

**AN EVALUATION OF BRAIN GYM AS A TECHNIQUE TO
PROMOTE WHOLE BRAIN LEARNING: A PERSONAL AND
PROFESSIONAL PERSPECTIVE**

by

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***The purpose of knowledge
is to make one's ignorance more precise***

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SYNOPSIS

Many learners start school at a disadvantage and stay disadvantaged. This results in an increasing number of learners needing extra support in order to benefit from schooling, obtain a qualification and become independent and part of an agile workforce. Failure to learn at school results in dependent adults with low self-esteem and low employability.

Reasons for learning failure can mostly be ascribed to diversity in: socio-economic milieu, levels of sensory stimulation and sensory integration, thinking language and learning styles. Diversity in learner needs, necessitates identifying a common denominator amongst all learners, which when stimulated results in greater learning effectiveness for all learners.

Whole brain learning is a common denominator and can be defined as receiving input equally through sight, hearing and active participation, processing the sensory input simultaneously with the left and right brain while filtering perceptions through emotions for appropriate and accurate verbal or active output. Brain Gym® is claimed to be a simple and cost effective technique that stimulates whole brain learning.

The aim of this research study was to scrutinise Brain Gym as a technique that promotes whole brain learning and contributes to learner success and independence. This scrutiny was approached from a Personal and Professional Leadership perspective, whose domain is (amongst others) the value of self-mastery through mental- and emotional-state management resulting in self-actualisation.

A multi-layered action research strategy was followed incorporating concept analysis, a descriptive and analytical literature study, qualitative and quantitative research methods and programme development.

The literature study indicated that the prevalent learning difficulties could be categorised in the following themes: language and literacy difficulties, math difficulties and difficulties in concentration and motivation. The list of difficulties Brain Gym claimed to address were narrowed down according to the themes and the following criteria: the concepts had to easily and accurately be evaluated in groups pre and post a Brain Gym intervention within a six-week time frame. Only the following concepts were evaluated:

- 1 Logic and gestalt brain integration
- 2 Crossing of the visual midline
- 3 Eye-hand co-ordination
- 4 Self image
- 5 Mathematical computation
- 6 Concentration.

Developing and implementing a Brain Gym programme for a period of six weeks and evaluating the resultant changes examined causality. Quantitative data was collected by means of the Aptitude test for School Beginners and qualitative data through focus group interviews and artefacts.

The qualitative data was analysed by means of descriptive and inferential statistics. The descriptive statistics regarding group distribution and tests indicated that the design was scientifically sound and presented a comparative basis for analysing the test results in terms of inferential statistics. The inferential yielded no significant results, which indicate that the Brain Gym intervention did not have a measurable effect on their ASB test scores.

The quantitative data was analysed by means of a descriptive narrative and presented in terms of the six concepts. Feedback from the principal educators, facilitators and the researcher indicated a noticeable improvement in all six concepts.

The findings indicated that the learners have improved on a physical, emotional

and social level in terms of sensory-integration, confidence, attitude, concentration and motivation. As indicated in the literature study physical, emotional and social development occurs prior to cognitive development. Due to the research period only being six weeks and thus an inadequate for measurable cognitive development, it may account for the lack of improvement on a cognitive level.

It can be concluded that a Brain Gym is a technique that can stimulate the whole brain state and as such address the vast array of learning difficulties effectively in the classroom conditional to regular implementation and for a period longer than 6 weeks. Stimulating the whole brain state is the first step towards learning receptiveness and higher levels of literacy and numeracy resulting in an agile and competent workforce in South Africa.

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CHAPTER 1

ORIENTATION AND RESEARCH DESIGN

1.1 BACKGROUND TO STUDY

Humans are born with the urge to grow, to develop and optimise their potential. This instinctive urge to develop is not only determined by inborn instincts and environmental influences, but also in the way in which people accept, internalise and adapt to influences (Louw, 1987:193). Jensen (1995:i) expresses the same notion in stating that humans are biologically designed to survive and their single competitive advantage is their ability to learn.

Learning, according to Honey and Mumford (1982:1), has occurred when:

- 1 A person knows something that he did not know earlier and demonstrates a change in behaviour.
- 2 A person can do something he was incapable of before.

The question can be raised that if learning is a natural process that all learners are biologically designed to master, why are the academic results indicating that an increasing number of learners do not know or are unable to do more than before? Why does learning not occur for all learners, often resulting in a sense of academic and personal failure? Why do heterogenic classes in the South African context lead to challenges? If learners are designed to learn, why do the grade 12 results, the number of children receiving extra help by therapists and remedial teachers after school, the failing rate in schools as well as the dropout figures at tertiary institutions indicate that many learners are not succeeding?

In contrast to the innate drive of humans to learn, the current reality in schools is that many learners are not able to read or write and are not experiencing academic success. Possible reasons for the current state of affairs thus needs to be investigated prior to attempting this study on evaluating Brain Gym® as a technique to enhance learners' ability to learn.

