LEARNER INTERVIEWS

A descriptive analysis of educator and learner responses was extensively undertaken above, in paragraphs 6.3.1 and 6.3.2. The researcher carried out triangulation independently, but sought the opinion of his supervisor in order to maintain objectivity.

Objectivity was maintained for the following reasons:

(i) First, to ensure that the data collected and analysed had only one meaning or interpretation.

(ii) Second, to make certain that the influence of the researcher was minimised.

(iii) Third, to strive to maintain the highest quality in the data collected, categorised, reconstructed and interpreted.

The process of coding and classification took place from the beginning of July 2004 and was finalised on 21 July 2004. It resulted in the coding/classification illustrated in the table below.

Cognisance should be taken of the fact that the researcher is not claiming to have identified all the possible themes stemming from the mediation of life sciences to blind and visually impaired learners; neither does the researcher claim to have generalised that the themes featured in this work are typical of all teachers of special schools facilitating life sciences to blind and visually impaired learners. Below is a table illustrating the selected text segments from the educator and learner interviews and their codes, as well as an attempt to show how they link together in the quest for the identification of themes.

EXPERIMENTS – E	
Experiments are conducted by educators and learners	E.1

Simple tests and surveys are conducted by educators and learners	E.1.1
Experiments should be conducted by educators and learners	E.1.2
Lack of basic equipment	E.2
Lack of basic equipment - Lower standard	E.2.1
Resources will improve development of SPS	E.2.2
Necessity of resources	E.3
Problem for blind learners to execute	E.4
Problem that learners cannot operate independently	E.4.1
We (learners) don't do experiments	E.4.2
Experiments are too complex for blind learners	E.4.3
Use of home-made equipment	E.5
Improvisation is conducted by educators	E.6
Lack of innovation by educators	E.6.1
Do not develop innovative SPSs (science process skills)	E.6.2
Lack of adapted material in laboratories	E.7
Value/use of adapted material	E.8
Motivation increases through the use of aids	E.8.1
Aids make them (learners) independent	E.8.2
Comprehend better	E.8.3
Braille books outdated	E.8.4
Limited resources	E.9
Media centre poorly equipped	E.9.1
Need simple laboratory with apparatus adapted for the blind	E.9.2
Lack of Braille material	E.9.3
A lack of laboratories experienced by blind learners	E.10
RACTICAL – P	
Complexities of and challenges to educators regarding the performance of practical work	P.1
TEAMWORK – T	
Blind learners are supported by partially sighted learners	T.1
Blind learners are supported by teachers	T.2
Partially sighted learners read to them (blind learners)	T.3
Partially sighted learners refuse to read to them (blind learners)	T.3.1
MEDIATION STRATEGY OF EDUCATORS– MS	
Transmitting – give notes or oral information to learners	MS.1
Provide cues (prompts) and clues to learners	MS.1.1
Explain things in great detail – compensate for loss of sight	MS.1.2

Educators provide ready-made tables to learners	MS.1.3
Teachers explain all the steps to learners	MS.1.4
Educators provide Braille notes to learners	MS.1.5
Use concrete things such as models during teaching	MS.2
Learners prefer to be given real things	MS.2.1
Models are not enough	MS.2.2
Avoid dealing with abstract things during teaching	MS.3
Recall of prior learning an important strategy	MS.4
Ordinary/basic concepts taught	MS.5
Exceptional features are illustrated by educator	MS.6
Use of common/everyday examples during teaching	MS.7
Use of abstract examples during teaching	MS.8
Problems with OBE often experienced during teaching	MS.9
Activity/active participation encouraged	MS.10
Drawings/Sketches	MS.11
Educators draw sketches for the blind	MS.11.1
Detailed sketches cannot be comprehended	MS.11.2
Link Braille with drawings	MS.12
Blind learners see Braille is equivalent to print	MS.12.1
Blind learners should be given Braille notes	MS.12.2
Use of info from Resource Centre	MS.13
Borrow “talking books” from Tape Aids for the Blind and Print Handicapped	MS.13.1
Blind learners have to be supplied with the same resources as for normal learners	MS.13.2
Lack of textbooks experienced	MS.13.3
Blind learners should be given own books	MS.13.4
Own books contribute to independence and self-reliance	MS.13.5
Theoretical/theory only, with less emphasis on practical work	MS.14
Asking of questions an important strategy	MS.15
Employ narrative strategies when teaching	MS.15.1
Scientific field trips contribute to new info and knowledge	MS.16
Scientific trips not undertaken	MS.16.1 (change)
Scientific trips should be undertaken	MS.16.2
Educators use comparison and controls	MS.17
Reading important (as broad category)	MS.18
Reading on your own gives you time to digest info better	MS.18.1
Learning mediation material has to be enlarged	MS.19
Issues have to be discussed with learners	MS.20
INTELLIGENCE – I	

Intelligence support prediction of SPS	I.1
Intelligence enhances analysis of data	I.2
TECHNOLOGY – TEC	
Adapted technology used during learning mediation	TEC.1
Too expensive	TEC.1.1
Blind learners should have access to computers	TEC.1.2
LEARNER RESPONSE – LR	
Understanding of concepts an important learning principle	LR.1
Explaining abstract things	LR.2
Plotting critical points	LR.3
Performing experiments	LR.4
Filling up bottles with water	LR.4.1
Learners are able to describe and to explain things	LR.5
Explain to assistant what has to be done	LR.5.1 (change)
Learners should search for information on their own	LR.6
Blind learners listen attentively and understand better	LR.7
Blind learners enjoy talking to express themselves	LR.8
Blind learners want to undertake field trips	LR.9 (change)
Find it difficult to draw sketches	LR.10 (change)
Blind learners want to do everything sighted learners can also perform	LR.11 (change)
Blind learners can do everything sighted people can (practice makes perfect)	LR.11.1
Learning depends on what has been handed out	LR.12 (change)
Simplicity or difficulty of performances depend on simple or difficult conditions and situations	LR.13 (change)
Explanation depends on the way we understand something	LR.14 (change)
HUMAN RESOURCES – HR	
New in the field of educating blind learners	HR.1
SCIENCE PROCESS SKILLS – SPS	
Acquaintance with SPS	SPS.1
SPS Not taught	SPS.2
SPS taught at lower levels	SPS.2.1
SPS taught to a limited extent	SPS.2.2
Measurement	SPS.3
Learners cannot measure long distances	SPS.3.1
Learners have to measure	SPS.3.2
Experience spatial relationships	SPS.3.3

Prediction	SPS.4
Prediction has to do with understanding and intellectual ability	SPS.4.1
Use common sense	SPS.4.1.1
Relevant information has to be given to learners as prerequisite in for prediction	SPS.4.2
Prediction depends on guessing and blind learners can do that	SPS.4.3
Prediction will be determined by the type of intervention	SPS.4.4
Few opportunities given to predict	SPS.4.4.1
No prediction when experiments are not done	SPS.4.4.2
Adding information to tables	SPS.4.5
Blind learners find it difficult to draw tables	SPS.4.5.1
Blind learners don't draw tables	SPS.4.5.2
Blind learners not taught how to draw tables	SPS.4.5.3
Analysing data	SPS.5
Analysing data depends on a person's intelligence	SPS.5.1
Analysing data depends on mental growth	SPS.5.1.1
Analysing data depends on type of information	SPS.5.1.2
Blind learners know and understand the SPS	SPS.6
Blind learners informed orally of the SPS	SPS.7
Blind learners can interpret	SPS.8
Interpretation does not depend on visual ability	SPS.8.1
Interpretation depends on intellectual ability	SPS.8.2
Interpretation depends on own understanding	SPS.8.3
Impossible for blind learners to design things	SPS.9
Can describe concepts, principles and laws	SPS.10
Blind learners are exposed to similarities and differences	SPS.11
Models and shapes are used to show differences and similarities	SPS.11.1
One can use common and uncommon things	SPS.11.2
Learners are not exposed to similarities and differences	SPS.11.3
Accumulation of information	SPS.12
Use of experts	SPS.12.1
Use of reference books	SPS.12.2
Use of educational technology	SPS.12.3
Requesting information from friends	SPS.12.4
Acquiring information is difficult	SPS.12.5
Readings: taking readings	SPS.13
Do not take readings	SPS.13.1
Only record readings	SPS.13.2
KNOWLEDGE ACCESSING - KA	
Access Internet	KA.1

Adapt Internet for blind learners	KA.1.1
Internet not functional	KA.2
Not the task of teacher to access information for learners	KA.3
OBSERVATION – O	
Cannot observe visually	O.1
Apply alternative senses	O.2
Learn from other countries	O.3
Listen attentively	O.4
RECORDING OF INFORMATION – R	
Does not find it difficult to record	R.1
Blind learners do not take readings but record them	R.2
Blind learners can interpret information	R.3
EDUCATOR PERCEPTIONS – EP	
Blind learners cannot describe and explain because they cannot observe	EP.1
EDUCATORS – ED	
Educators are not Braille literate	ED.1
Educators should be dedicated	ED.2
Facilitating blind learners is a tedious process	ED.3

6.8 SUMMARIES AND CONCLUSION

Four themes and their sub-themes were discussed. The views of educators and learners in relation to the acquisition of science process skills, strategies for recording data, sources of information, predicting, analysing and evaluating biology programmes, et cetera, were analysed and discussed.

The chapter has shown that much still has to be done in changing educators' perceptions so that they can effectively mediate biology to blind learners. The chapter further revealed that educators' understanding of and perceptions towards biology and blind learners add a complex dimension to the debate that South African blind learners must or must not learn biology.

Educators play an important role in the development of learners in all education settings and in different learning mediation environments. It will be necessary to investigate why they do not mediate learning to the blind as expected of them.

Ostensibly, viewpoints of caution and advice have emerged from the data: that education authorities from national level to local level must not expect miracles in the mediation of biology to blind learners, in the absence of the provision of adequate resources and relevant support. It is necessary and important first to address learning mediation problems, before high expectations and demands are placed on educators of blind learners. This, however, does not suggest that educators have to sit back and wait for all these problems to be solved first, before they use their own dynamism in their attempts to accommodate blind learners.

CHAPTER 7

SUMMARY OF THE RESULTS OF THE EMPIRICAL INVESTIGATION, CONCLUSIONS, RECOMMENDATIONS AND IMPLICATIONS

7.1 INTRODUCTION

For the reader to keep in mind what this work intends achieving, it should be remembered that the main aim of the investigation is to determine how the learning of the life sciences is facilitated (mediated) in special schools for visually impaired learners and to establish how the lessons learnt from this experience could be implemented to the advantage of these learners in the Senior Phase and Further Education and Training Band and in Outcomes-based education settings.

The purpose of this chapter is in the first place to summarise for the reader the main findings that emerged from the literature survey and the empirical investigation. This is followed by the recommendations which apply to the investigation as well as the implication of such recommendations to theory and practice. The limitations of the investigation as well as possible future research are also listed in this chapter.

To achieve the aim listed above, the following objectives were envisaged for the study, as outlined in paragraph 1.4.2, chapter one of this thesis.

- To determine how their lack of visual ability during the learning mediation of biology and other life sciences impacts on blind learners, life science educators, special schools and Outcomes-based education itself.
- To assess whether the present teaching of blind learners in special schools is in line with the Outcomes-based Education policy and to determine whether educators are achieving the learning outcomes specified for the teaching of the life sciences.
- To determine (assess) the outcomes specified for the teaching of the life sciences/biology in secondary schools in terms of the revised national curriculum statements.
- To examine the characteristics (substance and syntax) of the life sciences/biology as a subject and to use these characteristics as criteria for the selection of appropriate learning mediation strategies.
- To evaluate existing learning mediation strategies and methods for the life sciences against the outlined national curriculum statements and to determine to what extent these strategies and methods are being met by educators in special schools.
- To determine whether and how visually impaired learners achieve the learning outcomes specified for the life sciences/biology and establish which variables restrict effective teaching and learning in the life sciences/biology classroom.
- To apply and assess the findings regarding the mediation of the life sciences/biology in special schools to the practices and strategies proposed for the mediation of learning in the life sciences/biology in inclusive educational settings.

From the data collected and analysed, it appears that the mediation of life sciences to blind learners in special schools is difficult regardless of the resources available and the varied expertise their educators may have. One's motivation for this claim will be justified in the paragraphs to follow. Placing blind learners at inclusive schools presently has serious implications for the teaching/learning environment. Perhaps these implications could be an option to be considered in future, after the socio-economic impact of the policy has been tested and taken into consideration. The problem of not effectively mediating learning to blind learners and the failure in not rendering adequate services could be attributed to the fact, as Yoken (1979:iii) puts it, "…(t)hat we have barely scratched the surface in serving disabled individuals". Blind learners in South Africa who are studying life sciences are marginalised from many educational activities and will remain in this position unless and until something to correct the existing trend is done to alleviate their plight. The problem is further complicated by the fact that not enough research into the mediation of life sciences to blind learners is conducted.

To bring a halt to the unfavourable learning mediation conditions that blind learners experience, and to their marginalisation from the life sciences, proper solutions are urgently required. Governmental and non-governmental organisations need to expand their efforts in these and other areas discussed in this report:

- Research;
- Educational services;
- Employment services/opportunities; and
- Public awareness.

7.2 SYNOPSIS OF THE STUDY

In this study, the researcher elucidated the roles of special schools regarding the mediation of life sciences and lessons learnt towards establishing an inclusive education policy for the Outcomes-based classroom. The study further considered how the researcher intended addressing the problem of properly mediating and accommodating blind learners in biology learning mediation classes.

The research provided a framework for developing, facilitating and providing a qualitative, accommodative and supportive education system. Such a system will only become possible when all stakeholders take into consideration the guidelines proposed in this study and the suggested techniques or strategies for accommodating and mediating learning to blind learners. Proposed guidelines and listed techniques and strategies are essential for improving education settings and the curriculum.

The study has investigated the learning mediation of biology to blind and visually impaired learners, and made recommendations regarding aspects of the mediation and adaptation of biology as a subject. The learning mediation strategies for the blind and visually impaired learners have been dealt with in chapter four of this thesis. A report on the findings of this work is presented and entails advice, mediation challenges, curriculum challenges, adaptation challenges, needs and concerns.

This investigation was guided by the following research hypotheses, as outlined in paragraph 1.5 (chapter 1), which the researcher believes to be verifiable because the data collected and analyses supports them.

1. The mediators of the life sciences/biology to visually impaired learners in secondary special schools are well-acquainted with the envisaged learning outcomes to be achieved in science classrooms but rely heavily on the transmission of information as delivery mode, as opposed to investigative and inquiry teaching strategies, mainly because of the lack of visual ability of learners and inadequate resources.
2. Visually impaired life sciences/biology learners rely heavily on instructional support mechanisms as principles for effective teaching and learning in the science classroom but these conditions are not met because of the lack of resources and of the necessary financial and logistical support in special and inclusive schools.
3. Life science and biology educators apply creative and innovative learning mediation strategies in special schools for the blind and visually impaired learners.
4. Educators responsible for the mediation of biology and life sciences in special schools for the blind are fully equipped to optimise the potential of their learners in terms of the requirements put forward by the outcomes for biology and the life sciences in an Outcomes-based learning environment.

Furthermore, the study by means of qualitative data collection techniques and strategies sought for a better understanding of whether life sciences possess the potential to improve the quality of learning for blind learners. The researcher further verified that everyone (blind and visually impaired learners included) enjoys the right to education, which the State through reasonable measures should make progressively available and accessible.

The “truths” sought, include the question whether the four learning outcomes discussed in chapters 5 and 6 are achievable by blind learners. The Education White Paper 6 (2001:30) depicts education as accommodative, flexible and accessible to all learners, regardless of the nature of their learning needs. The study revealed that the biology curriculum created the most significant barrier to learning in terms of the exclusion of many blind and visually impaired learners, especially regarding experiments/observations, tabulations, acquisition of science process skills in the absence of visual ability and adapted equipment, acquisition of information in the absence of accessible learning mediation materials, et cetera.

Additional barriers to the learning mediation of biology seem to be stemming from each of the following:

- The content of the learning mediation programmes;
- Poor management or organisation of learning mediation classes;
- Negative perceptions that some educators still hold towards the blind and visually impaired: that they cannot cope with biology since they lack visual ability;
- Inappropriate mediation style and pace of educators;
- Rigid timeframes for the completion of the biology syllabus;
- Inadequate methods and techniques of assessment; and so on.

One further observed that certain barriers arose from the facts that:

- Blind and visually impaired learners experience difficulties in applying science process skills because of their lack of vision, of confidence, and a lack of motivation from among educators, and so forth.
- Tabulation remains a problem to blind learners and during the investigation, it was revealed that learners were given "ready made" material and not taught how to draw.
- Many educators engage their blind learners very seldom in practical work, field trips or related activities. This observation is supported by some educators who participated in the focus group interviews.
- One gained the impression that the practical activities in which blind learners were involved were limited to very simple and elementary exercises that called for minimal intellectual challenges or few advanced problem solving skills.
- In his conversations with learners, the researcher formed the impression that very few of them had access to subject-related information, with specific reference to computers, encyclopedias and recent publications. This was confirmed during the follow up interviews.
- Many educators indicated that they adapted the traditional facilitation strategies (such as demonstrations) to enhance learning for the blind learners. The learners, on the other hand, indicated that many of the activities relied heavily on a "tell and talk" strategy.
- It seems educators at special schools do not attend, or are not invited to, workshops where the developments in adapted learning facilitation mechanisms are shared.
- At some schools, learners did not follow a cooperative learning strategy because the totally blind and partially sighted learners were in separate classes.
- The researcher also gained the impression that not much is done by educators to stimulate and develop the senses of blind learners during the teaching of the life sciences.
- Finally, he further observed that certain barriers arose from the physical and the psycho-social environments within which mediation of learning occurs.

7.2.1 FINDINGS EXTRACTED FROM THE LITERATURE REVIEW

(a) Learning of biology and/or life sciences (chapter four)

Authors such as Mwamwenda (1990); Drinkwater and Niewoudt (1999); Van Wagner (1994); Fraser *et al.,* (1996); Pauw (1984a, 1990b and 1991c); Engelbrecht *et al.,* (1999); Feuerstein (2001) revealed, as discussed in chapter four (subsections 4.1.1-4.1.3), that learning is governed by the law of effect, readiness and exercise (doing/practice/experiment). When all learners learn, they successfully make or unmake connections on the basis of the subsequent results.

Various authors further argued that for learning to be effective in all respects, educators should possess competences that will encourage them to mediate knowledge and truth. As a result, all learners should be able to learn when educators present to them teachable, understandable and learnable information. Neibaur, Day and Sebastian (2002:103) argued that education is broader than the distribution of reading and study materials. For learning to occur, there must be more than this. Communication is the part of the "more". Learning is supported by dialoguing with the teacher and with other students.

(b) Subjects or learning areas (chapter three)

Van Aswegen *et al.,* (1993) argued, as shown in the literature reviewed (chapter three subsection 3.2), that subjects/learning areas are not complete when no substantial effort is made regarding the development of some appreciation of the structure of subjects/learning areas themselves, as these structures relate to learning mediation. The structure of the life sciences is one that is characterised by an active field of inquiry complemented by experimentation, based on principles and concepts that are subjected to modification and adaptation.

(c) Exploration, experimentation and explanation (chapters three, five and six)

The researcher found during the literature review that extensive and intensive testing, observation, evaluation, assessing, discovering, et cetera are important during the learning mediation of life sciences and must be carried out.

According to the literature reviewed, learners should possess cognitive skills so that they are able to explore, experiment, explain, infer, classify, attach meaning to information, as well as to associate various types of information with each other.

When learners are able to carry out these tasks, this will reveal to the educator an idea of:

- The basic science process skills the learner possesses;
- The learner's interests towards the subject;
- The learner's general attention;
- How the learner can be evaluated or assessed; and
- The progress the learner makes in that subject.

(d) Learning environments (chapter four)

It became clear from the literature reviewed that for proper, accessible, effective and accommodative learning to take place, the social and psychosocial environments have to be conducive (please refer to chapter four subsection 4.1.3). Authors such as Friend and Bursuck (1999) and Pauw (1984a, 1990b and 1991c) support this notion. Fraser *et al.,* (1996) argued that the best way to learn is when someone is aware of the demands of the task. This implies that one knows exactly what is expected of him or her. Therefore, the educator and learner's duty will be to decide whether learning should take place, when it should take place, why it should take place and how it should be achieved.

An adequate learning environment possesses the potential to encourage the learner to allow his or her intellectual competence to guide and direct the learning processes. However, environments cannot on their own succeed in making learners learn. Learners will need appropriate learning mediation strategies, resources and support. Van Wagner (1994); Pauw (1984a and 1991c); Ball and Keller (1994) argue in support of these issues.

(e) Observation (chapter four)

Owing to lack of visual ability, blind learners find it difficult to conduct experiments or observe them. Please see chapter six; the subsections titled educators' interviews and Focus Group interviews particularly (The conduction of simple tests and surveys)

Betts (1993) and Gettys and Jacobson (2000) pointed out that most experiments/observations are visual, e.g. reading a scale or "noting a colour change". If vision plays an essential role in experiments, and while the lack of it deprives blind and visually impaired learners of those visual experiments, then the hypothesis that blind and visually impaired learners will not cope in life sciences is true.

(f) Educational Technology (chapter four)

The literature revealed that technology is indeed a force more than ever before, in the current technological era, that possesses the ability to penetrate the core of life and mind. (Please see chapter four, subsection 4.1.3 and section 4.9.) Blind learners can benefit from it in life sciences and other subjects. Owing to technology, access to information is possible and practical. Authors such as Singh and Manser (2000); Pierce (2002) and Mani (2001b) have expressed this sentiment. Abner and Lahm (2002:98) quoted Earl and Leventhal (1997a:14), who stated that "(a)ny blind person not learning Windows is severely limiting his/her job marketability."

Literature review revealed that technology enhances learning mediation for and the lives of learners with special needs and those of their educators. Technology offers fundamental support for the whole range of learners with special needs.

Additional benefits of information communications technology, according to Allen (1997:6-7), include:

- Information contained could constitute resources for educators;
- Technology enhances professional development;
- Some websites could offer ideas on teaching mechanisms;
- Some websites contain information on specific subject areas;
- Connection to the internet offers educators and learners the facility to contact their peers, regardless of location;
- The internet offers an opportunity to take information directly into schools;
- The internet allows educators and learners to share information and offer mutual support.

(g) Educator training (chapter four)

The researcher noted arguments Pauw (1984a and 1991c); Spungin (1977a); Mani (2000a); Mason (2000) and the Government Gazette, (Vol. 415 2000) that educator training is necessary for educators to understand the educational needs of learners. Furthermore, educators will be made aware of specific assistive devices used by blind learners, and so forth.

Abner and Lahm (2002:98) stated that "(t)o provide high-quality services and instruction, it is vital that certified teachers of students with visual impairments be well versed in the selection and application of current access technology." According to them, the following are compelling reasons for educators to develop skills in the use of microcomputers and access to technology. First, educators will be able to provide effective instruction about basic computer skills, to select and use the best access devices, and provide opportunities for the functional application of these skills. Second, educators will be able to maximise the efficient use of their time by using technology to thoroughly prepare instructional materials, maintain records, and complete other necessary paperwork. Third, such educators will be in a position to advocate the purchase of appropriate equipment for students' use. Abner and Lahm (2002) argued further that to benefit from assistive technology, "…(s)tudents who are visually impaired must have contact with dynamic teachers who have sufficient knowledge and skills in the use of technology." Adequately trained educators are more likely to facilitate and develop skills in their learners, as they will focus more on the outcomes of learning and the application of knowledge by their learners. Other advantages of educator training were discussed in chapter four (subsection 4.10).

