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.

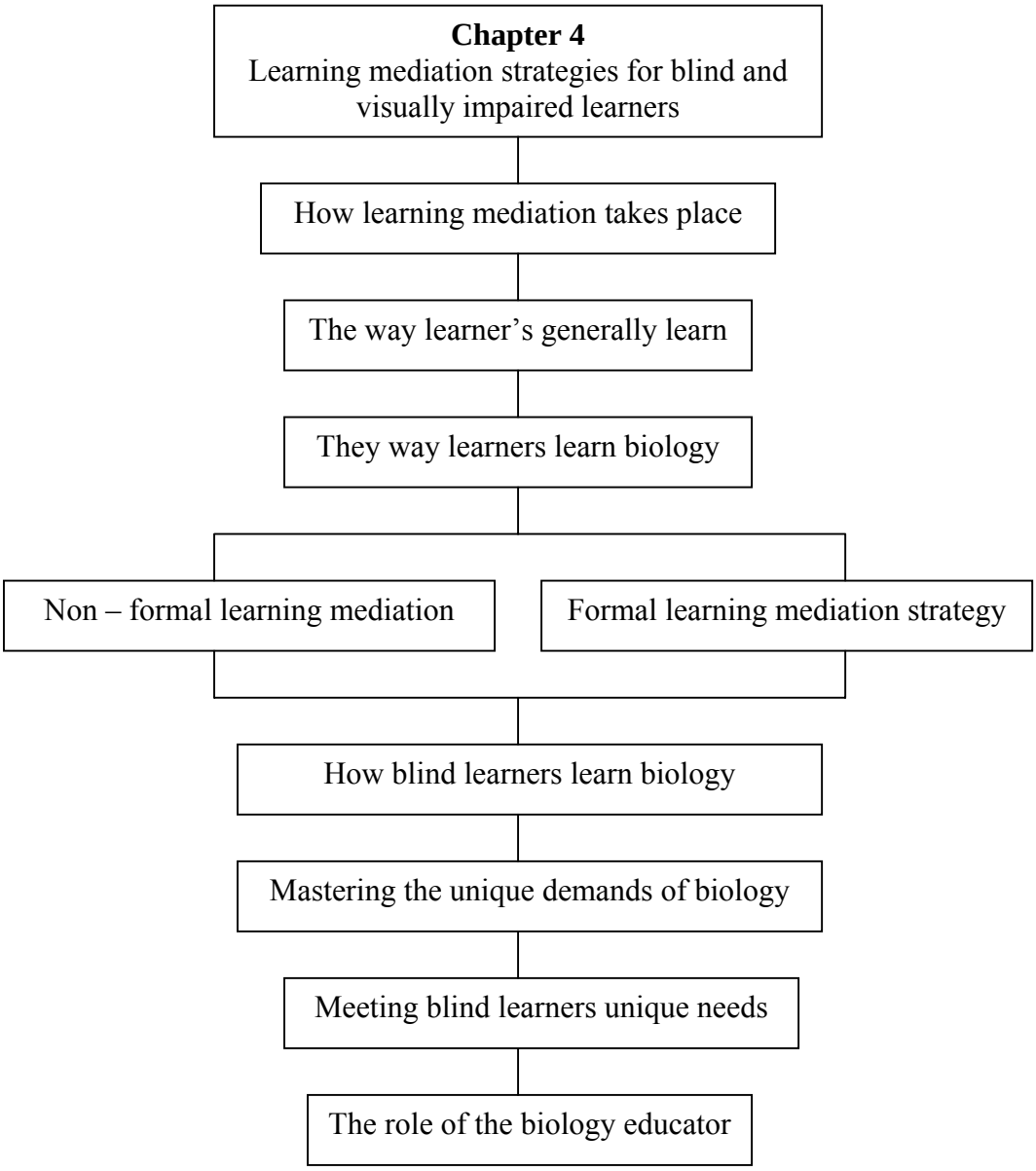
The researcher prefers Reigebuth's (1987:2) definition that strategies "… may be individual strategy components, the elementary building blocks from which methods are created. Or they may be models of instruction: sets of strategy components that have been combined to optimise the quality of instruction."

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.