(h) Modification/adaptation of learning mediation activities (chapter four)

The literature reviewed, advocated the adaptation of the various learning mediation activities, including experiments, daily lessons, and the like. According to the literature, adaptations lead to greater autonomy for learners and as a result should be robustly pursued. (Please see chapter four section 4.7.) Techniques necessary for integrating learners as well as for providing them with more meaningful experiences have to be developed. Betts (1993); Flair and Seizer (1990); Van Wagner (1994) and others , are advocates of modifications and adaptations. Flair and Seizer (1990:795-799) argued that experimental modifications leading to greater autonomy for these individuals must be pursued. This implies that techniques that can help in integrating handicapped students into science subjects must be developed.

According to proponents of modifications to learning mediation, modifying and adapting techniques is not the only answer to the problem of mediation of learning to blind and visually impaired learners. Mediating learning to such learner's further calls for a firm grounding in a multi-sensory approach if blind and visually impaired learners are to receive positive benefits, such as being able to take part in activities related to tactile and auditory interactions. To achieve this, opportunities to manipulate and explore equipment and materials have to be provided. Furthermore, science-learning mediation involves taking risks. Blind and visually impaired learners must not be discouraged from doing so.

(i) Learning mediation aids (chapter four)

Authors such as Betts (1993) and Lipkin (1995) support the idea that mediation aids must be used because they help blind learners to comprehend the different structures of different things. Abner and Lahm (2002:99) argued that with learning mediation aids, learners achieve greater independence in school: for example, scanners, CCTV's, voice synthesisers, and Braille translation software enable blind and visually impaired learners or students to navigate word-processing software, complete maths assignments, and explore the Internet. This implies that the ability of blind and visually impaired learners to gain access to text and the ease of editing papers on computers significantly improve their reading and writing skills. In this new educational order, most certainly, learning will be closely associated with and facilitated by learning mediation aids. Authors stated above as they put it, "(f)or those who are visually impaired, technology will certainly be one of the tools used to promote literacy."

Technological learning mediation aids provide blind and visually impaired learners with good access to print materials and, as a result, enhance their competitive equality. Literature reviewed demonstrated that other learning mediation aids are also effective in involving and stimulating blind and visually impaired learners' other senses. Objects, relief maps, embossed diagrams and scale models are some of the learning mediation aids that possess the capability for enabling blind and visually impaired learners to come into contact with new realities. Other advantages of learning mediation aids are discussed in (4.1.5).

(j) Educational approaches (chapter two)

The Education White Paper 6 (2001) argued that there are different education approaches for disabled learners. According to that policy document, the objective of the service sector in any country must be to provide effective services for persons with disabilities. However, before any education system is implemented, stakeholders must carefully weigh the advantages and disadvantages of adopting any particular approach. Different approaches were also discussed in chapter two (subsection 2.5.3).

(k) Attitude towards inclusion (chapter three)

Wall (2002) argued that including blind learners is made difficult because of factors such as educators' lack of confidence and ability to teach these children. The literature further revealed that educators at special schools expect too little from blind learners. According to the literature reviewed, such educators with pessimistic attitudes and experiences will beget more negative attitudes in such learners. Higgins and Ballard (2000:164), regarding negative attitudes, argued that what individuals like to think of as their attitudes, their values, their actions are in fact public rule systems or codes which define all possible modes of thought and action.

According to the literature, attitudes, stereotyped beliefs or stigmas attached to individuals who are blind and visually impaired can be attributed to many factors, e.g. their being perceived as helpless, docile, dependent, melancholic, aesthetic (more sensitive to music and literature) and serious minded. The above-referred authors contended that those stereotypes lead to stigmas because people with severe vision impairments are seen as "different": physically, psychologically, morally and emotionally inferior to sighted persons. The inferiority complex that educators associate with blind and visually impaired learners contributes towards the former not being convinced that these individuals can master biology. This sentiment featured prominently during interviews with educators and focus groups.

(l) Prejudices (chapter three)

The literature revealed that unnecessary demands, unfamiliar surroundings, an inflexible curriculum, inflexible assessment standards, inadequate learning and teaching facilities, badly timed instructions, unwelcoming teaching and learning environments are prejudicial factors resulting in ineffective learning of persons with visual impairments. Authors such as Bond (1998), Van Huijgevoort (2002), Charles and Yewpick Lee (2003) and Mani (2000a) support this notion. According to Van Huijgevoort (2002:60), "(p)eople are limited not only by physical barriers, but by the attitudes of others." He further argued that "(s)tigmatization is an important factor in a person becoming … isolated." Prejudices may put blind learners at risk of isolation, possessing few friends and inadequate social skills.

According to Charles and Yewpick Lee (2003:53), educators' attitudes and assumptions influence their interactions with and expectations of learners. They stated, “(l)ike most children, children who are blind and vision impaired usually respond positively to being given class responsibilities, to warm friendly guidance and support, opportunities to help others and not always be on the receiving end of help, high but realistic expectations, opportunities to take risks and learn from their mistakes, and opportunities to succeed, both individually and with their peers. The most vulnerable aspect of many learners is a lack of self-esteem. A teacher's positive attitude and belief in a child is crucial and can have lasting effect.”

(m) A need for change (chapter two)

According to Curriculum 2005 Lifelong Learning for the 21st Century (1997), Bertram *et al.,* (2000), Education White Paper 6 (2001) and other sources, change in education was necessary for empowering all citizens. Such a change has been instrumental in altering the old values and beliefs. Change had to take place in order to encourage and promote critical thinking. It was instrumental in introducing a lifelong education system which is people centred. Because of this, for the first time in this country, high quality education will be available to everyone regardless of age, gender, race, ability, and so on. Central to that change is the introduction of the new curriculum for Outcomes-based Education and Training.

7.2.2 FINDINGS EXTRACTED FROM THE INTERVIEW TRANSCRIPTS AND FOCUS GROUP INTERVIEWS

The following discussion reflects on the findings that have been uncovered by the feedback in and the reports from the focus group interviews, as explained and reflected in chapter six of this thesis.

FINDINGS APPLICABLE TO THE GRADE 12 BLIND AND VISUALLY IMPAIRED BIOLOGY LEARNERS

Overall, just a small number of blind learners take science related subjects up to Grade 12.

One could attribute this problem to the following factors:

- Lack of educator training in special education: Most educators working at schools for the blind and visually impaired received a general education training qualification. They lack ideas to adapt the curriculum and accommodate blind and visually impaired learners in the life sciences’ environment. This implies that they will not encourage learners to do a difficult subject while they cannot mediate or facilitate it properly.

- Educators’ negative perceptions (see paragraphs 6.4 and 6.5): Some educators express the view that blind and visually impaired learners cannot cope with the demands and challenges of life sciences, including observation, exploration and experimentation. Special schools’ educators are not prepared to take risks by allowing their learners to do science. The researcher deduces that in the opinion of such educators, simple subjects (comprising theory and not practice such as languages, commercial subjects, religious subjects, social sciences subjects, et cetera), will assist blind learners to obtain good Grade 12 grades and as such, be testimony to the entire country that they are good educators, while science subjects may tarnish their teaching reputation because there is a likelihood that the same results may not be achieved.

- Life sciences competences (see paragraph 6.5): Educators lack the competences to mediate life sciences to blind and visually impaired learners; hence they do not want to expose their weaknesses.

- Resourcing (see paragraph 6.5): Some schools are poorly resourced. Science subjects require good resources to be successfully mediated. In the absence of human and material resources, few blind learners will follow the science stream.

- Curriculum: In the past, special schools used to offer their own curriculum (comprising pre-vocational training, commercial subjects, religious subjects, languages and social sciences subjects). Educators, therefore, find it difficult to offer a curriculum nationally prescribed by the Department of Education. This is why they do not abide by the department's directive that mathematics and science are compulsory for all children. Should these problems not receive immediate and urgent attention, few blind and visually impaired learners will gain access to science subjects in general.

- Physiology: Blind learners seem to cope better in physiology than other life science subjects. This is so because although there are drawings and also good models that the blind can feel tactually. In addition, physiology seems to present fewer problems in terms of adaptations because it comprises more theory than practice. Furthermore, it is offered because it opens a door to one of the popular careers for the blind, which is physiotherapy. It is for this reason that educators prefer it as a subject because it does not expose their weaknesses.

- Sources of information: Braille books, recorded tapes, friends, educators, magazines, internet, experts, the environment, radio and television are methods recorded as being used when blind learners and their educators at South African schools obtain information in unfamiliar and complex settings.

Regrettably, most schools use outdated and worn out books without diagrams, relief maps, and other methods of tactilely presenting information. When orders are placed with printing presses, books arrive some months or a year later, when they are no longer required. In other instances, printing presses do not produce them because it is not cost-effective to do so due to the small orders placed by schools. Computers could be a solution, but those who are in charge of them are not computer literate and they use them for their private matters. When learners loan books from book lending institutions, because of huge demand learners can keep them for a few months only. When they return them, it means they have no sources to refer to or obtain information from. In the past, special schools used to have Braille specialists whose tasks among others included producing Braille books. Such posts have at the present moment been terminated, with the implication that in-house Braille production is no longer done - at the expense of learners. Print sources are readily available but blind and visually impaired learners cannot access them independently. Public libraries do not make a special effort to acquire accessible print and electronic information. This implies that without the assistance of sighted people, blind learners cannot benefit from these facilities. Such factors debar blind and visually impaired learners from obtaining information in unfamiliar and complex settings.

- Potential and interest to learn biology (see paragraph 6.4): Blind learners have the potential and interest to learn biology and it has been proven that biology opens many career opportunities for them. Factors alluded to in previous paragraphs, however, cause them not to study biology, though they may have shown interest and have the potential.
- Special apparatus (see paragraph 6.4): Special apparatus is very expensive. This not only inhibits learners from using and accessing it, but limits their participation and contribution.

One may attribute this deficiency or total unavailability of special apparatus to:

- The rand/dollar exchange rate: Importing this kind of apparatus from international manufacturers is expensive, taking into account the current rand /dollar exchange rate.
- Schools do not show interest in obtaining it: Schools do not invest in this apparatus because learners do not do science up to Grade 12l. They feel that this expensive, state-of-the-art, accessible apparatus will just gather dust in the schools' storerooms because of not being effectively utilised, and will constitute a so-called white elephant.
- Unpreparedness of engineers to invest in small markets: South African engineers do not invent disabled user-friendly technology because it is not a lucrative market to invest in.
- Lack of innovative and creative skills: Educators are also not creative and innovative even though there are simple things they could do.
- The non-recognition of technical 'know how': Schools do not have a technical section that could be responsible for adapting some kinds of apparatus or manufacturing others.

The variables highlighted above restrict effective teaching and learning in the life sciences/biology classroom.

THE IMPORTANCE OF ACQUIRING TABULATION SKILLS

Most blind learners lack skills to make tabulations independently. Blind learners should be equipped with such skills, though. The only technique that is applied to make tabulation possible for blind learners was discussed in the previous chapter. This is also indicative of the fact that educators are not innovative. Poor resources also have a profound effect on learners' attainment of tabulation skills.

The value of accessible material (see paragraphs 6.4 and 6.5): Accessible material in Braille and electronic formats helps to lessen blind learners' dependency on partially sighted classmates and educators.

Tests and surveys: Simple tests and surveys are conducted, but only to a limited extent and this should be increased.

Data recording: Learners are encouraged to record data correctly by putting it into Braille for later use. They are encouraged to write notes in Braille. Joaquin Correa in his article entitled, "What Braille has meant to me" (WBU 2000:6), argued that Braille and typing, which he had been taught at a school for the blind, were to be his only working tools. Braille has enabled him to "…(d)evelop a considerable ability to take notes, summarize and transcribe texts, and learn mathematical symbols, in short, to make the very most of Braille and make up for … educational disadvantages with creativity."

He continued that "(a)fter a very rewarding academic experience, I graduated from middle school and decided to go on with my career training. Now I believe that without the background I had acquired thanks to my ability to make direct and personal contact with texts of all kinds, without my knowledge of spelling and punctuation and, above all, without the skill to elaborate on texts that I'd drafted in Braille, I couldn't have succeeded in that stage of my education and Braille has been essential in my professional life." Not only has my ability to read and write allowed me to mix skilfully and confidently in different work and intellectual environments, but it has helped me express myself in written form and perform any number of tasks, ranging from drafting the minutes, reports, and all other documents associated with serving as secretary of the board, to public speaking and teaching, in which I use Braille to outline my lectures, read out full texts, and engage in other intellectual activities".

Field trips: Field trips are infrequently undertaken. This could be attributed to:

- Learners and educators expecting Government to subsidise trips.
- Educators not realising their importance.

Observations: There are instances where blind learners observe biology phenomena. However, lack of full visual ability deprives them of the advantage of observing and experimenting.

Blind learners should do experiments even though they experience problems and frustrations. The researcher points out that observations are experiences leading to the systemic recording of events that will be analysed and synthesised by a researcher. Observations are one of any researcher's best and most effective tools to gather data. Observations depict researchers' subjective and objective experiences through the meanings they provide. Through observations, researchers investigate and reveal complex and difficult everyday life situations and events. Through observations, sighted people obtain visual experiences, knowledge and understanding. In the sighted researcher's quest to analyse and synthesise collected data, s/he can be objective. The blind researcher, who depends on second hand information, may be subjective. The reason why blind researchers may not be comfortable with observations is the bias that such practices may present as a result of depending on someone. The dependency may negatively impact on the trustworthiness of the results.

Describing and explaining: Blind learners are able to describe, explain, interpret, analyse, hypothesise, and evaluate programmes. They, however, find it difficult to design certain structures and patterns on their own. Designing normally involves vision. Because blind learners do not see, they therefore, believe that they cannot design structures and patterns.

Blind learners' biology predicaments (see paragraphs 6.4 and 6.5): These seem to be stemming from the following:

- The content of the learning mediation programmes;
- Poor management or organisation of learning mediation classes;
- Stereotypes that some educators still possess towards the blind: that they cannot cope with biology since they lack the visual ability;
- Educators' inappropriate mediation style and pace;
- Rigid timeframes for the completion of the biology syllabus;
- Inadequate methods and techniques of assessment, et cetera.
- The researcher further noticed that certain predicaments could be attributed to the physical and the psycho-social environments within which mediation of learning occurs.

Most of the variables listed above have been discussed in great detail in this thesis and will therefore not be reiterated again.

7.2.3 FINDINGS EXTRACTED FROM THE INTERVIEW TRANSCRIPTS WITH EDUCATORS

Science process skills:

In 6.3.1.2 (Learning outcome 1: scientific investigation question 1) the data revealed that educators are acquainted with science process skills but due to unavailability of equipment, lack of creativity and innovativeness, learners just concentrate on theory and not practice.

The promotion of a flexible and accessible learning mediation environment:

Data gathered and analysed under 6.3.1.2 (Learning outcome 1: scientific investigation) revealed that few educators worked very hard to promote the accessibility of the biology learning mediation programme and to provide adequate support to blind learners. It became clear that most educators have shown little enthusiasm, dedication, creativity and innovativeness. Educators rarely embarked upon processes that recognised learners' knowledge, techniques and strategies for observing and conducting experiments.

Similarities and differences:

Empirical data, as discussed in 6.3.1.2 (question 2), revealed that educators created opportunities for their learners to distinguish between similarities and differences. The importance of providing blind learners with concrete objects rather than abstract objects was emphasised. Other strategies used for this include comparison and contrast, talking about familiar things before unfamiliar things, and the like.

Recording of data:

Question five in 6.3.1.2 revealed that educators used different strategies to encourage learners to record data correctly. Strategies, e.g. dictating notes to blind learners, giving blind learners prepared notes, and indicating salient points during the learning mediation were used.

Tabulation skills:

Data (in Learning Outcome 1: Scientific Investigation question 6) indicated that it is a challenging exercise, for many educators, to equip learners with tabulation skills. Though a solution to this problem is found in technology, unfortunately blind learners cannot draw nor operate tools such as the Zytec machine.

Learning mediation strategies:

Data in (question 7) showed that educators used common strategies to mediate learning to blind learners. Any recognisable difference was found in modifications here and there to meet learners' needs, their styles of learning and their pace of learning.

Information acquisition:

Data discussed in 6.3.1.2 (Learning Outcome 2: Constructing Science Knowledge, question 8) revealed that different methods, including textbooks, magazines, periodicals, co-workers, newspapers, radio, television, scientific video tapes, the internet, the environment itself, scientific excursions, experts, and so on were used by educators to acquire valuable information.

Describing and explaining phenomena:

Data gathered and analysed (question 9) revealed that educators created opportunities for their learners to describe and explain concepts, principles, laws, models and theories. However, educators emphasised that ability is influenced by the situations in which blind learners find themselves. Educators warned that blind learners should not be expected to describe and explain things that need to be visually observed.

Prediction of outcomes:

Data gathered and analysed (Learning Outcome 3: Science, Society and Environment, question 11) suggested that in order for blind learners to predict the outcomes of an intervention, educators have to give them background knowledge prior to the conducting of an experiment. When learners are given background information, and possess understanding and intellectual ability, predicting the outcomes of an intervention will be possible. The same applies to analysing data, expressing opinions about or reflecting on the mediation of life sciences. For learners to express such reflections, strategies such as discussions, interaction and sharing information, prompting correct responses from them and the like must be used.

7.2.4 THE CENTRAL FINDINGS OF THE STUDY

Having studied the findings extracted from the literature review, feedback and the report on educators and focus group interviews, one realises that there are findings that are crucial and deserve to be discussed further. The central findings of this investigation comprise the following main categories:

Specialised education and support systems:

The study revealed that the needs of blind and visually impaired learners are enormous and largely unmet. This could be attributed to educators not receiving specialised education to effectively and meaningfully mediate learning to theses learners and support systems that are not in place. Institutions of higher learning in South Africa offered and continue to offer special needs education programmes. Great emphasis is laid on learning behaviour and personality development. Aspects that are prominent in those programmes include: contemporary juvenile problems, sexuality, drug abuse, teenage suicide, the milieu deprived child, abuse, juvenile delinquency, child in crisis, et cetera.

The researcher wishes to bring to light the fact that while all of us may argue that blind and visually impaired learners are currently served or would be served by educators who have undergone training in "special needs education" experience with similar efforts and endeavours to homogenize disability specific issues into other large scale human development initiatives, always yield the same results. This implies that the needs of one or more disability groups simply get overlooked or totally lost. In the same breath, the needs of blind and visually impaired learners are overlooked or get lost in the current "special needs education" programmes because such programmes do not equip educators with knowledge of expanded core curriculum for blind and visually impaired learners comprising areas such as: language and communication, literacy through Braille and/or print, listening skills, concept development, visual efficiency, physical abilities, developmental orientation and mobility, social skills, life skills and adaptive technology.

Obtaining knowledge about aspects listed above under the current "special needs education" programme is imperative to any educator. However, cognisance should be taken of the fact that educators facilitating learning to blind and visually impaired learners need both extra knowledge and specific skills to deal with classroom challenges that lack of vision may pose. The body of knowledge and skills unique to the needs of blind learners that educators should acquire, provides a tool for access to the regular curriculum as well as development of independence skills by blind learners. Disabled learners and in particular blind and visually impaired learners, require and deserve specific strategies that address their unique learning mediation needs.

It is a truism that ordinary "special needs education" programmes do not equip educators with skills to reach and meet SPS outcomes listed in the biology Revised National Curriculum Statement. Without the "special needs education" programme/s devoted and dedicated to the teaching and learning mediation of blind and visually impaired learners, educators would battle to efficiently mediate learning to blind and visually impaired learners.

In instances where specialised education and support systems are not in place, effective advocacy, professional advice and technical assistance will not prevail. Further, the goal of equal participation by blind and visually impaired learners and the right to be mediated by educators who fully know and understand them better, cannot be achieved. The implication therefore would be that blind and visually impaired learners in South African schools would continue to be marginalized and deprived the privilege of effective and meaningful learning on the grounds of their educators having not received specialised training. Specialised education and support systems have the capability to drive the promotion and the provision of early detection of blindness programmes, early intervention programmes and other school services which encourage parent/s participation, other family members and the community in general. Further, when adequate support systems are in place, these will ensure that blind and visually impaired learners receive a firm educational foundation. Blind and visually impaired learners will then be "... equipped with relevant skills and knowledge to function effectively" (Support to Schools Programme 2002:24). Furthermore, support systems are important because they fulfil the role of preparing the learner for lifelong learning.

It is incumbent upon the Government to commit itself to support education for blind learners since it is one of the models of service delivery on the condition that all necessary steps are taken in order to put in place the required numbers of educators trained in the special needs of blind learners. Support systems such as: necessary equipment, accessible learning mediation support material, learning mediation aids, funding, transport to public libraries, career counsellors that understand the unique needs of the blind and visually impaired learners, Braille experts, strengthening of special schools and capacitation of educators, sensory development, et cetera, should be provided on a continuous basis. On the funding front, the researcher is of the view that the previously disadvantaged schools should be strengthened and capacitated. When all those are provided, they promote a high quality education in special schools as an alternative to inclusion or mainstream education.

Resources:

By resources, the researcher is referring to educators, support staff, assistive devices, learning support material and related matters. This study revealed that most blind and visually impaired learners do not have access to a fair share of the available special education resources and that partnerships between learners' families and education providers is essential in overcoming barriers to learning. This study further revealed that regardless of setting (special or inclusive schools) and disability, if the blind and visually impaired learner is provided with timely and adequate human and material resources, he or she can develop appropriate skills that will enable him or her to achieve success and independence. It should be borne in mind that if blind learners do not receive both human and material resources necessary to enhance the development of their competences that meet the sensory deficits of blindness, critical learning mediation opportunities will be lost, thus, diminishing the potential for future accomplishments.

Resources are necessary to guarantee proper mediation and accommodation of their needs. Resources and related matters are capable of enhancing blind and visually impaired learners' functionality during learning mediation. The provision of resources promotes the establishment of a sound education system. Therefore, the government will recognise the basic requirements discussed at length in this work regarding education for the blind and visually impaired learners.

Curriculum adaptation:

The researcher regards curriculum adaptation as the translation of policy into "accommodative action" thus encouraging a transformation in the entire educational system which then become sensitised to the educational needs of blind and visually impaired learners.

This study brought to light the fact that an adapted curriculum has a potential of "reaching the unreachable" and thus eliminate exclusion practices from any type and form of education. It also serves as an instrument to meet and/or accommodate the unique and diverse needs of blind learners. The study further revealed that educators have a tremendous role to play in enabling the policy makers of education better understand the educational needs of blind and visually impaired learners and other disabilities.

Below is a list of alternative approaches to curriculum adaptation/delivery and assessment:

- Setting a substitute task of similar scope and demand
- Replacing one task with a task of a different kind
- Allowing the learner to undertake the task at a later date
- Using another planned task to assess more outcomes or aspects of outcomes than originally intended
- Allowing the learner extra time to complete task
- Using technology, aides or other special arrangements to undertake assessment tasks
- Using an estimate based on other assessments or work completed by the learner (in circumstances where the above provisions are not feasible or reasonable)
- Considering the format in which the task is presented, e.g. the complexity of graphs, diagrams, tables, illustrations, cartoons, etc. A range of strategies can be followed to make these accessible to blind and visually impaired learners such as:
    - Picture or diagram simplified or shown differently without compromising complexity of question
    - Picture or diagram replaced by written description
    - Picture or diagram supplemented by written explanation
    - Picture or diagram replaced with a real item or model
    - Unnecessary picture or diagram removed
- Amount of information reduced
- Measurements altered
- Inherently visual material replaced with equivalent non-visual material [s.a.] [s.p.]

However, the researcher is of the view that in order to achieve this, the curriculum should be flexible without lowering the set standards. Adapted curriculum guarantees to the blind and visually impaired learners unlimited access to life-long learning as from pre-school, General Education and Training, Further Education and Training, Higher Education and Training and Adult Basic Education and Training. This will minimise dropouts, push-outs and failures in the learning mediation of biology. People who understand blindness and not be administered by those who run psychological services should head the education of the blind. Technical sections to construct apparatus and models should be introduced at special schools. When books are written, or before they are published, an expert or experts in blindness should be consulted and be given the task and opportunity to make them user-friendly. Educators have to know how to adapt diagrams, experiments, and the like.

The provision of assistive devices:

There are no policies regarding the provision of assistive devices to blind learners in order to enable them to participate actively and competently in the education processes. This lack hampers the development and extension of their potential in science subjects. By educational technology, the researcher refers to Braille slate and stylus, Braille writing machines, thermoform machines, computers, et cetra. Advantages and examples of educational technology for the blind and visually impaired learners were discussed at great length under 4.1.5 and 4.11.

Lack of guiding principles and strategies:

Presently, there are no broad guiding principles and strategies adopted by education authorities to accept their responsibility and accountability to make education as accessible and flexible as possible, as well as acknowledging its social and economic value. In the absence of such principles and strategies, there will be no education justice for all.

Educator training:

Education authorities and institutions of higher learning are doing very little to bridge the training gap between regular and special educators. Most institutions of higher learning have not introduced courses in the facilitation of learning to blind learners. This implies that those educators are inadequately skilled and demotivated, because courses, workshops and seminars re-energise them. Student-teachers should be placed at inclusive or special schools for the blind to acquire experience on how to mediate or facilitate learning to blind and visually impaired learners. Not only will they acquire experience but will as well, experience pressures, particular needs and challenges in facilitating learning to these learners.

Baxter (2004:131) has acknowledged that: "(a)s parents, we all want our children to have the best possible chances of maximising their educational attainment. We know that children's best chances of success come when they have access to teachers who understand the particular needs of children with a visual impairment and who have particular skills in meeting these needs. Appropriate training for teachers is obviously a crucial element in the success of our children."

Negative perceptions:

Educators exhibit negative perceptions towards the ability of blind learners. All stakeholders will only be able to change such perceptions when there are necessary accommodations and unwavering support from educators, parents and government.

Science process skills:

Data collected from respondents and analysed, indicated that tabulations, poses several problems for blind learners. In his investigation, the researcher discovered that blind learners are only given "ready made" drawings and are not taught how to draw independently. Further, it became clear that no other activities or measures are put in place to supplement a loss in drawing ability. The problem is further complicated by the shortage of diagram producing equipment.

Conducting practical work and experiments at school:

The researcher's observation is that many educators engage their blind learners very seldom in practical work, field trips or related activities. This observation was supported by some educators and learners who participated in the focus group interviews, and caused the researcher to conclude that theoretical work was more prominent than practical work.

Very simple and elementary exercises:

When the researcher circumspectly looked at the practical activities in which blind learners were involved, he formed the impression that the activities were limited to very simple and elementary exercises that called for minimal intellectual challenges or advanced problem-solving skills. He is of the opinion that this finding could be ascribed to factors such as lack of visual ability, negative perceptions stemming from educators, lack of innovative and creative skills, and so on.

Lack of access to subject-related information:

From the interviews conducted with learners, the researcher obtained the impression that very few of them had access to subject-related information, with specific reference to technology, (computers), encyclopaedias and recent publications. Educators disputed the allegation. They indicated that such information systems were available to their learners at all times. Blind learners also complained that the information in Braille was outdated and limited. Educators were actually not facilitating the use of additional information technology systems because they assumed that their learners would access such systems independently.

Traditional facilitation strategies:

Many educators indicated that they adapted the traditional facilitation strategies (such as demonstrations) to enhance learning for the blind learners. Contrary to this, learners indicated that many of the activities relied heavily on "tell and talk" activities. The researcher is also convinced that educators actually used the "tell and talk" strategy because during interviews, they could not give good examples of how they actually go about adapting the traditional strategies.

Special workshops:

Seemingly, educators for blind learners in this new educational dispensation are not invited to special workshops where the development of adapted learning facilitation strategies is shared. This is why many of them called for in-service training.

Cooperative learning:

At schools where blind and partially sighted learners attend separate classes, cooperative learning becomes difficult or impossible when all learners are blind. This further means that experiments are not done because the educator is not able to demonstrate, to explain things and to help learners to record information properly.

Sensory stimulation:

One formed the impression that not much is done to stimulate and develop the senses of blind learners during the teaching of life sciences. Educators lacked clear activities for doing so.

The disposition of blind and visually impaired learners:

What became evident in the investigation was the good amount of time and effort educators were spending with their learners in the biology and life science classrooms. It appeared as if the pastoral role of the educator as defined by the "Norms and Standards of Educators" (2000) predominantly exceeded the teaching of biology and life sciences to these learners. The researcher got the impression that the emphasis does not fall strongly enough on the achievement of the outcomes envisaged with the biology curriculum but more on the establishment of a caring and supportive classroom environment.

Reality is therefore not exposed to its full capacity and the blind and visually impaired learner is therefore excluded from the full capacity the learning environment and learning mediation strategies have to offer.

Such inferior intervention impacts negatively on the development of the learner. Not only is the learner being excluded from the life science world, but is the learner also leaving a school system that has not fully prepared him or her to take up their positions in society.

7.3 WAYS IN WHICH THIS RESEARCH SUPPORTS AND ADDS TO BOTH PREVIOUS AND CURRENT LITERATURE

It became clear during the literature review that little previous research had been performed in South Africa and elsewhere regarding the teaching of life sciences to blind and visually impaired learners in special schools, and lessons learnt towards establishing an inclusive education policy for the Outcomes-based classroom. Erwin *et al.,* (2001:339) declared that "(a)lthough the literature on the pedagogy of science and children with disabilities is growing, … there is a dearth of knowledge specifically about science and children with visual impairments. Most of the information on the science curriculum and adaptations for students who are visually impaired was written over 20 years ago."

One has established that most schools for blind learners offer physiology and natural science to blind learners, while biology is offered to partially sighted learners. The present study further supports this, because it seems the same trends are apparent for blind learners at inclusive schools.

Therefore, the research is deemed to be significant because of the following reasons:
It will encourage South Africa to address the learning mediation problems of biology for blind learners. It will provide a basis for further research in this area (the life sciences) by exploring their current status and their accessibility to blind learners. It will shed light on the perceptions of educators regarding the mediation of biology to blind learners. It has addressed the constraints educators face when facilitating learning for blind learners in an Outcomes-based Education learning mediation environment.

Regarding learners, this study is significant in identifying the constraints they experience when they have to learn biology. Although much information on how to facilitate life sciences to sighted learners is available, there appeared to be little documentation on the availability of such information or material concerning the learning mediation of life sciences to blind learners. Blind learners are a particularly disadvantaged group in South Africa. Therefore, the research adds value to the poor base and limited scope of literature in this field in South Africa. Its findings, recommendations and implications could be useful to stakeholders in education because it will inform them as to how much needs to be adapted, what strategies proved to be useful, whether the outcomes stated in the National Curriculum Statement Grade 10-12 (schools) Biology

Life Sciences Draft October 2002 are achievable by blind learners, and so forth. The study uncovered many barriers that prevent blind learners from benefiting from biology.

The research further builds on the reasons why biology is useful for improving blind learners' level of education, interest and knowledge. It shows how life sciences can offer increased career opportunities for the blind or other learner populations that are vulnerable and whose conditions and situations make them isolated.

It appears that very few blind learners in South Africa have the opportunity to do life science subjects in the senior grades (10-12). If this trend is not reversed, blind learners will be less likely to learn biology than sighted learners. This research could further be useful in dispelling the myth that visual ability is a prerequisite for learning biology. The study makes the authorities aware of the fact that blind learners have special needs and other learning mediation challenges, which must be considered when making the mediation of life sciences accessible to them.

7.4 WEAKNESSES AND LIMITATIONS OF THE RESEARCH

On two occasions, two educators were not tape recorded because of the tape recorder's mechanical failure. One interviewee refused to be interviewed on the basis that his or her principal did not inform him or her in time and consequently, he or she was not ready or prepared for any interview. Because the researcher's assistant was not skilled at using the videotape, only half of most lessons were recorded. Therefore, a complete reflection of the lesson was not videoed. Information that the sighted assistant captured cannot be relied upon by itself as it is much more open to misinterpretation by the blind researcher.

It is the researcher's prerogative to include or exclude information during the collection of data. If an assistant does this for the researcher, it is likely that the information might be inaccurately recorded, resulting in further errors of analysis being made. Some respondents lacked a good command of English and the researcher exercised his own discretion in clarifying what they intended saying. The problem is that the way he perceived matters might not necessarily have been what the respondent tried to bring to his attention.

In addition, qualitative research cannot be divorced from research biases (refer to the "methodology" section). Interviewees were not given a chance to check mistakes in transcripts.

The researcher has directly experienced other factors contributing to weak areas in the research. They include but are not limited to:

Lack of access to research material:
The researcher experienced problems regarding effective access to print material. The issue was that one had to do a significant amount of reading, which was not accessible as it was in print and the researcher is blind. As long as institutions of higher learning and other public libraries do not possess the right

technology for the blind, it then becomes a daunting task for the blind student and researcher to work independently. Maguvhe (2003b: 117-118) argued that, like any other researcher, the blind researcher is very passionate about access to print: it is always fulfilling, rewarding and satisfying when the blind researcher is able to get without difficulty what s/he wants from the vast store of published work, whether instructional, cultural, recreational, academic, and so on. However, in South Africa at the present moment, and in particular at both public libraries and libraries at institutions of higher learning, accessible material and technological tools are not available for blind researchers to read what they need and want independently and timeously.

Accessible material and technological tools are not only essential in blind researchers' academic lives and contributions. They also play a meaningful role in blind researchers' professional lives and afford them numerous and exciting opportunities to take full advantage of them.

The researcher further believes that the following factors might have flawed this study:

- The possibility of the researcher not having kept fully abreast of the workload, challenges and high demands of the study, as a blind researcher having to be reliant on sighted readers.
- The possibility of not having extracted enough or sufficiently relevant information from the limited text despite much energy, dedication and research time.
- The possibility of misinterpreting the supervisors' comments, which were in some cases in print.

7.5 RECOMMENDATIONS AND IMPLICATIONS OF THE STUDY AND ITS IMPACT ON THE BROADENING AND STRENGTHENING OF POLICY ON INCLUSIVE EDUCATION

Under this header, the following recommendations and implications are discussed:

- Accommodative measures for blind learners;
- Research;
- Government duties and responsibilities;
- Policies and legislation;
- Special devices;
- Modification of materials;
- Inclusive settings;
- Provision of better services;
- The development and field-testing of a comprehensive science package; and
- The South African National Council for the Blind's responsibilities.

7.5.1 ACCOMMODATIVE MEASURES FOR BLIND LEARNERS

The first batch of recommendations comprises accommodative measures for blind learners. Guidelines discussed in chapter four should form the basis of how blind learners must be accommodated.

In addition, it is further pointed out that:

Blind learners require from educators and stakeholders the delivery of an education that meets and suits their learning mediation needs and that is on par with that of their sighted peers?

The implication therefore is that experienced blind individuals, themselves experts in the field of blindness and blind learners, must play a monitoring and advisory role as to the way the psychosocial, physical and classroom environments are prepared to accommodate these learners.

In activities such as experiments, if possible, educators must accord blind learners individualised mediation or encourage a collective and co-operative working relationship among learners.

The researcher further recommends that:

Blind learners be provided with assistants who will help them during experiments. The implication is that more teacher assistant posts will have to be created for this purpose.

Inclusive schools should utilise special educators in making the overall classroom atmosphere conclusive for blind learners.

To achieve this, it is recommended that:

Such a person must promote and inculcate an understanding of the blind learners' potential. The implication is that the Department of Education will have to allow educators from special schools to play a leading role.

In order for blind learners to learn biology, the researcher recommends that:

They must request from their educators clearly defined objectives regarding the outcomes they have to achieve. This will guide them concerning what to look for and expect during learning mediation. In this regard, this implies that the role of the educator will be that of assessing and evaluating the results and progress of learners in order to see whether the strategies used have been helpful in meeting educators' objectives.

It is further recommended that:

Blind learners' tactual and kinaesthetic skills are stimulated in order for these to be used in biology learning mediation. This implies that sensory development and sensory stimulation programmes will have to be initiated so as to achieve this. Should other senses be stimulated, they could compensate for the loss of visual ability. This further implies that educators should not only use media to stimulate verbal, symbolic and cognitive learning but also accord their learners the opportunity to handle, touch, smell and, where possible, taste examples. Sensory experiences are important for helping blind learners to remember and retain information.

In order to enhance effective discrimination between objects and other biological components, schools for the blind, and in particular their educators, must work very hard to present colour, intensity, depth, three-dimensionality, contrast, change and movement to blind learners.

It is further recommended that:

Schools must acquire suitable equipment that will encourage blind learners to count, measure, list, compute and weigh data and objects. The implication is that schools will have to budget for the acquisition of such equipment and that technical sections should be established to adapt or develop equipment.

It is also recommended that:

Blind learners are taught how to manipulate pens, pencils, rulers, protractors, etc. from a very young age, in order to gain a good grounding regarding the manipulation of such tools.

7.5.2 RESEARCH

The researcher recommends that the education authorities, independent researchers and other research institutions:

1. Conduct research into typical South African life sciences mediation problems hampering blind and visually impaired learners' success in life sciences. Erwin *et al.,* (2001:339) contended that "(i)n schools in which there is a preponderance of children with disabilities, a critical examination of the science curriculum and its accessibility for all students has yet to be conducted, however."
2. Conduct research into employment opportunities for blind scientists. Houtenville (2003:133) argued that "(e)mployment is one of the major social roles that people perform over their lives. The inclusion of people with disabilities in the world of employment is crucial to their social integration and economic independence."

   On the other hand, Spungin (1997b) argued that "(a)s a field, we need to be much more supportive and actively involved with these research efforts. Given the small size of the population of visually impaired students, there needs to be a national research center, not only to collect data to verify our needs, but to show our successes and market those accomplishments far and wide."

   Regarding what Swartz (2005) [s.a.] [s.p] refer to as "capacity-building and workforce diversity" as a nation, we face major challenges in the developing cadres of disabled researchers, of whom there is a shortage. As he argues, "(t)his relates partly to "downstream issues". Many competent disabled people in South Africa have been denied access to adequate education, even at school. A good example is that of a colleague who had a keen interest in electronics, but was advised at school that, since he was blind, he could not study mathematics. This colleague has now excelled in an area of the humanities, but South Africa has lost the potential contribution to the "hard" sciences of a person who had both the interest and aptitude to study further in this area. There are many people of talent who have been denied any hope of tertiary education, let alone specialist research careers. Stereotypes still abound, such as the idea that blind people should become telephonists, wheelchair users should become call-centre operators, and that deaf people should become stock controllers. We have a long way to go before it is universally accepted that it is not the disability which should determine a person's career path, but the person's talents and abilities."

The benefits of conducting research into employment opportunities for the blind include:
Assisting blind individuals to enter, re-enter, or retain employment by providing career counselling, training opportunities, accessing job placement services and job maintenance services. Further, research will provide valuable "… information and technical assistance to schools, employers, and community organizations to facilitate recruitment, placement and accommodation" (Houtenville 2003:134). Employers will be obliged to provide reasonable accommodation for individuals with disabilities. O'Day (1999:234) argued that the creation of employment opportunities for the blind will encourage blind and visually impaired individuals to develop concrete career goals and by so doing not "...(b)ecome pigeonholed into specific occupations that are designated for people who are blind, or drop out of the labor market altogether."

3. Encourage the establishment of consultation services for blind and other people who would want to conduct research in this field.

Swartz (2005) [s.a.][s.p.] argued that even when disabled people themselves do not primarily define a research issue, it is important to have a credible consultation process with representatives from the disabled community. The disability sector in South Africa is well organised and experienced at providing constructive and invaluable feedback.

The implications of conducting research include:
Units for research into the disabled: Research agencies/organisations should establish such units and these units must be an integral component of the research system. The creation of such units will be instrumental in ensuring that disabled researchers are supported technically and materially: "(t)he units would have to be well equipped so that they would be able to provide for the full learning and research needs experienced by blind students or researchers" (Maguvhe 2003b:118).

Bina, Barnartt, and Cole (1997:198) support the previous point by commenting that "(w)hen I think of some of my former … students, many of whom went on to graduate from college, I know that they were able to succeed even without a special college for blind students. But I wonder, if some of these college graduates had had ongoing … instruction in college, more disability-sensitive professors, and better accessibility to learning materials, for example, how much more successful could they have become? How much more could they have thrived and fulfilled their full potential if the playing field had been more level?"

4. Research practices and styles: Research agencies/organisations must be encouraged to develop and promote flexibility in research practices and styles. The implication is that a variety of research methods/options where blind researchers can be accommodated have to be put in place. "(t)his implies that a variety of research options need to be put in place so as to accommodate blind researchers and encourage them to become part of the research team" (Maguvhe 2003b:118).

Furthermore, flexibility, technical and material support will encourage disabled researchers to participate in research activities. Swartz (2005) [s.a.][s.p.] noted that "(w)herever possible, disabled people should have meaningful roles in research concerning disability. Research leadership by disabled people should be a goal."

De L'Aune (2004:323) maintained that as a research consulting editor and as a member of editorial boards of several journals in the field of blindness and visual impairment, he is constantly complaining about the need for more rigorous research designs and larger studies. Unfortunately as a researcher, he is confronted with a low-incidence population, minimal resources, ethical and logistical issues, and a constellation of other constraints making it difficult to implement these designs and studies.

5. Accessible information programmes: The government must play a leading role by establishing an accessible information programme. "(t)his would not only support, but also encourage training institutions to follow suit" (Maguvhe 2003b:119). Swartz (2005) maintains that "(a)n interesting feature of disability research is that it can combine fascinating technical questions (such as the design of computer software to increase disabled people's access to print and other media) with questions about how to change social attitudes (such as how to assist companies and departments to develop an integrated, skills-based workforce)." The author continued noting that it is important for researchers, and for all concerned with building a cohesive society, to realise that research which brings us closer to the goal of what is called, a "barrier-free society" in disability literature is not only necessary for our social role, but is also very stimulating intellectually.

   Based on the argument of making information as accessible as possible, the implication would therefore be that the government must provide accessible material and basic accessible research equipment to blind researchers. Another implication is that research institutions must, as part of their staff establishment, employ individuals with an in-depth knowledge of blindness who will be in a position to adapt research techniques. Maguvhe (2003b:119) argued that "(w)ithout the involvement of such experts, blind researchers will continue to be deprived of the opportunity to achieve academically and therefore fail dismally to contribute to the development of our country". Institutions must provide blind researchers with paid readers in instances where equipment in libraries is inaccessible. With paid readers at institutions of learning and public libraries, these researchers will be able to access some of the information they don't have access to right now.

6. Funding: Maguvhe (2003b:117) argued that blind researchers in South Africa in this new political dispensation, just as in the past, are marginalised and prejudiced in terms of access to resources. The problem emanates from funding agencies and academicians who doubt blind researchers' intellect and capability to conduct research. He further argued that "(a)ttempts to do research work would be virtually doomed unless blind researchers had access to financial assistance, both from Government and private sector funding agencies. Since most potential donors are not aware of successful blind researchers, it seems as if they have their doubts about the latter's intellect and their capability to conduct useful research. They probably also doubt whether a blind person would be able to meet the high academic requirements and keep up with the demands set by research."

7. Skilling: Institutions of higher learning must equip blind researchers and other interested individuals with research competences to encourage research in the field of blindness. This will help to dispel the myth that "(m)any people believe that if one sense is gone, then it means that everything else is gone, so they can't realize that just because your eyes are short doesn't mean that the rest of your brain isn't functioning" (O'Day 1999:230).

8. Publications: Editors of and contributors to current publications and others that may be established in the future must invite and encourage researchers to write articles, critiques, and the like in the field of disability education so as to contribute to its development and growth.

7.5.3 CAPACITATING PROCESS

The Government must take the responsibility upon its shoulders to see that educators for the blind are better skilled and motivated. In addition, skilling and motivation of staff must also involve the holding of training workshops and the provision of resource persons with specialised knowledge.

Many other things will be possible when:

- The Government takes financial responsibility for ensuring that schools provide accessible equipment, apparatus and learning support material to blind learners. These resources are undeniably some of the valuable factors that could make learning mediation much easier for the majority of blind and visually impaired learners.
- Government must offer specialised training on how to adapt the curriculum, the learning mediation environment, the production of books and sketches, and so on in order to enhance educators' teaching skills.
- Access to the Internet and Braille books for blind learners through public libraries must be investigated and implemented.

ICEVI and WBU Joint Education Policy Statement (3rd IDP Africa Forum 23-27 May 2004:3) urges governments to:

- Guarantee to blind and visually impaired children, youth and adults the same rights and access to educational services as is guaranteed to all children, youth and adults in accordance with the Universal Declaration on Human rights.
- Place the educational services for blind and visually impaired children and youth should be placed under the same Government bodies as that of children without blindness or visual impairment.
- Guarantee all blind and visually impaired children and youth in integrated, inclusive, or special school programs – as well as their teachers – access to the equipment, educational materials and support services required, such as:
- Books in Braille, large print or other accessible formats, and low vision devices for those who require them, at the same time as non- disabled students, in order to facilitate their equal access to all aspects of the educational services provided to other children.

- Offer education of a high quality and standard in a range of educational options, including special schools.
- Give prominence to the voice of parents and (where appropriate) children and youth in decisions about placement.
- Provide quality literacy and independence skills and lifelong opportunities for adult blind and visually impaired persons who have not been given basic education in their childhood.

7.5.4 POLICIES AND LEGISLATION

Educator and learner responses in chapter six provided insights into barriers to learning and some potential policy solutions. Insights gained from this research could be validated with qualitative research. The following paragraphs present policy recommendations, aimed at those who make and implement them.

O'Day (1999:627) argued that policies must be promulgated in order to "...(a)ddress both the barriers ... and the specific needs of each group of ... people with visual impairments." Further, inaccessible education "...(i)s the frontier that must be conquered in the 21st century if people with disabilities are to become fully integrated into this society."

Based on this argument, one therefore recommends that:
Laws be passed or clauses be inserted in the Rights Chapter that deal specifically with the education of the disabled, access to information and access to assistive and conventional technologies, similar to the British Act SENDA (Special Educational Needs and Disability Act 2001) and the American Individuals with Disabilities Education Act (P.L. 101-476), supplemented by Americans with Disabilities Act (P.L. 101-336), Technology-related Assistance for Individuals with Disabilities Act as amended in 1994 (P.L. 103-218) and Rehabilitation Act as amended in 1992 (P.L. 102-569).

The implication of education related legislation is that there will be a guarantee that all disabled learners will receive free public education that is appropriate to their learning mediation needs.

Secondly, the legislation law will ensure that these learners are provided with supplementary services that permit them to benefit from education, including orientation and mobility training, activities of daily living, physical therapy, and assistive technology services.

According to New Beacon (2002:26) educational laws are also important because they ensure that disabled learners are not treated less favourably, "…(w)ithout justification, for a reason which relates to their disability; and to make reasonable adjustments so that disabled pupils are not put at a substantial disadvantage to pupils who are not disabled …" Laws ensure that there are duties in place for authorities to plan strategically and make significant progress in increasing accessibility to schools, premises and to the curriculum, and "…(i)n improving the ways in which written information provided to pupils who are not disabled is provided to disabled pupils.".

A law regulating access to information will guarantee to blind and visually impaired learners the availability and accessibility of all information in whatever format. Such a law will provide accommodation measures in public facilities. Therefore, that law must be put in place.

Regarding technology related legislation, the researcher recommends that:

The proposed Technology Act must focus on the elimination of barriers that prevent consumers of disability services from gaining access to assistive technology. According to the USA Technology-Related Assistance for Individuals With Disabilities Act of 1988 (Public Law 100-407, August 19, 1988) [s.a] [s.p] assistive technology in this context should be understood as any item, piece of equipment, or product system, whether acquired commercially or off the shelf, modified or custormized, that increases, maintains, or improves functional capabilities of individuals with disabilities. Furthermore, it could mean anything from a single tool with no moving parts to a sophisticated mechanical/electronic system. Neibaur, Day and Sebastian (2002:98) argued that the advantage of using computer technologies in education is that they provide flexible delivery of information and opportunities for collaboration in learning. Computer technologies are capable of linking educators and learners and allow for group interaction without meeting face to face as a group.

The Disabled Children Action Group (2004:1), regarding the importance of having unrestricted access to technology, argued that "(c)hildren with disabilities have the right to access appropriate assistive devices that are necessary to ensure their participation in community life."

The implication of a technology-related law is that:

Assistive devices will be part of the service package offered free of charge to qualifying learners. Although the total costs and degree of Governmental support (particularly the national Department of Education) for these proposals are not known, one is convinced that a major overhaul of the educational programmes and the provision of adequate support are needed if blind and visually impaired learners are to enjoy and benefit from education in significant numbers.

Abner and Lahm (2002:100) stated that "(a)ddressing assistive technology in students' Individualized Education Programs (IEP's) is a hot topic, since it has significant financial implications for school districts." The implication therefore would be that the Government should commit funds for assistive devices and will be informed by data provided by schools, parents, organisations, and other sources. There will be co-ordinated information and monitoring systems on assistive devices that have been distributed by the Department of Education both nationally and provincially. This will further imply that there would be some kind of legislation/policy that will ensure the provision of assistive devices as a "right" for learners with disabilities. It will ensure that assistive devices are appropriate and suit the different conditions and situations that learners find themselves in.

Wittenstein and Pardee (1996:203) argued that technological devices are useful in the enhancement of Braille but do not replace it. Further, they remarked that technology and Braille play important roles and that "…(c)hoices should be made on the basis of the needs and preferences of individual students."

Technology will reduce dependency amongst students and the effective severity of learners' disabilities.

In addition, the authorities will have to:

- Keep a record of numbers and types of assistive devices that have been issued;
- Keep a record of numbers and types of assistive devices that are awaited; and
- Keep a record of qualitative changes occurring as a result of assistive devices; for example, documenting how an assistive device contributes to enabling a learner who is blind or visually impaired to actively and fruitfully participate in different activities. Blind and visually impaired learners can participate in different activities if they, for instance, have access to some of the following equipment:

(a) Science kit

It will be necessary for all schools to have adapted standard science kits, which the blind will make use of during the learning mediation of life science subjects.

(b) Scientific calculations

For scientific calculations, blind learners must be encouraged to use the abacus and other related instruments. Knowledge about such instruments must be part of the curriculum. Wittenstein and Pardee (1996:203) advised that more emphasis must be placed on the abacus. They added that "(i)t is a more easily accessed and speedy way for "(d)oing calculations."

(c) Computers and scientific calculators

Computers and scientific calculators are essential tools in modern science. As a result, the researcher believes that appropriate teaching regarding how to use these instruments and other equipment must be emphasised.

(d) Tactile models

Because tactile models reinforce the mediation process of blind learners studying life sciences more effectively than drawings, the researcher recommends that they be made readily available at institutions solely for that purpose. In addition, models could be research tools in the hands of blind learners. They are capable of making a difference during the teaching and learning mediation. Lipkin (1995:122-123) argued that just having models surrounding blind learners makes a big difference. He also contended that there is a great need for tactual tools in mediating learning in subjects like chemistry to blind learners or disabled learners, because they simply learn better by holding something in their hands. Spungin (1977a:157) maintained that "(f)or visually handicapped children, the sense of touch is even more important than it is for sighted children, since it must be relied upon to mediate aspects of perception that vision would ordinarily perform. In addition to its general role as an important avenue of information about the world, touch is particularly important for certain specific functional behaviors, such as the acquisition of tactual material via Braille and the perception of pictorial or other representative educational material, such as maps of the spatial environment." Blind learners make more sense of what they tactually perceive.

Lipkin (1995:123) indicated that blind people are severely underrepresented in the scientific community. According to him, "(w)ith the right educational technologies, more students with disabilities could participate in science and choose it as a career." Models represent some of the technologies referred to in Lipkin's work. Blind individuals doing biology, physics, toxicology and other subjects benefit from models. He further argued that "(t)here is a tremendous need for better teaching tools at every academic level."

It should further be borne in mind that blind and visually impaired learners need different types and amounts of assistance in order to benefit from and effectively participate in educational activities. Based on this argument, the researcher therefore recommends the establishment of technology lending institutions, so as to allow learners who are visually impaired to take equipment to their schools, or to borrow such assistive devices until their schools or public libraries are able to purchase what is needed. The Government, through the national Department of Education, must work with schools, parents and learners to develop networks for the purpose of knowing who possesses what equipment, which will be useful for learners. Such services could be instrumental in ensuring that blind and visually impaired learners obtain the assistance they need.

Appropriate laws will help to ensure that they enjoy equal education opportunities and to create and guarantee enabling education environments. Laws, policies, principles, programmes, processes and practices will protect and advance disabled people educationally, as people who were previously and presently disadvantaged. Hunter House Inc. (1996:55) argued that when laws are enforced, they have the potential to greatly improve the civil rights of people with disabilities. Among many benefits, these pieces of legislation provide access to assistive and conventional technologies for individuals with disabilities in certain situations. When laws are enforced, institutions of learning and government departments become "…(m)ore accessible and sensitive to the needs of persons with disabilities" (Bina, Barnartt and Cole 1997:198).

(e) Training in assistive technology

The researcher recommends that:

Educators be prepared regarding how to appropriately facilitate learning to blind learners in the manipulation of notetakers, print enhancing programmes, Braille translators, scanning programmes and more.

It is further recommended that:

Educators be exposed to actual learning mediation methodologies with each programme or device. Such training should be geared to improving the professional development of educators and should also include all communication methods, reading and writing methods which are suitable for the blind learners.

Educators should be equipped with adaptation or modification skills which will help them to cope with Outcomes-based Education demands and expectations, e.g. difficult formulas, equations, illustrations, tactile graphs, maps, tables, etc.

7.5.5 EDUCATOR TRAINING

Training is severely lacking, for educators currently at special schools or who want to join special schools in future. Forlin and Cowan (2004:5-6) argued that whilst the emphasis on adapting the curricula is to be commended, they have concerns that both current and pre-service teachers are being provided with insufficient training to be able to meet the demands to be associated with appropriately differentiating the curriculum for students with diverse needs and abilities.

Educators who will deal with blind learners on a daily basis must receive both pre-service and in-service training in order to acquire competences for effective and meaningful mediation of learning, not only in life sciences but in other learning areas as well. Wittenstein and Pardee (1996:202) stated that "(m)ore comprehensive training is needed. No one should have to claw and scratch …"

Abner and Lahm (2002:102) have cautioned, though, that at times such training does not have an impact on educators. They stated that "(t)he primary way teachers receive training is through participation in in-service training and workshops. These training formats, which are short term and focused, have been found to have little impact … but other opportunities are seldom available or used …."

According to Van Huijgevoort (2002:63) educator training is important in helping educators to understand the role that visual impairment plays in a person's life, how such a person constructs meaning out of his or her impairment, and which tasks and challenges have to be faced by that person during learning mediation. Abner and Lahm (2002:102) declared that "(i)f teachers are adequately trained and provided with support to continue learning, their students will be better trained … and hence will have the skills they need to succeed in college and the job market."

The Educator (2004:63-64) suggested that educator training is essential for providing student educators with a positive orientation towards disability, "...(t)hereby developing an understanding of what can be achieved in schools with locally available support services. The knowledge and skills required are mainly those of good teaching and include assessing special needs, adapting curriculum content, utilizing assistive technology, individualizing teaching procedures to suit a larger range of abilities, etc. In teacher-training practice schools, specific attention should be given to preparing all teachers to exercise their autonomy and apply their skills in adapting curricula and instruction to meet pupils' needs as well as to collaborate with specialists and co-operate with parents."

Training in special needs education leads to additional qualifications, which must be integrated with or preceded by training and experience as a regular education educator in order to ensure complementary and mobility. Specialised training must be offered with a view to enabling educators to work in different settings under different conditions and play an instrumental role in special educational needs programmes. The Educator (2004:64) stated that "(a) non-categorical approach encompassing all types of disabilities should be developed as a common core, prior to further specialization in one or more disability-specific areas."

This means that South African institutions of higher learning have a major advisory and training role to play in the process of developing special needs education, pertaining to research, preparation of educator trainers, designing and evaluating training programmes and study materials. Weisser (2004:74) is of the view that courses developed at institutions of higher learning have two advantages. Such courses are accredited, thus providing graduate level units in special education. Undergoing such training could lead to extra benefits to educators in the way of promotions and salary increases. He indicated further that courses initiated by government institutions, while sometimes difficult to initiate, are likewise not easily discontinued.

The researcher fully concurs with Forlin and Cowan (2004:6) that:

- There should be more emphasis on policies which recognise that teacher quality makes the greatest contribution to student achievement;
- Professional development should achieve long-term self-analysis and growth for teachers; and

One further concurs with Flair and Seizer (1990); Friend and Bursuck (1999) Pauw (1984a, 1990b and 1991c) and Spungin (1977a:119) that educators mediating learning to blind learners must possess the following competences:

- Knowledge of formal and informal assessment procedures; this implies that an educator possessing this competency will have knowledge crucial for selecting assessment procedures and instruments for specific blind learners; procedures for administering and/or scoring of assessment for blind learners; methods for interpreting, reporting and analysing information acquired from assessments;
- Ability to transmit assessment of blind learners, using a variety of procedures, to other school personnel, parents and community workers;
- Knowledge of content of the specialised curriculum for blind learners.

This competency, according to Spungin (1977a:119), would help educators in possessing knowledge:

- Of the specialised curriculum regarding concept development for blind learners;
- Of communication skills necessary for blind learners;
- Of social and independent living skills necessary for blind learners;
- About the basic orientation and mobility skills necessary for blind learners, including orientation concepts, movement skills, obstacle detection or avoidance skills.

Additional competences include: knowledge of the pre-vocational career education skills for blind learners; knowledge of the visual and perceptual process in learning mediation and utilisation of low vision; knowledge of auditory and linguistic processes in learning; knowledge of the sequence of development in tactual learning; knowledge of the sequence of development of gross and fine motor skills; knowledge of the requirements for an effective field trip for a variety of blind learners; knowledge of play skills for blind learners in order to maximise "...(t)heir intellectual, emotional, social and physical development" (Spungin 1977a:120); and knowledge of the effect of blind individuals on the seeing population.

Educators with these competences will be able to accommodate blind learners' needs because they understand them. According to the ICEVI and WBU Joint Education Policy Statement (3rd IDP Africa Forum 23-27 May 2004:5), educator training assures that teachers who are in different education settings with different programmes, receive adequate training and skills in Braille and other educational means in order to provide quality education. However, ICEVI and WBU encourage remuneration commensurate with qualifications and training in order to ensure that investments in human resources are adequate. Education authorities therefore have to organise local, regional, national and international seminars, training courses and conferences to regularly update the skills and knowledge of educators and others working with blind and visually impaired children, youth and adults.

7.5.6 MODIFICATION OF MATERIALS

According to O'Day (1999:230) lack of accommodation and outright discrimination, natural outgrowths of the fear of blindness, and other negative attitudes are a common experience as far as blind and visually impaired persons are concerned and one that impacts negatively on their education, social and economic lives. Blind and visually impaired learners (because of their disability) need more accommodative measures in order to be equal.

Bina *et al.,* (1997:198) argued that "(c)ertainly, some blind students achieve in spite of this lack of special accommodations, but I suspect there are more who could benefit from assistance that puts them on an equal footing with their sighted counterparts." On this basis one recommends that:
Posts in the Departments of Education from national level to local level be created for the purpose of modifying materials and Common Tasks Assessments. New Beacon (2002:27) argued that Government must take the lead in establishing national co-ordinating machinery to increase the amount of accessible school material and speed up its delivery.

The Government must look closely at requiring, from the publishers of prescribed learning support material in specific learning areas, access for the public to circumspectly examine that material. Publishing companies must, as a condition, provide the public and authorised bodies with an electronic file or one in any other format in order to examine and facilitate the job of creating accessible formats for blind learners.

This thinking has been brought about by the following general discoveries:

- Only a handful of educators have an understanding of the complex situation and didactic principles that apply in the modification of visual materials in accessible formats;
- That in most of the schools for the blind, biology in particular is not taught in upper grades;
- That the Department of Education and schools for the blind would have to acquire the capacity to modify curricula and examination papers to allow blind learners to work at levels equivalent to those of sighted peers;
- That the technology used in the mediation of science is expensive; and that
- In addition to the intellectual challenge of biology, the physical processing of information by blind learners requires considerable manual dexterity.

According to the researcher, accommodating blind and visually impaired learners imparts major benefits, including:

The feeling that even if one is disabled, one is on an equal footing with sighted counterparts. In other words, learners will not have to ask for services and as such, there will be no limitation on their participation in any learning mediation activity. According to Bina *et al.,* (1997:199-200) blind and visually impaired learners will, in short, enjoy and make the same choices as do other students. Accommodations encourage learners to become part of the community and network. Enabling/accommodative environments will allow blind learners to "…(f)ocus on their education without the distractions that disability status conveys".

Accommodative environments are capable of creating more opportunities for learners to develop their academic skills, "…(a)s well as the confidence that comes from accomplishment, and … there is plenty of time for coping skills to be developed after college". Bina *et al.* also argued that accommodative measures offer blind and visually impaired learners adequate support in the use of additional methods for taking and putting out information. Bina *et al.,* (1997:201) added that "(a)ll students would know when to use their braillewriter or portable notetaker and when their slate and stylus is most handy."

7.5.7 INCLUSIVE SETTINGS

(a) Sensitisation

Inclusive education should create a learner population that accommodates, appreciates and acknowledges the diversity of needs and the many learning mediation techniques that enable the entire learner population to access education without hindrance. To be able to achieve this, the learner population or student body, personnel from local to national level, educators, therapists, examiners, markers, and all professionals involved in education have to be trained in and sensitised to the learners' needs, equipment, learning mediation techniques and adaptations of learning resource materials.

(b) Avoid conflicting interests

The researcher recommends that educators must balance their interests, because if they focus more on sighted learners, who are in the majority, blind learners will suffer. Similarly, if they focus more on blind learners, who are in the minority, sighted learners will suffer. He therefore suggests that educators must pursue education initiatives, which will address the needs, interests, and aspirations of their learners on an equal basis.

(c) Inclusive education programmes

He further recommends that:

Programmes such as networking and capacity building, adaptation of the environment (physical, environmental, educational, and, communicative) be developed to make all stakeholders aware of the implications of including blind learners.

7.5.8 THE CURRICULUM

Blind learners cannot learn biology if there are still myths and misconceptions that this learning area is only suited to the sighted, because of the particular challenges it poses.

The researcher recommends that:
The adaptation of the curriculum must include correcting misperceptions of the disability because when people mention disability or access, they often only mean built environments. Adaptation of the curriculum must also focus on access to information, technology, etc. Educators must know basic Braille, orientation and mobility, touch typing or basic computer skills, behavioural management, leisure activities for the blind, independence training, social skills, etc.

7.5.9 SUPPORT SERVICES

Learners and educator support services must be put in place and properly co-ordinated so that the learning mediation processes can be effective and productive and the goals of learning can be reached. Goals can also more easily be reached if the status of blind learners is improved. Such an improvement should entail the modification of the learning mediation environment in the course of time, identification of needs, styles of learning, pace, interests, etc. Should this be carried out, more appropriate services will be rendered to blind learners. In other words, there must be interventions with regard to blind learners' different needs, aimed at increasing "…(f)unctional independence and optimum participation in life situations" (Van Huijgevoort 2002:61). Parents of blind learners must be offered courses on how to help their children at home in different learning areas.

7.5.10 TERTIARY INSTITUTIONS

South African tertiary institutions should be encouraged to admit blind students to pursue undergraduate and graduate degrees related to life sciences so that they gain in-depth knowledge in this regard and become valuable assets for other blind people.

7.5.11 EXPERT KNOWLEDGE

It is recommended that:
Seminars on expert knowledge and sound methodologies in the facilitation of biology and consultative meetings be held, which are outcomes focused, for the inclusion of blind learners in the learning mediation of biology and learning mediation practices in general. The approach to be adopted should be that of bridging the gap between blind and sighted learners and an accessible education and assessment model, which offers academically viable solutions that benefit both the education system and the individual.

For blind learners to benefit from biology and their education in general, the Department of Education must:

- Develop and implement accessible learning mediation programmes;
- Develop and promote, through workshops, seminars, symposia, distance learning and so on, the acquisition and improvement of learning mediation skills;
- Conduct, from time to time, audits of disabled learners (especially of blind learners) who have taken biology as one of their subjects, to determine what outcomes they have achieved, what needs to be improved, how, when, why, where, etc. The audit must also take into account such factors as the learning mediation environment, human and material resources, and equipment available.

7.5.12 THE DEVELOPMENT AND FIELD-TESTING OF A COMPREHENSIVE SCIENCE PACKAGE

The national Department of Education in collaboration with the Department of Science and Technology must develop and field-test a comprehensive science package for the benefit of visually impaired learners.

The package should cover the following areas:

(a) Methodology of teaching science

This area should deal with the general techniques and strategies used for teaching science in general and for teaching the learning area to blind and visually impaired learners. It should further specify methods and techniques for preparing science text material, the learning needs of blind and visually impaired learners, and assessment procedures in science.

(b) Use of science equipment

The area should provide a list of available adapted science equipment, sources where it can be obtained, detailed self-instructional procedures to learn to use it effectively, and so on.

(c) Use of science Braille code, signs and symbols

The area should focus on providing illustrations on how to use the science Braille code, signs and symbols. These should be described and accompanied by pertinent illustrations.

(d) Science mediation strategies

The area should provide guidelines on how to adapt procedures and practices for teaching science concepts at school level. In addition, procedures are useful in helping educators to be aware of and to understand those concepts before they teach them to blind and visually impaired learners.

(e) Creative science

This area must, specifically, deal with a whole range of creative activities, e.g. using available material and the natural environment for mediating and understanding science concepts.

(f) Low-cost mediation aids

The area must provide guidelines for the acquisition and preparation of low-cost learning mediation aids to teach science properly. This knowledge will help poor schools to save money.

7.5.13 THE RESPONSIBILITIES OF THE SOUTH AFRICAN NATIONAL COUNCIL FOR THE BLIND

The following are the activities, which the South African National Council for the Blind should carry out:

SANCB needs to closely work with educators and other service providers, including advisory services, in ensuring that the needs of the learners are adequately provided for.

It should further:

- Train its staff members and those of member organisations regarding all education legislation and policies, and consider the implications of these documents for the service rendered by it;
- Offer training to stakeholders in education concerning legislation and policies for meeting the needs of both blind children and young blind people;
- Work with a diverse group of professionals to promote and facilitate the development of what is known as "multi-agency" work that will ensure that the needs of blind children are met;
- Empower the youth (through its youth co-ordinator and education services co-ordinator) so that they can take an active role and participate in present and future educational decisions which will affect them;
- Continue to campaign for the right to read, learn in conducive environments and have access to information;
- Campaign for better transport services so that blind learners can go to public libraries and related facilities to expand their knowledge;
- In collaboration with other service providers, needs to ensure that when children and young people who are blind are discriminated against, it can act as an advocate on their behalf and hold discussions to solve their problems;
- See to it that learners receive equal education in all education settings.

7.5.14 FURTHER RESEARCH POSSIBILITIES

- How can biology be adapted so that it is flexible and accessible to all learners regardless of their learning needs?
- To what extent are blind learners who are not doing biology or any other life science subject at a disadvantage, as compared to those who do study these subjects?
- Are blind learners in South Africa more excluded from doing life science subjects than their counterparts in the rest of the world?
- How can blind learners benefit or not benefit from carrying out observations?

- How does South Africa compare with other countries with regard to supporting blind learners in the education system?
- How can other South African researchers contribute in this field so that we can gain more insights and achieve more worthwhile results?

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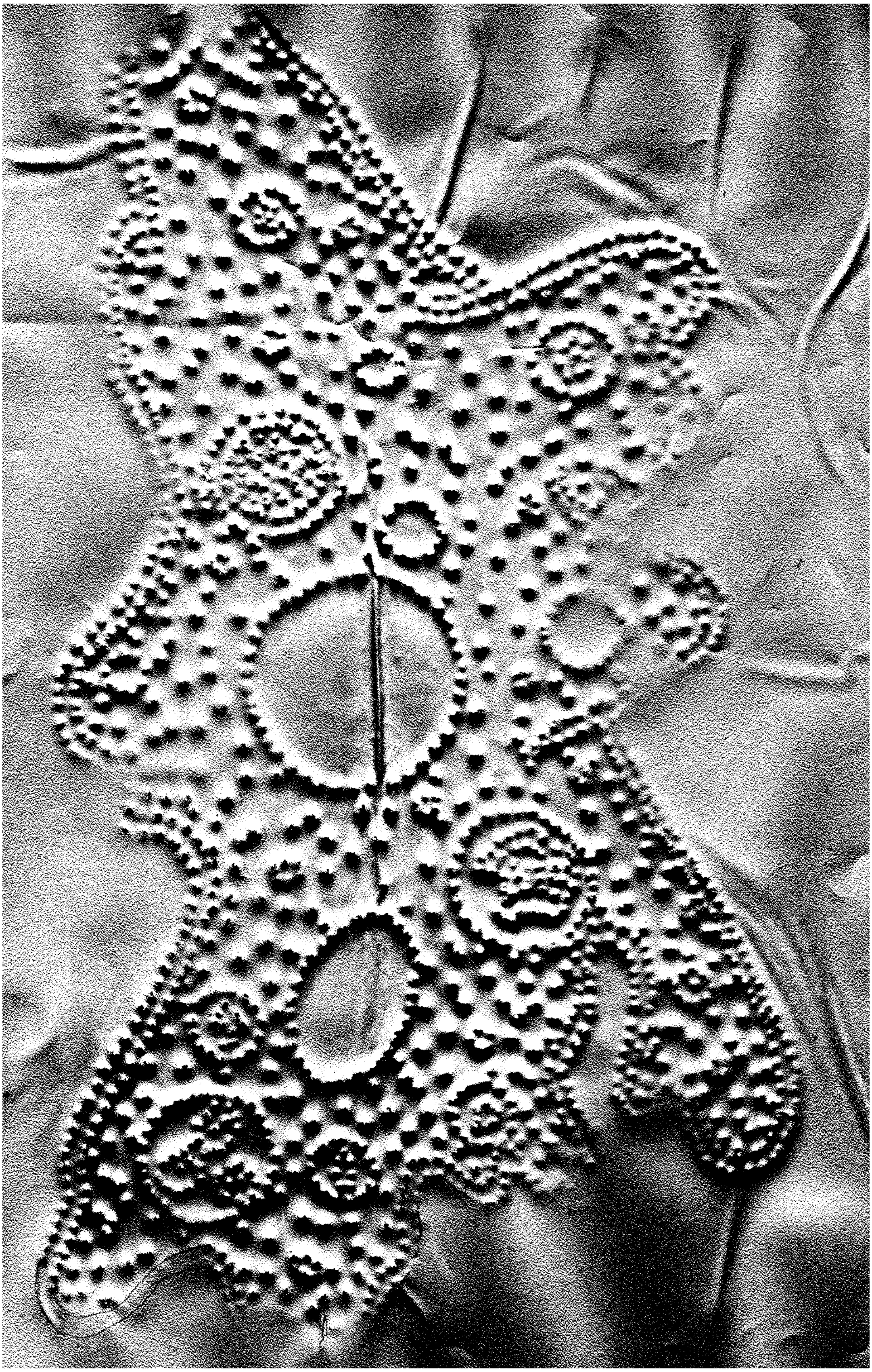
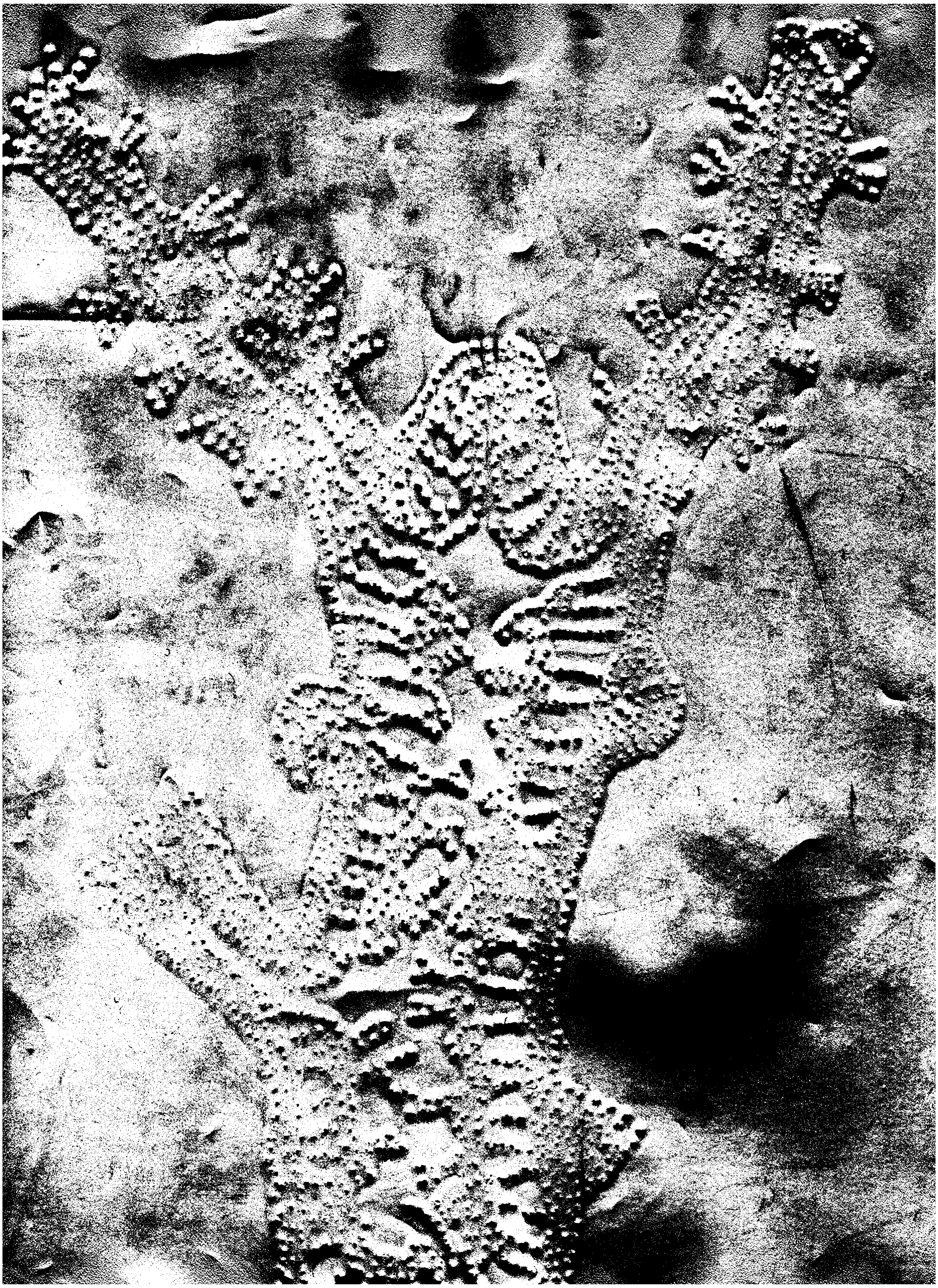
APPENDIX A

A PHOTOCOPY OF A SCANED TACTILE AMOEBA SKETCH ILLUSTRATING HOW A SMALL THING COULD BE BLOWN OUT OF PROPORTION IN A TACTUAL FORMAT



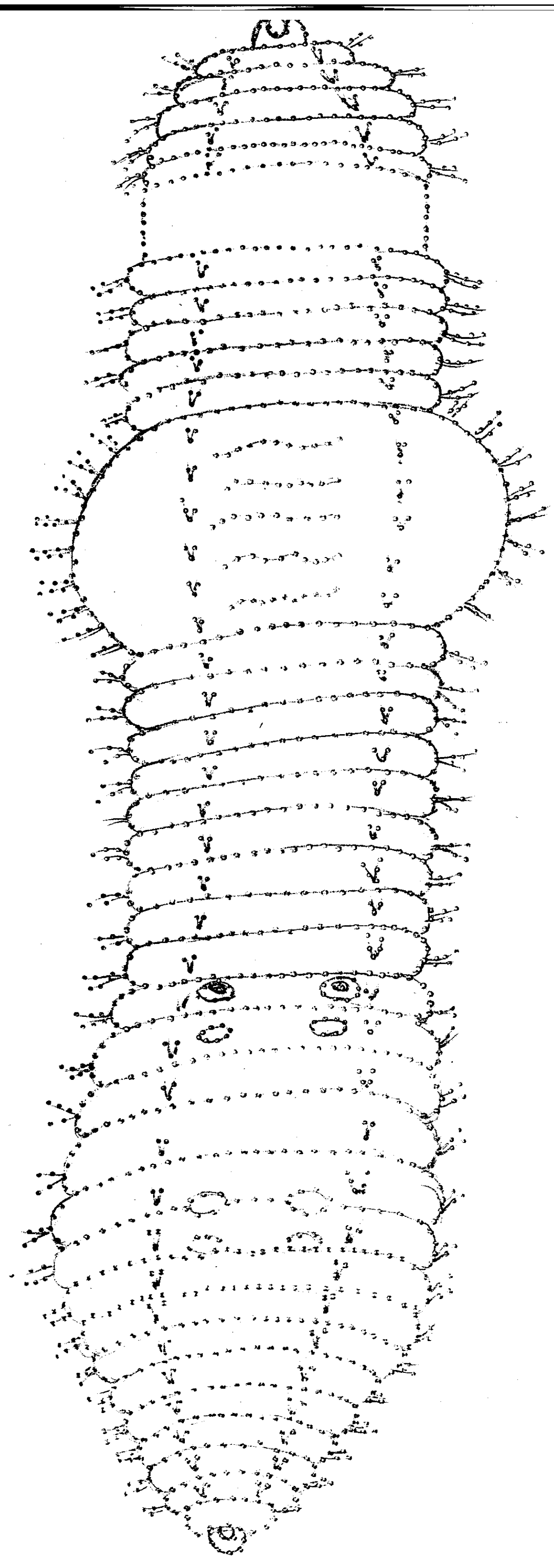
APPENDIX B

A PHOTOCOPY OF A SCANED TACTILE HYDRA SKETCH ILLUSTRATING HOW COMPLICATED IT BECOMES FOR A BLIND LEARNER TO UNDERSTAND A TOO DETAILED TACTILE SKETCH



APPENDIX C

A PHOTOCOPY OF A TACTILE EARTHWORM SKETCH DRAWN FROM THE ZYTEC MACHINE USING A SWELL-PAPER ILLUSTRATING THE POOR QUALITY OF SUCH SKETCHES AS COMPARED TO THERMOFORM ONES



APPENDIX D

SA National council for the Blind
P.O. Box 11149
Hatfield
0028
2003-08-11
To the School Principal

Dear Sir/Madam

A REQUEST TO CONDUCT MY Ph.D. RESEARCH AT YOUR SCHOOL

I M.O. Maguvhe Co-ordinator: Education Services at the SANCB is a Ph.D. student at the University of Pretoria. My research title is: "A STUDY OF INCLUSIVE EDUCATION (POLICY) IN SOUTH AFRICA AND ITS IMPACT ON THE MEDIATION OF BIOLOGY TO BLIND LEARNERS IN AN OUTCOMES-BASED EDUCATION AND TRAINING CLASSROOM."

I am at the present moment through with the literature review and should be involved with the real research. I therefore, request you to grant me permission to visit your learning site to conduct the research which would involve interviewing educators and learners, observing (by the sighted assistant), photographing, videotaping and recording lessons. Since I am blind, my promoter wants as much information as possible so that he could help me analyse and synthesize the collected data. I know that it is possible that your school is not teaching biology but, any life science class would still serve the purpose. I have to conduct the research either towards the end of this month or, in the middle of September.

Your immediate and positive response pertaining to this matter shall be highly appreciated.

Sincerely yours
M.O. Maguvhe

Tel.: (012) 3461171 ext. 343

Fax.: (012) 3461177

E-mail.: Obert@sancb.org.za

APPENDIX E

UMnyango WezeMfundo
Department of Education

Lefapha la Thuto
Departement van Onderwys

TO: BMT MEMBERS
DISTRICT POLICY & PLANNING OFFICIALS
HEADS OF INSTITUTIONS

DATE: 9 April 2003

SUBJECT: RESEARCH REQUEST PROCESSES WITHIN THE GDE

The Strategic Policy Development, Management and Research Coordination Directorate wishes to provide an outline to all those listed in this communiqué, the key research request approval processes that prevails within the Gauteng Department of Education (GDE).

The organisational structure of Gauteng Department of Education makes provision for research to be conducted across all the different tiers of the Department, namely, Head Office Branches, Divisions, Directorates, District Offices and Institutions. The primary function of the Research Coordination and Advocacy Unit within the Strategic Policy Development Directorate is to perform a liaison, co-coordination and advisory role to both researchers and officials of the GDE.

The steps that follow, intends to provide all prospective researchers that wish to utilise the GDE (at whatever level) as a focus of their research, with a sense of the manner in which they may seek and be granted approval for their particular research request.

1. All students and organisations that wish to conduct any study within the GDE have to complete the prescribed **GDE Research Request Form**. The form may be obtained from both the Policy & Planning Officials in the 12 Districts and from the Research Coordination & Advocacy Unit at Head Office. Among the key details to be completed in the form are the following:
   - 1.1 Particulars of the researcher
   - 1.2 Details of the proposed research to be undertaken
   - 1.3 The Proposed research methodology to be utilised
   - 1.4 The GDE organ (Institution/s and/or District/s and/or Head Office Branch, Division/s and/or Directorate/s) that would be involved
   - 1.5 A declaration by the researcher and the supervisor and/or promoter of the research

SIBONILE SCHOOL
TEL: (011) 903-8903
2003 -05- 07
PO BOX 534
KLIPRIVIER 1871

Office of the Senior Manager – Strategic Policy Development, Management & Research Coordination
Room 904, 111 Commissioner Street, Johannesburg, 2001 P.O.Box 7710, Johannesburg, 2000
Tel: (011) 355-0475 Fax: (011) 355-0512 E-mail: SallyR@gpg.gov.za Cell: 083 310 1910

2. All prospective researchers must submit the following documents before any research request may be entertained:
   2.1 The full Research Proposal i.e. a full and detailed outline of the research plan
   2.2 A full list of the institutions and/or offices that would be participating in the study (a list of the names and addresses of all GDE institutions and offices is available from the Department of Education on a paper cost-recovery basis)
   2.3 Copy/ies of questionnaire/s and interview schedules to be utilised in the study

3. The Gauteng Department of Education will interact with the research proposal, and when satisfied that all the required criteria have been met, will issue an approval letter, that would serve as a formal contract between the Department and the researcher. The approval letter will contain a GDE registration number that will be used for tracking, monitoring and database maintenance purposes.

4. A research request approval letter would only indicate that a researcher has been granted permission to conduct research within the GDE. The final say would however rest with the Principal and School Governing Body of an institution and the Branch/Divisional and/or Senior Manager in charge of any office. Once the Principal and SGB and/or relevant District or Head Office manager has granted permission for the research to proceed, all research processes may only commence from the beginning of the second week of February and has to be concluded by the end of the third quarter of the academic year.

5. Listed below are some key considerations for a researcher to bear in mind once permission has been granted:
   5.1 All Social Research Ethics must be honoured
   5.2 The researcher must utilise his/her own resources to complete the study.
   5.3 The name/s of the official/s, school/s, principal/s, educator/s and learner/s may not appear in any research report without the written consent of each of the individuals and/or structures listed.
   5.4 On completion of the study the researcher must supply the Department with 2 bound copies of the approved, final report and must be prepared to present his/her main findings and recommendations to both the officials of the Department and the institutions that were involved in the study.
   5.5 The senior manager of the relevant office and both the principal and SGB of each institution must be notified by the researcher, in writing, about the study being undertaken within their respective offices and/or institutions respectively. The official letter issued by the Senior Manager: Strategic Policy Development & Research Coordination granting approval for such request must be attached to the letter of notification sent by the researcher/s.

6. Researchers are requested to apply for permission at least 2 months before the actual research investigations are to be conducted at any site within the GDE. During this time the Research Coordination Team would interact with all the relevant documents submitted by researcher and facilitate a process within the GDE in order to make a decision around whether approval should/should not be granted.

2. PURPOSE & DETAILS OF THE PROPOSED RESEARCH

2.1	Purpose of the Research (Place cross where appropriate)
Undergraduate Study - Self	
Postgraduate Study - Self	X
Private Company – Commissioned by Provincial Government or Department	
Private Research by Independent Researcher	
Non-Governmental Organisation	
National Department of Education	
Commissions and Committees	
Independent Research Agencies	
Statutory Research Agencies	
Higher Education Institutions	

2.2	Full title of Thesis / Dissertation / Research Project
A study of Inclusive Education (Policy) and its effects on the teaching of Biology to blind learners in an outcomes-Based education classroom in SA	

2.3	Value of the Research to Education (Attach Research Proposal)
It is going to benefit blind learners and educators when coming to the facilitation or learning mediation of Biology.	

2.5	Student and Postgraduate Enrolment Particulars (if applicable)
Name of institution where enrolled:	University Of Pretoria
Degree / Qualification:	Ph.D.
Faculty and Discipline / Area of Study:	Education Curriculum Studies
Name of Supervisor / Promoter:	W.J. Fraser (Prof.)

2.6	Employer (where applicable)
Name of Organisation:	S.A.N.C.B
Position in Organisation:	Co-ordinator Education Services
Head of Organisation:	Doctor W.P. Rowland
Street Address:	514 White street Baileys Muckleneuk . Pretoria
Postal Code:	0181
Telephone Number (Code + Ext):	(012) 346-1171 ext 343
Fax Number:	012 346-1177
E-mail:	Obert@sancb.org.za

2.7	PERSAL Number (where applicable)

3. **PROPOSED RESEARCH METHOD/S**

(Please indicate by placing a cross in the appropriate block whether the following modes would be adopted)

3.1 ***Questionnaire/s (If Yes, supply copies of each to be used)***

YES		NO	

3.2 ***Interview/s (If Yes, provide copies of each schedule)***

YES	X	NO	

3.3 ***Use of official documents***

YES	X	NO	
If Yes, please specify the document/s:			
all subject matter official			
policy documents.			

APPENDIX F

For Official Use	
Ref. No.	

GAUTENG DEPARTMENT OF EDUCATION

GAUTENG PROVINCIAL GOVERNMENT

RESEARCH REQUEST FORM

REQUEST TO CONDUCT RESEARCH IN INSTITUTIONS AND/OR OFFICES OF THE GAUTENG DEPARTMENT OF EDUCATION

1. PARTICULARS OF THE RESEARCHER

1.1	Details of the Researcher
Surname and Initials:	Maguvhe
First Name/s:	Obert Mbulaheni
Title (Prof / Dr / Mr / Mrs / Ms):	Mr
Student Number (if relevant):	21226475
ID Number:	67062659082

1.2 Private Contact Details	
Home Address	*Postal Address (if different)*
P.O. Box 11149	
Hatfield	
Postal Code 0028	*Postal Code*
Tel: (012) 346-1171	
Cell: 082 668 1717	
Fax: (012) 346-1177	
E-mail: obert@sancb.org.za.	

7. The Department is involved, on an ongoing basis, of developing and updating its own list of Research Priorities and is prepared to engage with prospective researchers around adopting those research topics that may be considered of importance to the organisation. A full list of the GDE Research Priorities will be made available to all prospective researchers on written request.

8. All prescribed forms are available electronically and prospective researchers are encouraged to utilise the electronic means of communication (e-mail) when both requesting and forwarding any information related to their research requests. The sole proviso in this respect relates to those pages that require the original signatures of the researcher and his/her supervisor or promoter. These pages may be faxed to the relevant office only after the researcher has communicated with the Research Coordination & Advocacy Unit and has acquired a reference number. The reference number must be quoted when forwarding all outstanding information through fax.

Notwithstanding paragraph 8 above, should you require any additional information pertaining to research activities within the GDE, kindly contact the Convenor of the Research Coordination Team: **Ms Nomvula Ubisi** and/or her assistant **Ms Ntombi Maswanganyi** (See contact details below).

Tel:	**(011) 355 0483/0488**
Fax:	**(011) 355 0512**
Street Address:	**Room 904/910, 111 Commissioner Street, Johannesburg**
Postal Address:	**P.O. Box 7710, Johannesburg, 2000**
E-Mail:	nomvulau@gpg.gov.za or violetm@gpg.gov.za

Sally Rowney (Senior Manager)

4.9 *Time of day that you propose to conduct your test/research.*

School Hours	During Break	After School Hours
X		

4.10 *School term during which the research would be undertaken*

First Term	Second Term	Third Term
		X

DECLARATION BY THE RESEARCHER	
1. *I declare that all statements made by myself in this application are true and accurate.*	
2. *I have taken note of all the conditions associated with the granting of approval to conduct research and undertake to abide by them.*	
Signature: M. O. Maguvhe	
Date: 08/11/2003	

DECLARATION BY SUPERVISOR / PROMOTER / LECTURER	
I declare that: -	
1. The applicant is enrolled at the institution / employed by the organisation to which the undersigned is attached.	
2. The questionnaires / structured interviews / tests meet the criteria of: • *Educational Accountability* • *Proper Research Design* • *Sensitivity towards Participants* • *Correct Content and Terminology* • *Acceptable Grammar* • *Absence of Non-essential / Superfluous items*	
Surname:	Fraser
First Name/s:	William John
Institution / Organisation:	University of Pretoria
Faculty / Department (where relevant):	Education
Telephone:	(012) 420 2207
Fax:	(012) 420 3003
E-mail:	wfraser@hakuna.up.ac.za
Signature:	[signature]
Date:	2003/08/22

N.B. This form (and all other relevant documentation where available) may be completed and forwarded electronically to either Ntombi Maswanganyi (violetm@gpg.gov.za) or Nomvula Ubisi (nomvulau@gpg.gov.za). The last 2 pages of this document must however contain the original signatures of both the researcher and his/her supervisor or promoter. These pages may therefore be faxed or hand delivered. Please mark fax - For Attention: Ntombi Maswanganyi at 011 355 0512 (fax) or hand deliver (in closed envelope) to Ntombi Maswanganyi (Room 910) or Nomvula Ubisi (Room 914), 111 Commissioner Street, Johannesburg.

APPENDIX G

SA National Council for the Blind
P.O. Box 11149
Hatfield
0028
2003-08-11
To the School DISTRICT MANAGER

Dear Sir/Madam

A REQUEST TO CONDUCT MY Ph.D. RESEARCH AT SIBONILE SCHOOL

I M.O. Maguvhe Co-ordinator: Education Services at the SANCB is a Ph.D. student at the University of Pretoria. My research title is: "A STUDY OF INCLUSIVE EDUCATION IN SOUTH AFRICA AND ITS IMPACT ON THE MEDIATION OF BIOLOGY TO BLIND LEARNERS IN AN OUTCOMES-BASED EDUCATION AND TRAINING CLASSROOM."

I am at the present moment through with the literature review and should be involved with the real research. I therefore, request you to grant me permission to visit your learning site to conduct the research which would involve interviewing educators and learners, observing (by the sighted assistant), photographing, videotaping and recording lessons. Since I am blind, my promoter wants as much information as possible so that he could help me analyse and synthesize the collected data. I know that it is possible that your school is not teaching biology but, any life science class would still serve the purpose. I have to conduct the research either towards the end of this month or, in the middle of September.

Your immediate and positive response pertaining to this matter shall be highly appreciated.

Sincerely yours
M.O. Maguvhe

Tel.: (012) 3461171 ext. 343

Fax.: (012) 3461177

E-mail.: Obert@sancb.org.za

SIBONILE SCHOOL

For visually impaired pupils

PO Box 534
KLIPRIVIER
1871

Tel/Fax: [011] 9038909
E-mail: sibonile@iafrica.com

Fundraising No: 01 101346 000 4
NPO Reg No: 004 664

TO: MR MAGHUVHE
FROM: MRS MORTHANE
TEL: 012 3461171

4.5 Number of pupils to be involved per school

Grade	1		2		3		4		5		6	
Gender	B	G	B	G	B	G	B	G	B	G	B	G
Number	10											

Grade	7		8		9		10		11		12	
Gender	B	G	B	G	B	G	B	G	B	G	B	G
Number							2	2	2	2	2	2

4.6 Number of educators/officials involved in the study /per school

Type of staff	Teachers	HODs	Deputy Principals	Principal	Lecturers	Office Based Officials
Number	2					

4.7 *Are the participants to be involved in groups or individually?*

Participation	
Groups	X
Individually	X

4.8 *Average period of time each participant will be involved in the test or other research activities (Please indicate time in minutes)*

Participant/s	Activity	Time
Cluster of 10 learners per school	Focus group analysis	1 – 2 hours

APPENDIX H

DEPARTMENT OF EDUCATION

DEPARTMENT OF EDUCATION
PRIVATE BAG X895
PRETORIA
0001

TO					
The Principal					
Fax Number:	(013) 262 2084				
Institution:	Bosele School for the Deaf and Blind, NEBO				
Remarks: Please find attached					
NO. of pages: (including this one) 3			Date: 02 September 2003		
FROM					
Name:	Wendy Ndlovu				
Room number:	228	Tel No:	(012) 312 5485	Fax No:	(012) 312 5029
Directorate:	INCLUSIVE EDUCATION.				
* Please phone immediately if the transmission is not satisfactory. Thank you.					

DEPARTMENT: EDUCATION
REPUBLIC OF SOUTH AFRICA
Private Bag X895, Pretoria, 0001 Tel: +27 12 312 5911 Fax: +27 12 321 6770
Sol Plaatje House, 123 Schoeman Street, Pretoria, 0001, South Africa
Private Bag X9023, Cape Town, 8000 Tel: +27 21 465 1701 Fax: +27 21 461 8110
120 Plein Street, Cape Town, 8000, South Africa
http://education.gov.za

The Principal

Bosele School for the Deaf & Blind

Private Bag X128

NEBO

1059

Fax: 013 262 2084

Dear Sir/Madam

A REQUEST TO CONDUCT PH.D. RESEARCH AT YOUR SCHOOL

Mr Maguvhe is a co-ordinator of Education Services at the South African National Council for the Blind (SANCB). He is currently pursuing a Ph.D at the University of Pretoria.

Mr Maguvhe made a request to visit your learning site to conduct the research that would involve interviewing educators and learners, observing (by the sighted assistant arranged by Mr Maguvhe), photographing, videotaping and recording lessons. Since he is a blind person, his supervisor wants as much information as possible so that he could help him to analyse and synthesize the collected data. The focus of his research is on the possible impact of Inclusive Education policy in South Africa on the mediation of biology to blind learners in Outcomes-Based Education and Training classrooms. In a case where biology is not offered in a particular school, any life science class would still serve the purpose. He has to conduct the research either towards the end of this month or, in the middle of September 2003.

Tirisano: Working together to build a South African education and training system for the 21st century.

It will be appreciated if you could please allow him to do this valuable research, which may be of enormous benefit to Education in South Africa.

May you please communicate directly with Mr Maguvhe to make the necessary arrangements. His contact details are as follows:

SA National Council for the Blind
P.O. Box 11149
Hatfield
0028
Tel.: (012) 3461171 ext. 343
Fax.: (012) 3461177
E-mail.: Obert@sancb.org.za

Yours sincerely

M. Schoeman

pp. **Dr S Naicker**
Directorate: Inclusive Education

APPENDIX I

TIRISANO
WORKING TOGETHER
DEPARTMENT OF EDUCATION

DEPARTMENT OF EDUCATION
PRIVATE BAG X895
PRETORIA
0001

TO					
The Principal					
Fax Number:	(012) 793 1358				
Institution:	Filadelfia Secondary School, Soshanguve				
Remarks: Please find attached					
NO. of pages: (including this one) 3			Date: 02 September 2003		
FROM					
Name:	Wendy Ndlovu				
Room number:	228	Tel No:	(012) 312 5485	Fax No:	(012) 312 5029
Directorate:	INCLUSIVE EDUCATION.				

* Please phone immediately if the transmission is not satisfactory. Thank you.

DEPARTMENT: EDUCATION
REPUBLIC OF SOUTH AFRICA
Private Bag X895, Pretoria, 0001 Tel: +27 12 312 5911 Fax: +27 12 321 6770
Sol Plaatje House, 123 Schoeman Street, Pretoria, 0001, South Africa
Private Bag X9023, Cape Town, 8000 Tel: +27 21 465 1701 Fax: +27 21 461 8110
120 Plein Street, Cape Town, 8000, South Africa
http://education.gov.za

The Principal
Filadelfia Secondary School
Private Bag X76
SOSHANGUVE
0152

Fax: 012 793 1358

Dear Sir/Madam

A REQUEST TO CONDUCT PH.D. RESEARCH AT YOUR SCHOOL

Mr Maguvhe is a co-ordinator of Education Services at the South African National Council for the Blind (SANCB). He is currently pursuing a Ph.D at the University of Pretoria.

Mr Maguvhe made a request to visit your learning site to conduct the research that would involve interviewing educators and learners, observing (by the sighted assistant arranged by Mr Maguvhe), photographing, videotaping and recording lessons. Since he is a blind person, his supervosor wants as much information as possible so that he could help him to analyse and synthesize the collected data. The focus of his research is on the possible impact of Inclusive Education policy in South Africa on the mediation of biology to blind learners in Outcomes-Based Education and Training classrooms. In a case where biology is not offered in a particular school, any life science class would still serve the purpose. He has to conduct the research either towards the end of this month or, in the middle of September 2003.

Tirisano: Working together to build a South African education and training system for the 21st century.

It will be appreciated if you could please allow him to do this valuable research, which may be of enormous benefit to Education in South Africa

May you please communicate directly with Mr Maguvhe to make the necessary arrangements. His contact details are as follows:

SA National Council for the Blind
P.O. Box 11149
Hatfield
0028
Tel.: (012) 3461171 ext. 343
Fax.: (012) 3461177
E-mail.: Obert@sancb.org.za

Yours sincerely

Dr S Naicker
Directorate: Inclusive Education

APPENDIX J

DEPARTMENT OF EDUCATION

DEPARTMENT OF EDUCATION
PRIVATE BAG X895
PRETORIA
0001

TO					
The Principal					
Fax Number:	(011) 905 1123				
Institution:	Katlehong School f/t Deaf and Blind. Leondale				
Remarks: Please find attached					
NO. of pages: (including this one) 3			**Date:** 02 September 2003		
FROM					
Name:	Wendy Ndlovu				
Room number:	228	**Tel No:**	(012) 312 5485	**Fax No**:	(012) 312 5029
Directorate:	INCLUSIVE EDUCATION.				
* Please phone immediately if the transmission is not satisfactory. Thank you.					

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REPUBLIC OF SOUTH AFRICA
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The Principal
Katlehong School f/t Deaf & Blind
P O Box16008
LEONDALE
1424

Fax: 011 905 1123

Dear Sir/Madam

A REQUEST TO CONDUCT PH.D. RESEARCH AT YOUR SCHOOL

Mr Maguvhe is a co-ordinator of Education Services at the South African National Council for the Blind (SANCB). He is currently pursuing a Ph.D at the University of Pretoria.

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Yours sincerely

M. Schoeman

pp. **Dr S Naicker**
Directorate: Inclusive Education

APPENDIX K

DEPARTMENT OF EDUCATION

DEPARTMENT OF EDUCATION
PRIVATE BAG X895
PRETORIA
0001

TO					
The Principal					
Fax Number:	(015) 303 1655				
Institution:	Letaba School for the Handicapped, Tzaneen				
Remarks: Please find attached					
NO. of pages: (including this one) 3			**Date:** 02 September 2003		
FROM					
Name:	Wendy Ndlovu				
Room number:	228	**Tel No:**	(012) 312 5485	**Fax No**:	(012) 312 5029
Directorate:	INCLUSIVE EDUCATION.				
* Please phone immediately if the transmission is not satisfactory. Thank you.					

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The Principal

Letaba School for the Handicapped

P O Box 2445

TZANEEN

0850

Fax: 015 303 1655

Dear Sir/Madam

A REQUEST TO CONDUCT PH.D. RESEARCH AT YOUR SCHOOL

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Yours sincerely

M. Schoeman

pp. **Dr S Naicker**
Directorate: Inclusive Education

APPENDIX L

DEPARTMENT OF EDUCATION

DEPARTMENT OF EDUCATION
PRIVATE BAG X895
PRETORIA
0001

TO					
The Principal					
Fax Number:	(011) 903 8909				
Institution:	Sibonile School, KLIPRIVER				
Remarks: Please find attached					
NO. of pages: (including this one) 3			**Date:** 02 September 2003		
FROM					
Name:	Wendy Ndlovu				
Room number:	228	**Tel No:**	(012) 312 5485	**Fax No:**	(012) 312 5029
Directorate:	INCLUSIVE EDUCATION.				
* Please phone immediately if the transmission is not satisfactory. Thank you.					

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The Principal
Sibonile School
P O Box 534
KLIPRIVER
1836

Fax: 011 903 8909

Dear Sir/Madam

A REQUEST TO CONDUCT PH.D. RESEARCH AT YOUR SCHOOL

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Yours sincerely

M. Schoeman

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APPENDIX M

DEPARTMENT OF EDUCATION

DEPARTMENT OF EDUCATION
PRIVATE BAG X895
PRETORIA
0001

TO					
The Principal					
Fax Number:	(015) 651 0222				
Institution:	Siloe School, Pietersburg				
Remarks: Please find attached					
NO. of pages: (including this one) 3			Date: 02 September 2003		
FROM					
Name:	Wendy Ndlovu				
Room number:	228	Tel No:	(012) 312 5485	Fax No:	(012) 312 5029
Directorate:	INCLUSIVE EDUCATION.				
* Please phone immediately if the transmission is not satisfactory. Thank you.					

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The Principal
Siloë School
Private Bag X7354
PIETERSBURG
0700

Fax: 015 651 0222

Dear Sir/Madam

A REQUEST TO CONDUCT PH.D. RESEARCH AT YOUR SCHOOL

Mr Maguvhe is a co-ordinator of Education Services at the South African National Council for the Blind (SANCB). He is currently pursuing a Ph.D at the University of Pretoria.

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Yours sincerely

M. Schoeman

pp. **Dr S Naicker**
Directorate: Inclusive Education

APPENDIX N

DEPARTMENT OF EDUCATION

DEPARTMENT OF EDUCATION
PRIVATE BAG X895
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TO					
The Principal					
Fax Number:	(012) 328 4170				
Institution:	Prinshof School, Pretoria				
Remarks: Please find attached					
NO. of pages: (including this one) 3			Date: 02 September 2003		
FROM					
Name:	Wendy Ndlovu				
Room number:	228	Tel No:	(012) 312 5485	Fax No:	(012) 312 5029
Directorate:	INCLUSIVE EDUCATION.				
* Please phone immediately if the transmission is not satisfactory. Thank you.					

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The Principal
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P O Box 2817
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Fax: 012 328 4170

Dear Sir/Madam

A REQUEST TO CONDUCT PH.D. RESEARCH AT YOUR SCHOOL

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Yours sincerely

M. Schoeman

pp. **Dr S Naicker**
Directorate: Inclusive Education

APPENDIX O

DEPARTMENT OF EDUCATION

DEPARTMENT OF EDUCATION
PRIVATE BAG X895
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TO					
The Principal					
Fax Number:	(015) 964 1843				
Institution:	Tshilidzini School for Special Education				
Remarks: Please find attached					
NO. of pages: (including this one) 3			**Date:** 02 September 2003		
FROM					
Name:	Wendy Ndlovu				
Room number:	228	**Tel No:**	(012) 312 5485	**Fax No**:	(012) 312 5029
Directorate:	INCLUSIVE EDUCATION.				
* Please phone immediately if the transmission is not satisfactory. Thank you.					

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The Principal
Tshilidzini School for Special Education.
Private Bag X910
SHAYANDIMA
0945

Fax: 015 9641 843

Dear Sir/Madam

A REQUEST TO CONDUCT PH.D. RESEARCH AT YOUR SCHOOL

Mr Maguvhe is a co-ordinator of Education Services at the South African National Council for the Blind (SANCB). He is currently pursuing a Ph.D at the University of Pretoria.

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Yours sincerely

M. Schoeman

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Directorate: Inclusive Education

APPENDIX P

INTERVIEWS

Mr Maguvhe and a lady teacher

Interviewer: Its Mr Maguvhe, "I just want to ask you short questions, thank you. Each short question is a follow up to what I asked you last year. "A le a e gopola ya science, ehh ka ehh October?" (Do you remember the science lesson in October?)

Respondent: Not clear … li be le ruta ko Tshilidzini?

Interviewer: Ehh, Emm. Ok, there are a number of issues that remain unclear to me after conducting that research last year. I just want to check with you whether my interpretation was correct or not. Emm, it appears to me that drawing remains a problem to blind learners and in my investigation I revealed that learners are given "ready-made drawings" and are not taught how to draw. Is it therefore sensible for blind learners to draw objects and observations? If not what other activities are there to supplement a loss in drawing ability? How often do you use tactile diagrams and do learners have the capacity to draw and interpret tactile diagrams? Do you have equipment to produce tactile diagrams?

Respondent: Ok, normally it is not that easy but, fortunately now we have a machine from people from America whereby the machine can also draw the type of drawings that we need the learners to do. But in actual fact, we don't normally encourage them to specifically draw. Normally we give them a drawing where by they have to label that drawing. Even with the cited ones, because most of them their their drawings are not that clear. So initially in the final exam for grade 12 question papers like this one they normally take a drawing out and they ask for labeling.

Interviewer: But then you confirm that you give them ready-made drawings?

Respondent: Ja.

Interviewer: Ok, how often do you use tactile diagrams?

Respondent: With the tactile diagrams, we don't use those diagrams especially because we only received the machine after July. it is something that is still new, newly introduced to us. Ja, but this time what I basically can say to you is that we don't have facilities like the thing that we encounter now is that we don't have textbooks that is one thing that we are trying to get from Pioneer but still they are not OBE books. So initially what I have to do is that I have to try to make Braille notes for them from the OBE books.

Interviewer: But then according to your experience are these learners able to interpret ehh I mean this diagrams?

Respondent: Ja, that's why I said that sometimes like even with the learners in grade 9 they normally don't draw because is not easy to give the blind learner a diagram what they do is that maybe is a goat, and water, the boy and green grass. We narrate a story looking at that drawing which will help us change those questions and answer those questions based on the story. Like if there is this situation like a boy, there is this green grass and everything we take out …(not clear) that the learners will say ok, it was said that there is a green grass and it needs …so initially, "ke gore" basically we don't give them drawings. We try to change those drawings into sort of stories and set questions based on those stories.

Interviewer: And you said you have just received the machine in July.

Respondent: Pardon

Interviewer: Ehh, you, you received that machine in July.

Respondent: We received the tactile producing drawing machine in July, but to show that it Is a very good machine even the map and so on it make all very nice structures. Ja.

Interviewer: Emm, are you able to operate the machine?

Respondent: Oh, only two teachers.

Interviewer: Only two teachers

Respondent: Only two teachers were asked to go for training that is one other teacher from here and the other problem that we have is that the department does not give us books for the blinds like when they introduce this OBE they only introduced it for the fine kids but for the blinds kids there are no reference that we can introduce in the mediation of these kids.

Interviewer: Okay, the other thing is that ehh, I realized that learners are seldom engage in practical work, field trips and related activities, so ehh, ehh I just want to understand in your opinion ehh regarding this statement, is it true or is it not true.

Respondent: That they are not, they are not introduced to the field work?

Interviewer: Ja

Respondent: It is not that true because with us we have Mrs Grobbler who basically who try train them to like doing the cards and all those things like building a car and all those things. But she is very much involved with the blind ones.

Interviewer: No, I mean like in science where you have to do experiments and so on, ehh, how, how often do you ehh, do experiments with them? Are they able to do them on their own or not?

Respondent: There are situations where that is not a problem. But the other problem that we have is that we should look at the point that Biology or natural science is only being done in grade 8 and 9, do you understand? So the experiment like if they have to do an experiment of, of soil mixing it with water so that we can see types, the different types of soil. It is a very easy experiment but basically they won't be able to see it. Do you get the point, so I have to do an extra explanation that this soil have larger particles. So in a way we try to teach them with the aim that they should also use their imagination. You can take them to try and feel the soil the different types of soil but doing that experiment practically like I do it with the blind learners is not going to, is not going to help them. You understand, but the only thing that you can do you can take them to feel that soil, the different textures of soil. If some of them are totally blind, they haven't seen, you understand the only thing that you can do you can take them and try to make them feel the texture of different kinds of soil. If maybe some of them are totally blind they haven't seen, if maybe I want to teach them about roots, stem and leaves, then I will go and look for a small tree and try to make them feel the roots, the stem and the leaves, do you understand. I take that initiative of trying to make them at least have the imagination specifically of what I'm trying to talk about.

Interviewer: To me that is just simple stuff, what about the, the complex types of activities, do you do them?

Respondent: If we have facilities we would be able to do even complex things. But as I have said to you that initially we don't have textbooks, if the books were there whereby the learners will be able to feel those structures and will even be able to prepare for the class and study on their own, it will be easier whereby we will be able to do even the complex activities.

Interviewer: Are you saying that this is the reason why you are not doing the complex things?

Respondent: Like one major issue is lack of textbooks and chemicals. That one is frustrating. Also, because they do not have books and I am the only one who has the book I am the only reliable source. Like now I have finished teaching all the chapters.

Interviewer: But, do you have equipment for, for, for complex things?

Respondent: Yes, basically what I'm saying is that if we had textbooks then from there we will be able to go hand in hand with them, without the help of it how should we tackle the section. So the problem is that I'm the only one having the book meaning that I'm their only reliable resource. And that is one negative impact because if I make a mistake, as a teacher you should be willing that is to be rectified by those learners, but are they in a position of rectifying you because they don't have the resources.

Interviewer: So, so, I also wanted to ask you but my impression was that learners have, I mean very few of them have access to subject related information so you are just confirming that they don't have things like computers, encyclopedias and recent publications.

Respondent: Ehh, and the computers have just been introduced in the beginning of the year sponsored by Telkom Foundations. Where by the have the micro… what do they call that, those that they put it on their ears. Teachers have been trying to teach them how to use a computer. You understand? And if we can have things like that whereby we can teach Mathematics and even Science and they encyclopedias where you give them an assignment and they are able to know that they will get it from an encyclopedia through the computer it will make life much easier for me and for them.

Interviewer: So how do you go about ehh, helping them ehh, collect, information independently to do their own assignments?

Respondent: That is the problem, so the teacher who is in charge with media, there are people who assist us in the library they do help them. As I've said basically even it means that if we don't have the everyday textbooks, can we expect that the library will have those textbooks, the recent resources or it might be outdated that have been used from 1987, 1989 and 1990.

Interviewer: But the other question that I want to ask, it seems as if the strategy of telling and talking ehh, seems to be the most popular when teaching blind learners. However, educators and learners rely heavily on a "tell and talk strategy".

Respondent: It has to be popular, because of the problem, like for instance if I do an experiment whereby I have to check whether the leaf has starch obviously I have to boil the leaf. They won't see the process and the procedure when I'm boiling them. The problem is that if you teach a blind learner you must try to be very ehh like aware of doing funny mistakes, you understand. And you should accept that you are the resources like if I throw iodine on top of that, they won't see that it is blue-black unlike if I'm teaching the sighted learners they will see the whole procedure and they will even see the results and they will be able to get to a conclusion. But with the blind learners when I go to them I have to tell them that if you want to test for starch the procedure is to do this and the results you should expect would be the following. You understand the problem. So it is not that teachers are not willing but the other thing is because of the different problems. But although some are at least short sighted but we can do that with them.

Interviewer: Do you have other strategies besides that one of "telling and talking" that you use in your classes to accommodate learners who are blind?

Respondent: Ja, that is the strategy one uses so far but I don't know with other teachers that is why we have been complaining about this and we manage to get the donation of the computers with the intention of being able to try and use the computers and the teacher can give each learner an attention. When the learner is trying to solve a sum on his own then he encounter a problem then he will raise the hand and we'll go and assist that child but most of the time he will be trying to do things on his own and that is where we try to encourage outcomes-based education so that teachers must be there to assist and not to feed them with information.

Interviewer: Okay, ehh, the second to the last question, at your school do blind and partially sighted learners attend the same class or do they attend separate classes?

Respondent: Partially sighted are you referring to the B2 or the albinos?

Interviewer: Ja.

Respondent: No, is only blind. But we do have learners from Tshilidzini nehh, some are very short sighted but they basically belong to the B1 but normally we don't mix the blinds with the albinos, no, the albinos go with the crippled.

Interviewer: Okay, then if you would encourage ehh, ehh, a co-operative learning as a strategy so that these learners can benefit from, would it be possible if they are separate?

Respondent: Do you mean whether it could or couldn't work?

Interviewer: Ja.

Respondent: It is also fine if they are separated but being combined it will encourage the issue of inclusion and if the learners are comfortable with other disabilities I won't deprive them of that but for me it depends on them but on the other hand we should look at learner attention. Do you understand, but if they feel like maybe they want to be mixed with physically disabled is also not a problem. But the problem is that as a teacher you are going to be divided for other leaning group like I was saying that if you are doing an experiment those who are short sighted they won't be in a position to see that experiment meaning that after that they have to wait for me to explain to the blind learners. But it depend on the education system if it want to propose that if it want every teacher have to accept that.

Interviewer: Okay, the last question now, I also got the impression that during teaching and learning, educators do not stimulate and develop the senses of blind learners during the teaching of science, ehh, how do you respond to this observation.

Respondent: Ehh, ee yona ye buti' (this one brother) I don't know.

Interviewer: Like ehh, you know that, that blind learners depend largely on their senses, say the sense of touch, sense of hearing, feeling smelling and so on. Ehh, I have realized that not much has been done regarding that, do you agree that not much has not been done or do you have a different opinion.

Respondent: I have a different opinion, I think teachers are trying their best. I'm not trying to protect them. To be honest they are trying their best and if the learners could use these committed teachers I think they will make it. We do try it is just sometimes we might have in a class whereby there are B ones, a learner may say I don't want Braille notes I want sighted ones. Ja, in a way you take it like say if the learner has not accepted her or his disability. Because in a class of ten learners I have to do six Braille notes and then four sighted ones. But when you give them answer sheets they can read Braille but when they do it through the notes they don't want to, do you understand. We can try to make them touch like for instance if you teach them about the parts of their body they will laugh at you and say Mum, you make us like grades 2 and 3 and they touch your tongue is for what, for tasting, your ear and from there they laugh but we do try to do that.

Interviewer: Okay, thanks very much for your time.

Respondent: Okay, "buti" (brother), okay bye bye.

Mr Maguvhe and Mr Mhlari

Interviewer: Okay let me see, (answering a phone call) hello are you there! I will ask very short questions. I have realized that drawing is a problem to blind learners, so ehh, I also observed that they are given ready made drawing. They cannot draw on their own. So would you tell me whether it is sensible for the blind learners to draw or whether it is not sensible.

Respondent: You mean partially sighted or totally blind?

Interviewer: Ehh, the totally blind.

Respondent: The totally blind, I don't know how to make them draw but if there was a way of which we can help to make them draw it would be a great thing I think. But at the moment I just don't know how.

Interviewer: Ja, but at your school do you have enough tactile drawings?

Respondent: No, we don't have enough but we use models but plastic ones. But, they are also no more there. We have models, let say I'm teaching Science I use models so that they can touch them. But now I don't see them anymore. They are no more there. And we don't find them even at shops.

Interviewer: But then if you give them drawings would they be able to interpret them?

Respondent: Ja, we don't have drawings as such. We, we I try to make a model like when teaching Science so that they can touch it because real things are, most of them are dangerous.

Interviewer: So do you have equipment to produce drawings?

Respondent: Except for that machine, the thermorform we don't have any equipment.

Interviewer: Ehh, I also realized that, blind learners are engaged in very few practical activities in science, what is your opinion on that?

Respondent: It is true there are very few because I do teach them science especially biology. With biology it is difficult to give them practical work. But we do try to teach them. Let's say I am teaching them about a flower, I do take them out and let them touch parts of the flower. But they seem to understand because when I ask them questions they do answer. Maybe they just memorise I don't know. In terms of ratio, it is more theory than practical work. I may say 75 % theory and 25 % practical.

Interviewer: Do you teach them complex experiments or do they only do simple experiments?

Respondent: Ehh, since I'm not teaching them ehh this what do they call physical science, is difficult for me to even start because the students can't see. But according to me I don't because even the sighted people it is difficult for them what more about blind people.

Interviewer: When I talked to learners they told me that they did not have subject related information with special reference to computers, encyclopedias and the recent publications. What is the situation here?

Respondent: Ja, now we have and in future it will be of a great help but at the moment they are few and we have to make room especially for the blinds. But at the moment very little.

Interviewer: One strategy that seems to be popular when I did my previous investigation was that of telling and talking. Ehh, would you say that the things have changed or teachers are still relying on this method of teaching for the blind?

Respondent: Telling method to the blind is still the only one mostly used by teachers.

Interviewer: Are there other popular strategies that are seen to be so powerful in accommodating blind learners?

Respondent: Of course there are, an example where they use this a radio and TV they can hear the person talking even if there are some drawings that they can show them and they can explain also.

Interviewer: Okay, are you as a science teacher, especially science teachers at special schools invited to workshops where the development of learning strategies is shared?

Respondent: Not invited at all, we have never been to any except when we come to Optima. So nothing. From the department side we do go to workshops but is not for the blinds but for the normal people. Most things we get are for the normal people only and not blind people. My view is blind teachers are reluctant togo to such workshops but they do force them to go and listen.

Interviewer: So at your school, do you teach blind learners and partially sighted learners in separate classes? So if you teach them at separate classes what happens when the have to be involved in cooperative learning?

Respondent: That's right. What made us, in fact I will answer that one in this way, what make us to separate them in the past is when we went to special education workshops we discovered that it was better to separate them because it is difficult to teach them both groups in one class. So we decided is better to separate them because the other ones are writing in print while the others are writing in Braille. And let say in my school, for example I have blind teachers I think it will be difficult for the blind teacher to teach both the shortsighted and the totally blind learners because she can't see what the partially sighted is writing.

Interviewer: Okay, the last question now, ehh I've also realized that ehh blind learners senses are not stimulated enough. How would you respond to this observation? The senses of touch, the sense of hearing and so on.

Respondent: As I've said that there have been very little like what I've request myself, I will add, I do give the model the only thing that I have and for class I take them out to the flower garden and touch them. Those are the examples. But in most cases it is just the telling and talking method.

Interviewer: OH is just telling and talking. Okay, Mr Mhlari thanks for your time. Those were the questions that I had, thank you very much.

Respondent: I wish you well, bye.

MR MAGUVHE AND MUM RALETJENA

Interviewer: Morning Mum Raletjena how are you?

Respondent: I'm fine, and you?

Interviewer: I'm fine. Do your learners draw? And if not, what other activities are there to supplement this loss of drawing ability?

Respondent: Ahh, I will say for us we are trying we are trying. In fact I cannot say it is drawing because it is tracing. Thus far we are to help them do something like that, they trace that is what we are doing. The partially sighted ones they do draw.

Interviewer: How often do you use diagrams?

Respondent: Often, very often because we especially for Maths and science natural science we do give them such drawings. But most unfortunately they do not do drawings by themselves. During examinations and lessons we make the them use drawings in their textbooks.

Interviewer: Do you have equipment to produce drawings?

Respondent: Yes we do have that, yes they are in a good condition and sometimes they don't, let say you draw something to show children a, the stages of maybe something is rough, fine and so forth and so forth so for that like they are not so tractable in that way so we do it by hand where we put sand, we put saw dust, we put… so that they can differentiate that is what we are doing.

Interviewer: Ja, my other observation was that educators engage blind learners seldom in practical work. Ehh I mean conducting experiments, taking field trips or related activities. Would you also regard that to be your opinion with regard to this observation?

Respondent: Emm, not in my school because we have field trips with learners. And especially because I'm offering Maths and Science we do involve them a lot. Yes.

Because let say we are doing measurement of distances we have the meter wheels with which they do measure their class. They do that. So to me is not that in our case they do go the kitchen if it is a practical lesson, which let say have to go to the kitchen to do that.

Interviewer: If you were to give percentages to practical work and theoretical work how much, what percentage will you allocate to practical work and how much will you allocate to theoretical work?

Respondent: I would say theory is 60% and practical is 40%, ja this are my observations but I will estimate it like that.

Interviewer: Emm. So emm the other thing that I would like to ask, is that it appears to me that blind learners are only engaged in simple exercises or practical work, is this statement correct or not?

Respondent: Simple like the easy ones not the complex ones is that what you are saying? But I cannot say that is 100% correct because I would say that if the lesson demands something that is what we offer to the learners. I cannot say that it is simple if simple that I what is offered by the syllabus and if it is complex I don't see a situation especially in my school that we jump other things because is difficult and you don't give learners such things I don't see that. I really don't agree with that statement because we teach learners what the syllabus or the especially using the environment because nowadays OBE concentrate too much on what is given by or offered outside learning area and the outcomes. If the outcomes ask this you have to offer that if it is simple that could be the outcome that would have asked it. But it would depend on individual teachers who are teaching that.

Interviewer: Okay, when I visited schools learners told me that they don't have enough or don't have good access to things like computers, encyclopedias and recent publications but educators told me that, I mean the opposite of that and what is the situation in your school?

Respondent: At my school our learners do have access to computers. It start from grade 5 that is standard 3, is typing ordinary typing, they type preparing them for computers to go to the computer level. Now recently we from grade 6 they have afternoon lessons unfortunately we don't have teachers who are willing to give them those extra lessons but there are some the few that are there to offer them these extra lessons are doing that they do that to introduce them to computers. And so far what I've discovered is that our computers for totally blind learners are not in a good number we have 1 or 2 which are talking which are, all the totally blind learners can use. But for partially sighted ones we have about 8 computers and they use then in the afternoon they do go for lessons in grades of course they cannot all go at the same time.

Interviewer: But do you have ehh enough books, recent books like encyclopedias?

Respondent: Oh yes, we have encyclopedias and then if there is an information they are allowed to go there, they make arrangement with the educator the educator arranges with the relevant person who is responsible with the encyclopedias. There are available for them.

Interviewer: Educators also told me that they adapt the traditional facilitation and instructions such as demonstrations to enhance learning with the blind learners. The learners on the other hand indicated that many of the activities rely heavily on tell and talk activities. Could you please indicate to me through the use of 1 or 2 examples on how actually you go about adapting the traditional strategies?

Respondent: Ahh, I'll say that, we cannot avoid it of course. But we engage learners to participate. Infact, for learners let say they, they, they see that we, teachers use the tell and talk ehh, the, your approach of OBE engage learners you cannot avoid it of course that it keep learners to participate and in fact learners direct you how you must teach them. I cannot say if you follow OBE correctly there'll be no way that you can just tell you will be the main participant in the lesson I don't think there is such a thing that you can do that it will be unfair to the educator not to say that it is not happening but I will say that it will be unfair because learners will give you, you ask learners what you, and they will give you that and you go around until you get to give them what you've prepared to give them. Or sometimes you prepare yourself to give them this and they direct you into a direction that you would never thought of I mean if you are a teacher you have to be flexible and direct, look at what your learners need especially for blind learners sometimes we take things for granted that they know them and if you find that they don't know them you have to go back and teach them that you build it gradually so that they know such things. I wouldn't say that is a, is the way you are asking about the demonstration, we do demonstrate but involving them because it is of no use where you expect them to do something while children could not see it. I don't find it possible that you can just demonstrate you go to individual learners to show how the child how to do something and they help each other in groups as maybe recommended by the office that they must also acknowledge each other that so and so can help and personally I ask the learner would you like the learner to help you and the learner can say learner B can help me, that is how we do it I don't know if I have answered your question.

Interviewer: Okay, do you know of any workshops or have you ever been invited to workshops where the development of adapted learning facilitation strategies were shared with educators?

Respondent: Particularly, you mean for the blind learners, not necessarily but there are educators from our school who attended such workshops but they come back and share that with us.

Interviewer: Ja, but there are, I mean were they taught special methods for teaching the blind or were they just taught ordinary methods for sighted learners?

Respondent: To us to adapt to blind learners, no I cannot say that because we have a volunteer here particularly for maths who is very experienced in teaching blind learners and personally that I get my help mostly from her because she knows that there are methods that are used particularly for blind learners. But for the workshop I cannot say it was particularly on how you teach blind learners. As teachers for blind learners we do apply what we think it will be, it will accommodate blind learners.

Interviewer: But do you think such workshops are necessary?

Respondent: Very necessary. I think that they are very necessary.

Interviewer: Ehh, at your school do blind and partially sighted learners attend the same, I mean are they, are they in the same classes or separate classes, are they taught in separate classes or are they combined?

Respondent: Partially sighted are you meaning those who use ordinary print, no we don't combine them. We are, they are not combined, those who are using Braille are in their own classes and those who are using print are in their own classes. We don't combine them.

Interviewer: But when you have to encourage maybe co-operative learning, how is it possible when they are in separate classes.

Respondent: Really we have not thought of that yet, we only say, we only said that because we are a primary school. We have to make a child to find things out herself better and then we are giving them the basics and the other activities, for the other activities like music and other things they are combined but for teaching really teaching we don't combine them. We only combine them with partially sighted partially sighted those who are using Braille.

Interviewer: What are the major reasons for not combining them?

Respondent: Initially we were afraid that sometimes the teacher is overloaded with work he has to write on the board for the partially sighted ones, she has to go around help the totally blind learners and then we find that one group is neglected and that has been our fear. We did that before we started with the section for the partially sighted learners so that really one group is suffering and mostly the group that suffers is the totally blind learners and we find that we were unfair to them and sometimes we don't we don't do it deliberately it just happen, it just happen but we saw it in that way that if you teach Braille teach Braille and for large print teach large print. And one other thing is that you write on the board if you write in a hurry saying that you have to help another learner you are not going to write typically for the partially sighted learner and that is going to really influence the child especially the learner's writing as well.

Interviewer: Okay, the last question now, I also got the impression that educators are not stimulating and developing the senses of blind learners during the teaching of science, how would you respond to this observation?

Respondent: I would say that ahh, I don't agree with it 100% because personally I'm also for a fact we do go out with learners they touch things even for things that, what I don't let them touch is hot things that of course will put me in danger and I do we do give them things to touch, things to do.

MR MAGUVHE AND MR SEMELANE

Interviewer: Let me put on the speakerphone, actually what I'm doing is to observe is check whether my interpretation of the data that I got last year is correct or not, ja.

Respondent: okay, that's fine.

Interviewer: Okay, Mr Semelane I observe that drawings remain a problem to blind learners and in my investigation I discovered that blind learners are given ready made drawings and not taught how to draw, ja but then would you say it is sensible for blind learners to draw objects and if not what other activities are there to supplement a loss of drawing activities?

Respondent: Okay, right I'm gonna answer that one in two ways, the first well sometimes it does not make sense to actually engage them in drawings normally in some cases we all go for an alternative it depends what kind of drawing that you are searching but some drawings is a must that they have to be done like if can make an example, we are talking about the globe, a nature of the globe the one that can actually actualize look at it directly rather than being told. And then once again some of these pictures we can also get for them some that are even related to the pictures and drawing that is where one will go for a verbal description of that drawing what it looks like, what is it doing and all sort of things. Although it is difficult, the last thing that I would like to submit is something different is for this year, there is programme by Freedom Scientific where it come up with drawings as I can make an example a dog it will come up like a real dog, it will come with an actual drawing although we have not reach that level our school have not yet purchase the product but that one I think it will be an answer to many things rather than that what we are doing because now we are …not clear, we are giving them a scenario or verbal description. Sometimes they don't have, you can even see that they don't ehh comprehend the whole picture you are trying to give them.

Interviewer: So how often do you use tactile diagrams?

Respondent: Very seldom, we do have this thermorform but really you know these objects we are now not in a position to…obtain these things as we like that they can see at this point of time although we are moving towards that but at the moment no. Some can interpret and others cannot. We make associations in order to accommodate them.

Interviewer: Do blind learners have the capacity to interprete those diagrams?

Respondent: Well there are two kinds of people we've got like some were born blind and there are some who got blind after birth and really they do have the vivid description, they do have a picture in case you give them the description verbally that learner will comprehend that for you, but the total blind one who was born blind still remain a problem maybe as he describe it herself you can feel that he haven't got the theme, the comprehensive part of the picture or the structure it remains a problem, it remain a problem if I can make an example if I have to teach, I'm teaching natural science I have to teach them about the cell, the parts the nucleus, the cytoplasm and the chromosome and also what is in there in order to give them a picture of how it looks like maybe imagine I have to start by taking an example of an egg is more like a round look like an egg all sort of at the end of the day the child don't have a real concept of a cell but something like an egg where you always relate it to an egg of which this things is not in line of an egg. So the problem is that we did not…(not clear) we make associations but we do accommodation to…(not clear).

Interviewer: Ehh, do you have equipment to produce tactile drawings?

Respondent: Ehh, no, we don't have but the province has … (not clear) and give us a demonstration and all sort, they said the school with the department to purchase that. They have a budget for the province although it is expensive but is available at this time not in my school but in …(not clear). In fact they can purchase it if they do like, but I so really absorbed with it because it also help the teachers who don't know Braille the problem that they come with is its gonna be doing it in one printing the Braille and the print on top of the Braille … not clear. Again is what we call that package we are having now it having the ability to do some of the drawings so which we won't imagine I even look at up to so far some of the drawings they can actual come up with like this one can create a number of things is quiet a nice thing.

Interviewer: Ja, my other observation was that many educators engage their blind learners very seldom in practical work, field trips or related activities, ehh this observation was also supported by some of the teachers and by learners participating in the focus group, what is your opinion regarding this statement or observation?

Respondent: That statement is absolutely true we do not engage them in 100% of that, you know the thing that, that is very true although some are trying some are trying to move an inch and some are not even attempting the thing is that it is actually rooted in the minds of people because some of the thing you can take with steps attempting some of the thing are difficult to do but the purpose suppose to engage the learners is rooted in his or her minds that agg, because they are…the change will be in the child's attitudes regarding the whole situation that is where…not clear.

Interviewer: But if you would take your whole years' activities into consideration what would you regard as the ratio between theoretical work and practical work in the teaching of sciences to blind learners?

Respondent: In the teacher of science if I can quiet…not clear, like me I am also blind person I happen to become blind after my matric I've seen experiments being done I've been to the laboratory really I would love to have my learners have the same feeling of thing how they go by a real touch of it I can give it 30% to me of it I'm not so sure but that is my thought and another thing, that is 30% of practical work and 70% of theory ja, that is the estimations. Because somewhere somehow we found that there is no support from the school, the school lack resources to can… even like to moving for an inch but you find that it is not supportive materials. Imagine we don't have a laboratory in a school, when we are talking about a number of things in science they don't…I can just a make a lousy example for you look the school does not have a laboratory they don't even know a measuring cylinder if you talk of a measuring cylinder, even if you think of a jug used in the kitchen at home that is what I usually do I just go to the kitchen and borrow their jug because if you…a measuring cylinder, so all the problems have to be balanced like we don't have in the school and looking at that we can do it especially with the measuring forces they can measure and do the actual pulling and see how much weight of this one and they match. And the heavy can help in looking at the accurate measurement reflected by the…not clear, but because of the school don't have that they have to depend on the theoretical basis on that …not clear.

Interviewer: So am I correct to say blind learners are involved only in limited, simple and elementary exercises that involves very little intellectual challenges or advanced problem solving?

Respondent: That is very true and somewhere somehow is the fault of the schools or the department actually to avail these things. Sometime we feel like doing it but you know we are from a background that our department availing top…but as you can see we might be able to deliver this, this whole stuff like this when we are in a blind school so now because of lack of understanding looking at the background really resources and also teachers some need to be internally trained especially the conditioning part of it maybe that their pattern of thinking when using. …learners they have to change their minds as well. It is not only the teachers but also the people from our department because they don't know they are actual leading but heading at us in a special school but they actually don't know how the school operates. Now and again we are fighting saying this and that is not, hey why this, no, no, no and start with apologies through ehh restructuring and all those things.

Interviewer: Last year when I spoke to learners I got the impression that very few of them had access to subject related information with specific reference to computers, encyclopedia and the recent publications, however when I spoke to educators many of them indicated that such information systems were available to their learners at their schools at all times, learners complain about the scarcity of information so I just want to know, would you say the learners are correct that they don't have access to computers, encyclopedias and recent publications because they complain that their books are outdated?

Respondent: Ja, I can say that there is an element of weakness on that one, but what we do have a center where they can actually…not clear. And also they have got the…not clear of CD that can be accessed through a computer by the learner we do have that but then we have a problem with those of doing observations it was a question of three year having such resource available in the school so it was not been applied to learners so I'm quiet sure with that one but still the whole problem was with the arrangement and managing how to actually apply also they have got the skilful person could apply that the question and mindset actually in the attitudes of people is one of the organization running of the problem. So people were not doing things with the people who are in charge they are doing it for them, they thinking for them, they claim it imposing it the way feel it has to be and it is wrong otherwise…

Interviewer: Okay, many educators indicated that they adapt the traditional facilitation strategies such demonstrations to enhance learning for the blind learners, the learners on the other hand indicated that many of the activities relied heavily on tell and talk activities, could you please indicate to me through the use of good examples how you actually go about adapting traditional strategies, if you would argue that it remains the task of educators to engage blind learner to tell and talk activities instead of engaging them in this adapted strategies, please feel free to confirm or reject this observations.

Respondent: Ja, although I don't fully agree with that statement, look the traditional approach was about the teacher giving all the information to the learner and the teacher being the only source of knowledge so we are seldom applying that somewhere somehow we do apply that maybe you find that they have got nothing no background they don't have any concept on that subject that you might be delivering but now we are approaching the outcomes-based one that one that is where the teacher becomes the facilitator although we know that we all not doing that at the same level same degree but the approach is different altogether, the approach is like the learners can, I'm making an example with that one, you just give them an example you just give them a topic and you let them to interact you trying to get from them how much they know about the problem, explore the concept with them when they come up without the understanding of what they know you assimilate with them you give them summaries of information and you try to …their problems here and there you bring that close discussions… like if I can come to them I have to teach them about the water already the learners know what water is, they know water can be in the different form I think then I will start with giving them the concept now you have to start analyzing the concept…not clear. Where I end up being the source of knowledge and I will end up coming with a summary, summarizing appropriately to their responses and all sort of things. And the feeling where the approach have changed is not only myself and the activities with the previous method as the only source of information they have to come up with…not clear, that is appropriate to that. Sometimes is not like in a traditional way and where possible we try to release them in a practical way of doing this the problem is that there are limited resources.

Interviewer: Do you know of any workshops, or have you ever been invited to workshops where the development of learning strategies was shared with educators?

Respondent: Meaning from our department?

Interviewer: Ja,

Respondent: Ehh, although not so well, in, no, no except the one that was once called by the national council although some of our schools did not attend it the question of management has important and less important and it is always a problem of information you see in one occasion if one has a background of normal functioning school…not clear, it is different thing altogether because that person will weight other things as weightless…not clear.

Interviewer: Ehh, at your school do you teach the blind and short sighted learners combined or are they taught in separate classes?

Respondent: No, in ehh combine classes.

Interviewer: So would you say combining these classes is useful in terms of co-operative learning strategies?

Respondent: Well, there is no and yes answer to that one because somewhere somehow we find that the combined classes does not work properly somewhere somehow it works properly look group work works very well whilst one would …not clear. And once again we found that the partially ones help the total blinds with pictures that …not clear it becomes strategy…not clear. And one would, my comment on that it will always depend on the educators up to each an every …of the strategies they applied to reach them all because somehow we will do the grouping but you can't do the common work and the group work you group the partial sighted alone and the total blind alone and …not clear.

Interviewer: Okay, ehh the last question, I got the impression that educators do not stimulate and develop the senses of blind learners during the teaching of sciences, how would you respond to this observation?

Respondent: Ehh, come up, come up…

Interviewer: Repeated the question.

Respondent: Ja, that one I'm not …I I'm not sure if you are referring to the ethical of the practical part I don't get the issue.

Interviewer: No, what I mean is that blind learners' senses have to be stimulated like the sense of touch, sense of smelling, sense of feeling, testing and so on, my impression was that in this department particularly with sensory stimulation not much is being done by educators during the teaching of sciences to stimulate and develop these senses.

Respondent: Ehh that one honestly is gonna be an individual different situation we are referring to how, that question can never be asked of course it depends on who you are teaching and what you are teaching some of the things really have got nothing to do with developing their senses some of the things you have to embark much on that one. If I can just make an example, collection and …not clear, population dynamics right based on that there is nothing that you will actually, there is nothing much for me that you will engage them in developing the sense of touching blar, blar because I'm talking population…. not clear.

Interviewer: Okay, thanks for your time Mr Semieane and once again thanks for being prepared to respond to my questions. Thank you, good day.

Respondent: Thank you very much for your time as well.

MR MAGUVHE AND MR NETSHITUNI

Interviewer: I would need to ask you 8 short questions, it is just the follow-up of what I did last year.

Ehh according to my observation drawing remains a huge problem to blind learners and my investigation revealed that learners are given ready made drawings and are not taught how to draw, ehh, is it therefore sensible for blind learners to draw objects and observations, and if not what other activities are there to solve this problem?

Respondent: Well, in case of drawing ja, I remember blind learners are not drawing, ehh in case of drawing we ask them to give the names of drawing such as to label. The challenge here is that there are no mechanisms that we can employ to draw; we do not have the equipment that we can use also.

Interviewer: So do you think drawings play an integral part during the learning mediation or rather they should be avoided at all?

Respondent: Drawings are necessary but currently we are not using drawings for blind learners.

Interviewer: Is it because you don't have equipment to produce them?

Respondent: Exactly.

Interviewer: Okay, the other observation is that educators engage their blind learners seldom in practical work and field trips or related activities, this observation was supported by some of the teachers and some learners who participated in the focus group interviews, what is your opinion regarding this?

Respondent: Ehh, with the fact of practical work here, most of the blind learners don't take part in practical work but in-group work are combined with other learners they can participate with other learners where they observe and if they cannot hear they touch, they can smell in case of chemical reaction etc.

Interviewer: If you are to take your whole year activities into consideration, what would you regard as the ratio for the theoretical work and practical work?

Respondent: Well, ehh, practical work is minimal to be honest. Theory, yes. I would say one is to ten.

Interviewer: One is to ten, okay, I also got the impression that when I looked at practical activities that blind learners were involved in, the activities were limited to very simple and elementary exercises that called for very little intellectual challenges or advanced problem solving skills, how would you respond to such an observation?

Respondent: Practicals that are based on primary schools demand like hands-on things like measuring things, observing some reactions, we have a very few of that but they do not take part on those things because of lack of capital, equipment, etc. Lack of resources and maybe also the dangers posed by some of the reactions that may take place. For the blind learner to be exposed in some chemical reactions might cause some danger. So, one must take care of that.

Interviewer: So those are your reasons why they are not engaged in many experiments?

Respondent: Ja, lack of resources and maybe the dangers caused by some of the reaction like I said, for a blind learner to be exposed to chemical reaction may cause some dangers. One must take extra care of that.

Interviewer: I also got the impression that blind learners had limited access to subject related information with specific reference to computer, encyclopedias and recent publications, what is your opinion on this?

Respondent: My opinion is books are there but some books are there but learners are not so motivated to go to the resource centers to find information by the themselves they need to be pushed is like when given assignment you need to push them to get information. When it comes to computers usage, well some are getting these lessons, computer lessons from time to time but they do not use computers as a source of information at the resource centers for information like making you mentioned encyclopedia they can't go to a computer and search for information they can only go to the library for such information.

Interviewer: But do they have enough research books in the library, are there new publications there, are they there in Braille?

Respondent: Most of the books that we have now are outdated but emm most companies are suppying us with books like Juta, Maskew Miller they are bringing books here that we keep in our library for the learners to refer to them you see. But emm it is quiet rare to find learners going to the library to search for information.

Interviewer: Is this not what discourages them from going to the library?

Respondent: Exactly. There are very few books in there, very, very few. If we need that book to be there we have to scan the book and all that.

Interviewer: And I also got the impression that many educators like to use the tell and talk strategy during the teaching of natural science, may you indicate to me through very good examples how you go about adapting the traditional strategies?

Respondent: The 'tell and talk' method that you are referring to here is of course the order of the day, I did mention that we do not complement it with with experiments and so forth because of lack of equipment or facilities. We theorize most of the things but where necessary like in grade 7 there is measurement acids and bases we use, we improvise get this whousehold things that we can get that we bring them to class. We take them to class and work with them.

Interviewer: Do you know of any workshop or, have you ever been invited to workshops where the development of adapted learning strategies was shared?

Respondent: Not at all, not at all.

Interviewer: If that is the case have you raised this concern say with the department of education?

Respondent: We always raise concerns when we go for workshops based on not necessarily blind learners but these other learners. That we should get for instance science books in Braille, workshops geared to the needs of the blind, etc. But, to update us, there is nothing happening.

Interviewer: At your school do you combine partially blind learners together with totally blind learners or are they taught separately?

Respondent: No, they are combined; both partially and totally blind learners are in one class.

Interviewer: What would you regard as the advantages of combining them?

Respondent: Well, doing that as far as science is concerned is concern is to there advantage because they can observe those who are partially sighted can help those ones who are blind who cannot see and so they are doing that to help each other.

Interviewer: So would that encourage co-operative learning.

Respondent: And moreover most of the books are in sighted so the sighted ones will help read to the blind ones. So, yes. This encourages co-operation between these two groups of learners.

Interviewer: But then as a teacher doesn't that make you to be stressful to concentrate on two different groups?

Respondent: Well as you know, ehh, all learners are unique and they need individual care, one way or the other you will have to reach every one of them that does not put any pressure on me.

Interviewer: Ehh, I've also realized that very little is done in terms of stimulating and developing the senses of blind learners during the teaching of science, how would respond to this observation?

Respondent: Stimulating the senses?

Interviewer: Ye, senses, stimulating the sense of touch, sense of smell, taste, hearing and so on.

Respondent: Ja, like you said there is only one sense that is stimulated that one of touch the rest is underdeveloped you are right.

Interviewer: But the sense of touch, how do you stimulate learners in that one?

Respondent: The sense of touch can be stimulated in various ways by giving them books to read, by giving them objects to feel and so forth.

Interviewer: Oh, those are the questions that I wanted to ask because I needed to verify whether I understood the educators correctly or not. Thanks Mr Netshituni for your time.

Respondent: My pleasure Mr Maguvhe. Have a nice day, sure, sure.

Interviewer: You too bye.

MR MAGUVHE AND MR SEKGOBEELA

Interviewer: Thanks Mr Sekgobela for your time, I'm just going to ask you 8 short questions. Ehh, this is just the follow up of last year's interview, it appears to me that drawing remains a problem to blind learners and in my investigation it was revealed that learners are given ready made drawings and are not taught how to draw ja, I just want to know in a way what activities are the in place to supplement this loss of drawing ability.

Respondent: I think practically, I haven't been able to see a situation where a blind child is able to draw. In most cases they would rather make sort of models using clay but drawing I really don't know how we can do it. They rather do some sort of modeling, you have written up what do we call…ja, but to put drawing right on a paper I don't know how they can do it.

Interviewer: But at your school do you have diagrams?

Respondent: We do but not that much present here.

Interviewer: Can your learners interpret those diagrams?

Respondent: To be fair to you Mr Maguvhe, we are having a very big problem you know. Teachers no longer have that dedication to teach the blind unlike during the old days. Those teachers who used to offer teaching to the blind learners, they were taught how to make drawings.

Interviewer: As a school do you have equipment to produce tactile diagrams?

Respondent: We do have the equipment to make drawings but teachers are reluctant to make use of those equipment. The problem is with our educators and not necessarily with the equipment because womewhere somehow teachers have improvise and make drawings.

Interviewer: You said you do have the equipment but the problem is?

Respondent: The problem is teachers are reluctant to make use of those equipments; they did even enquire skills…not clear (noise)

Interviewer: Ja, okay ….not clear

Respondent: With our …not clear

Interviewer: Ehh, I also observed that learners are seldom engaged at practical activities or related activities. are my observations correct?

Respondent: I can say with activities like ourselves we have blind learners mostly relying on the sighted ones but it unfortunate even educators do condone such situations. Even if they work for the sighted and to ask the sighted to help the blind learners the ultimately make the blind learners not to engage themselves but rely on the sighted ones.

Interviewer: If you are to take your whole year's activities into consideration, what will be the ratio between theoretical work and practical work?

Respondent: To be most honest with you I would say theory is about 90 % because every time we avoid practical work when it comes to the blind learners and with theory they observe very well and they have the outcomes-based education.

Interviewer: Am I also correct to say blind learners are only engaged in simple activities?

Respondent: Exactly, more especially with the primary schools.

Interviewer: So what is the reason is it because they are in primary or there are other reasons?

Respondent: If we see here not necessarily because they in primary just as indicated previously that they should acquire skille and the teacher should be dedicated because if you have learners who acquired some basic theory you will not have problem rather than maybe to attend those problems that should have been acquired in a lower primary schools with the results that the actual standard of education is being jeopardized.

Interviewer: I also got the impression that blind learners have a limited access to subject related information with specific reference to computers, encyclopedias and recent publications, is my observation correct?

Respondent: I think so, a bit of some information is quiet correct.

Interviewer: But then how do you as a school address this problem?

Respondent: I think so. I think so. Your observations are quite correct. I think with the acqusition of computers, the newly developed software and the dedication of teachers dedicated to make use of the equipment, learners will benefit. A teacher who cannot …not clear, cannot just work on his own you need the dedication of teachers, you need teachers who are very much keen to make use of these equipments so that they are available to the learner. Otherwise I can say …not clear (noise)

Interviewer: The method that seems to be popular in the teaching of science to blind learners to me appear that one of telling and talking and is that a correct observation or according to you how is it?

Respondent: to an extent yes, because it requires knowledgeable teacher who can improvise. If the teacher is not very much skilled in the teaching of the blind, he is not aware of the teaching of the blinds he might not be able to teach correctly he may always try to avoid this practical side, this experimental side he will only use talking and telling because that is the easiest way out he might not even to go an extra mile to think of what he can do in order for those learners to know.

Interviewer: The other, do you know of any workshops or have you ever been invited to workshops where the development of adapted learning facilitation strategies was shared as an educator?

Respondent: No, not to my knowledge, the only workshops not necessarily workshops where you have a software displaying and you should bear in mind that such exhibitions they are not necessarily workshops because they developers or the suppliers of that software are not competent in teaching of science to blind learners.

Interviewer: You were saying that the workshops that you only attend are not necessarily workshops with exhibitions. Okay, one last question now I realize that not much is being done in terms of stimulating and developing the senses of blind learners that is the senses of touch, smelling you name them, was my observation correct or not?

Respondent: Yes, exactly we also had a meeting exactly on this issue. Unfortunately some teachers do stimulate learners' senses and others are not. We think we should embark upon a continuation process where the teacher goes to the next grade with his learners so that those who are doing it sensory stimulation could carry on and those who are not doing it to be encouraged to do it as well. We talk about it all time unfortunately teachers are no longer interested on that … very experienced teachers who could offer … we seldom engaged them on what we normally call teaching from the … We seldom do that where learners hurry things … not clear. Such things no longer happen.

Interviewer: How would the management address this problem?

Respondent: We are busy engaged in trying to bring back the teaching of a continuation classes because we realized that we have teachers who have more that 10 years here who cannot even need to write or read Braille.

Interviewer: Oh, that is a problem.

Respondent: A very serious one, it is very, very difficult nowadays to engage educators in such a practice.

Interviewer: Well Mr Sekgobela those were the questions that I wanted to verify if my understanding was correct or not, thanks for your time.

Respondent: Thanks, bye.

MR MAGUVHE AND ELIZABETH

Interviewer: Thank you for your time, Elizabeth, ehh I just need to ask you very short questions they are 8 in number. The first thing that …I've realized that drawing is a huge problem to blind learners, drawing is a difficult issue to blind learners, of course they cannot draw what do you do to supplement a loss in this activities?

Respondent: Ehh, most of the time I totally don't let them draw, I draw for them and then I show them the different items or let them tell me the …not clear.

Interviewer: But then, if you give them the ready-made drawings, are they able to interpret?

Respondent: Sometimes, that is not much a complication but first you have to explain to them and let them find out what they can feel.

Interviewer: Did you have, I mean their school, are there equipment to produce such drawings?

Respondent: Ehh, we have a thermorform machine that we are using but those cannot use Braille we let them all print.

Interviewer: Ehh, okay lets go to the second question, I've realized that blind learners seldom do practical work undertake fieldtrips and relate activities, what is the situation in your school?

Respondent: At our school of course they are normally taken and most of the time the totally sighted goes with the blind ones so that they show them exactly what is done although is sometimes is difficult especially during lessons when we have to do the experiments nehh, so in some cases they cannot even think or recognize what is in the container or what, those days I was doing experiment with the grade 9s most 8 of them are partially sighted 7 of them and 1 of them is totally blind we were dealing with water with different chemicals they had to observe the color all the …in the container but it was difficult for the blind one to really know the what the color is and whatsoever I had to explain to him so that now I have added the coffee into the water the color of water now is brown so it difficult.

Interviewer: But then if you would take your whole year's activities into consideration what would you regard as the ratio between practical work and theoretical work?

Respondent: Practical work is less.

Interviewer: Is less? In terms of ratio would you say or if you would allocate percentages, how much would that be?

Respondent: Ehh, I believe 20% is practical work and 80% is theoretical.

Interviewer: Or you would say 20:80. Okay, the other question is that ehh, it seems as if the blind learners are only engaged in simple a, a, a experiments or exercises, is my observation correct or not?

Respondent: It is correct, because I am a teacher who is responsible for science and maths, and I realized that most of the time they do simple things because if you do not see must experiments are difficult ot perform.

Interviewer: But then do you have the equipment to perform complex experiments?

Respondent: Yes, we do.

Interviewer: You do, okay last year when I spoke to learners they gave an idea that they have limited access to subject related information with a specific reference to computers, encyclopedias and recent publications, have that changed or the situation is still the same?

Respondent: The situation is still the same, even though computers are available, they only attend the computer lessons infrequently. We don't have a library a such where we can say this is a library they can go and some research there are books and encyclopedias some encyclopedias that we have they are the old ones we don't have the new ones and ….not clear. They think of getting us a librarian we don't have librarian at the moment. The recent publications the problem is that are, we are addicted to that Sunday Times bring us a newspaper every week so the they have …not clear from the newspaper.

Interviewer: Okay, other question is that tell and talk strategy seem to be the most effective strategy used by teachers, are there other strategies that you use when you teach science to blind learners in order to accommodate them?

Respondent: Well, I only use tell and listen, I leave the practical but they have to be practical.

Interviewer: Okay, you as an educator do you know of any workshops or have you ever been invited to any workshops where the development of adapted learning facilitation strategies were shared?

Respondent: I was never invited in such the only one I've been invited was for grade 9s adaptation otherwise the rest we are not invited.

Interviewer: But do you think such workshops are important?

Respondent: Yes, they are especially…there are those that we don't have problems because we have the Braille workshop but with that one is a problem because we never had workshops and those educators who do not know…not clear.

Interviewer: But have you ever raised your concern with say the department of education?

Respondent: No I raised it with the representatives of the council of education for the blind learners while I was part of the committee.

Interviewer: Was it taken up to the relevant authority to address it?

Respondent: I don't think it was taken up because the only one I was taking about is that one of maths because last year we had maths and science was not applicable.

Interviewer: So from your previous answer I understand that at your school you combine both blind and partially sighted learners in one class, what are the advantages of doing that combining them in one class?

Respondent: They are advantages because if you take the blind ones with the partially sighted, yes the disadvantages most of the blind ones are disadvantaged because most of the we write it on the board or some diagrams we do them on the chalkboard why…not clear.

Interviewer: So it means that you write on the chalkboard and you never give blind learners Braille notes and that one can be the disadvantage.

Respondent: Yes, the disadvantage unless if we write them in the computer that way they will have their Braille notes.

Interviewer: Ehh, the last question is I also realized that not much is being done to stimulate and develop senses of blind learners during the teaching of science, that is the sense of touch, smell, hear you name them, how would you respond to this observation?

Respondent: Ja, most of the time is not done though it is not….not clear, we let them go out especially when we deal with animals, they have to go and listen to the different sound of animals the birds, especially the birds because they are the one which they can hear anytime. With trees they can also go out and feel the different parts of the plant, and sometimes when you work with chemicals those kinds of chemical we bring them to the class so that they could smell them and it becomes easier for them to identify them.

Interviewer: Okay, those were the questions that I wanted to ask, thanks for your time. Have a good day.

Respondent: All right.

MR MAGUVHE AND MR PRINSLOO

Interviewer: I wonder could I ask you just any question.

Respondent: Hold it a minute because I'm jut getting in here…okay.

Interviewer: Thanks for your time Mr Prinsloo, according to my observation drawing remains a problem to blind learners and in most instances they are given ready-made drawings and not taught how to draw. I want to know whether is sensible for blind learners to draw objects and observations and if not what are the other activities that are there to supplement a loss in this ability?

Respondent: I can tell you that I think that in primary schools in the junior classes they might definitely be able to differentiate between the different forms that is a triangle and shapes and make sure that they are three dimensional orientated in other words they must recognize shapes. And they must also get used to certain structures and they …because they get …not clear. They must get themselves orientated earlier on and in connection of the …that you ask there are certain ways in which we handle that we normally ask …not clear, in order words they must look at a sketch and they must be able to give an answer from the sketch. Sometimes if they are asked to draw a certain sketch they must …I normally teach them to be able to work out all the information that I required and that is what I basically can to answer that question so I don't know if there is something that you want to add to that question.

Interviewer: How often do you use tactile diagrams?

Respondent: Ehh, you see because they are costly I don't use this …not clear, they are very expensive so I only use the …I can only draw the sketch by myself, I also ask some of the parents to help to draw all the sketches required so that way I did draw the sketches that I like for my class so it makes it much easier for me to teach because I don't have to draw for everyone in class so that is how I conduct this matter.

Interviewer: So do your learners have the capacity to interpret drawings?

Respondent: Ja, well they get used to the idea as well initially especially with Geometry they are few, they don't normally want to get involved because its quiet a thing to get in touch to all the things on the sketch all the circles, the …and the blinds but the longer they work with the more they get to know the things that are asked from that.

Interviewer: Does your school have equipment to produce such diagrams?

Respondent: Yes, we've got the machines here and we also have the computers added here but I so prefer to draw them with the hands because I can leave out things that are less important. One can make changes on a paper whereas to do it with a machine it is permanent and that part cannot actual change

Interviewer: My observation is that educators engage their learners very seldom to practical work, fieldtrips or related activities, what is your opinion in this regard?

Respondent: The practical observation?

Interviewer: Yes.

Respondent: Yes, you see it I in fact a bit of a draw back for a blind learner say for instance we do linear programming like that they don't normally get the whole picture because it is very visual and there are certain things that I normally can't even try and I try to teach them the basic principles because is part of the art and the end of the matric exam so they must just be able to concentrate on certain things but it is really impossible for me to say for instance explain to them the different areas that we use to apply to a linear programming and the stuff like that. So I don't but do concentrate on certain basic principles that they gonna need to answer some of those questions but to really ask them to get the whole picture and interpret of a specific problem is very difficult.

Interviewer: Ja, so if you would take your whole year' activities in to consideration what would you regard as the ratio between the theoretical and practical work?

Respondent: The ratio between theoretical and practical, well I will say in the case of mathematics they do have to do all the work you know I can't leave anything out so in the case of mathematics okay, more or less, well it is difficult to say mathematics because you basically you will have to be able to do calculations ja, well in the case of science is another story because obviously they can't do all the chemical experiments we did the portfolio with them last year and they attended all the experiments and we explained to them what really happened during the experiments but very different other stories look at that give a layout of the experiments and what is gonna happen but they can't be involved in the activities the experiments as such. So what I basically do I normally ehh, prepare them and tell that they have to … not clear for a certain practical test depending on what they are going to do that specific day so I'm going to them a tutorial before the practical and test their general knowledge on that specific subject and then I explain to them the experiment and then latter on I just discuss the observations with them and then ask them to jot it down but it is very difficult to get them completely involved in this scientific practical work so I would say if you wanted 10 pictures for the science is about, lets make it 75% theoretical and 25% practical.

Interviewer: The other impression that I got is that blind learners are engaged in simple and elementary exercises and particular in science, do you share the same sentiments?

Respondent: I would agree completely because they must also do all the work I couldn't leave out anything. When we do the paper for the blinds we can't leave out some of the work, say for example try to change the questions that we so deprive knowledge so they must know all the chemical equations they must know how to balance a chemical equations they must know all the different calculations … not clear.

Interviewer: Ok, in terms of access to subject related information with specific reference to computers, encyclopedias and recent publications, what is the position at your school?

Respondent: At present here we are still busy at developing it we are I attended the course at Telkom because they brought us notice to help the school in reference to certain school programmes and stuff like that, we are getting there we are still struggling to, we are getting there and at present those who necessarily used the computers in those learning area I think is of a tremendous help to them if they can get access to the internet and make use of that information from the internet. Ja but at present we rely on the textbooks and the notes that we got that we try to convert anything and to try to make … not clear.

Interviewer: Am I correct to say telling and talking seems to be the most popular method employed by educators at blind schools?

Respondent: Telling and talking, ja well basically that's the … ja it must be the most important … because they can't do the discovery on their own you have to help them to make them, ja I agree with that one.

Interviewer: Do you know of workshops or have you ever been invited to the workshop where the development of adapted learning facilitation strategies were shared with you?

Respondent: Oh, well not a hundred percent you see we attended that one you were there as well last year at the blind conference and Mrs Viljoen went to Holland few years ago and she came back with a book on adaptations that can be made. Well but I think one can concentrate on that a little bit more but in my learning area I had to do everything on my own well you more or less sometimes develop a sense to know how to adapt things for the blind. You think know how they gonna interpret a thing, its easier for me to say for instance to make them know the infor.. in a specific sketch and to make it more accessible to them and not to confuse them you see because sometimes they turn to put too much infor.. in a sketch and is difficult for them to absorb all the information in that sketch so I try to minimize but these ask you that, you can really concentrate, especially for somebody who has never work with blinds and you can really concentrate and try to give basic layout for adaptation by the blinds.

Interviewer: And then at your school do blind and partially sighted learners share the same classrooms?

Respondent: Ehh, well unfortunately they have to because you see we struggle to get enough teachers and the we can't avoid to just have the blind kids in one class so we have them simultaneously and a bit of struggle but we manage to get it done because if you really think of that that the English and Afrikaans speaking kids in one class and they are partially sighted and the others blind and the preparations for those classes are tremendous and I don't really think that the teachers in the normal schools are aware of what the input really is to get those lessons ready for the blinds and partially sighted at one stage same time.

Interviewer: Are there any advantages for combining them?

Respondent: I think so because it really helps them a they get ready for the real world outside because there they are not going to … not clear. They are going to get used to the … not clear of the thing of which we are going on in the class.

Interviewer: But then what would be the disadvantages?

Respondent: Oh, the disadvantages obviously will be that they can be neglected sometimes especially when the partially sighted are demanding and you can't get time to present to them because for instance now say I've got a grade 10 mathematics class here they, I've got only one blind and but the others are not but they are very demanding and it is a problem because I've started to take that kid in the afternoon when I'm here, but ones I got the…they can easily cope and know how to cope with others and you must make sure that you have all the … ready before you meet and so forth with the introductory orientation for them to see how the graph work and stuff like that and I think they will be able to cope well in that class.

Interviewer: In terms of co-operative learning are they helpful to each other, are the partially blind helpful to the totally blind and vice-versa?

Respondent: Well sometimes they struggle when they are asked to do some research and how there in nature and whatever, but because you cannot possible think of …not clear. Then you have to do your preparation very thoroughly and you have to decide before hand how the topic is gonna help the blind kids and leave for the blind to find out on their own part of the job is not that the info… should be available for them they must also try to get all the infor…Ja, but I think they can work as a team they can work well along as a team.

Interviewer: The final question now, I also got the impression that educators are no longer stimulating and developing the senses of blind learners during the teaching of sciences, how would you respond to this observation?

Respondent: Oh, well I think I disagree with you I don't know if you are maybe more aware of eco than I am, but they normally take this kids on an eco tour trips and then they try to make anything possible to the kids. Ok, in science experiments classes as well we do experiments that you have to tell certain things, ja well…not clear. Maybe we can concentrate on that more but it not yet time to do all those thing and it is not really neglecting it, I don't know.

Interviewer: Mr Prinsloo thanks for your time.

Respondent: Sorry for my English, I tried my best

Interviewer: Oh, no, no the information is excellent, all I need is the information, I'm not an English speaking person, thanks again hope to see you in the near future, keep well bye.