After studying relevant literature, combined with the knowledge and experience gained through the years as a teacher and therapist, it became obvious that numerous reasons exist for learners failing to achieve success. Some of these are emotional, a number are intellectual; some reasons more social and others are more physiological in nature. The reasons for learning failure selected for discussion in this study were chosen due to its relevance to the rest of this study and can mostly be ascribed to diversity in:

- 1 socio-economic milieu
- 2 levels of sensory stimulation and sensory integration
- 3 thinking language
- 4 learning styles.

The above factors, which contribute to failure in learning will be discussed in depth in chapter 2, but for purposes of sketching the background to this study will briefly be described as follows:

Learners come from diverse social and economic environments where each background creates a frame of reference. According to Coombs (1985:92) a frame of reference acts as a database from which learners draw from what is known to make sense of new information. Due to diversity in the environment in which learners have been raised, they have been exposed to varying levels of sensory stimulation and sensory integration. Sensory stimulation refers to the deliberate act of arousing the senses (Sigelman & Rider, 2003: 260). Sensory integration refers to an attempt to understand the world by putting sensory information together (Sigelman & Rider, 2003:150) to form a complete picture of what is going on (Faure & Richardson, 2002:31). Sensory stimulation and

sensory integration thus impact on learners' learning receptive and perceptual abilities. Perception can be defined as the interpretation of sensory input (Sigelman & Rider, 2003: 139) and enables learners to make sense of what they are learning.

Not only is there a notable diversity in learners' frames of reference, sensory stimulation, sensory integration and perception, but learners are also raised to speak their "mother's tongue" and think in that language. According to Modau (2004:15) "learners come to school with knowledge gained through incidental transmission in their mother tongue that has taken place before the school start". Their mother tongue may often differ from the academic language used in class and hence these learners are called second language learners. Gibbons (2002:13) states that second language learners are not a homogenous group and elaborates by saying they are varied in terms of "their background, experiences, language, expectations, values, culture and social-economic status".

Learners having different learning styles (Shaw & Hawes, 1998:61, Jensen, 1994:88) further compound the complexities resulting from diversity in learner backgrounds.

The interplay between the frame of reference, level of sensory integration, language of thought and learning styles, constitutes the basic building blocks and foundation of the learning process for this study.

Figure 1.1 Some of the relevant factors that influence the learning process.

Due to these four factors influencing the learning process, many learners start school at a disadvantage and stay that way. The reasons for this are that their knowledge base and proficiency as learners are evaluated by the same exams at the end of grade 12 as that of learners from affluent social and economic backgrounds with enriched frames of reference and sensory acuity, and who are writing exams in their mother tongue.

The disparity in the spectrum of learners writing the same exams in South Africa is self-evident and as a result a wide range of learning receptive abilities exist and an equally wide range of teaching strategies are needed to accommodate each learner's needs. Added to the government's policy of equal opportunities and inclusive schooling for all, the current reality is that **teaching** today is presenting as serious a challenge to most educators as **learning** is presenting to many learners.

1.1.1 Need for a common denominator

To address these challenges posed by learning and teaching today, the need to identify something (an element, skill or state) that is common in and available to all learners becomes necessary. A critical criterion for such an element, skill or state would be that it must be a common denominator amongst all learners irrespective of frame of reference, sensory integration, and language of thought or learning style. If such an element can be identified it would follow that stimulating the common denominator would result in enhancing learning and promoting learning effectiveness.

Further if, according to Honey and Mumford (1982:1), learning has occurred when either learners know something that they did not know before and demonstrate a change in behaviour or they can do something they were

incapable of previously, it follows that stimulating the common denominator would result in agile, confident, independent and successful learners.

Failing to identify such a common denominator would perpetuate the current situation in education effecting learners' self-image, sense of purpose and ability to optimise their innate potential, resulting in another generation of dependent and unsuccessful learners.

Identifying a common denominator is no easy task, as research seems to focus more on the **differences** rather than on the **similarities** amongst learners. For example systems have been developed for identifying and generalising the diversity in learning styles such as the Meyers-Briggs Type Indicator (MBTI); Dunn and Dunn's learning styles, Howard Gardner's Multiple Intelligences (Hannaford, 1997); Kolb Experiential Learning Model; Honey and Mumford's Learning Style Questionnaire; Kathleen Butler's Style Differentiated Instruction (Bester, 2001); The Discus Behavioural Profiling System (Bester, 2001: 55); Hermann Brain Dominance Instrument (HBDI) (Hermann, 1988) and The Neethling Brain Instrument (Neethling, 1997). All of these instruments focus predominantly on the processing of information and on how the thinking processes of learners differ.

Continuing the search for a common denominator to enhance the learning process and optimise learning potential, the literature study yielded even more elements to add to the diversity in the learning process through the work of Dennison, an educator, (Dennison, 1985) and Hannaford, a neurophysiologist and educator, (Hannaford, 1995). Where the above-mentioned instruments focused predominantly on the processing of information, Dennison and Hannaford recognised two more stages in the learning process adding sensory receptiveness (INPUT) and application of knowledge (OUTPUT). Hannaford (1995:12-13) described these three distinct but interconnected stages by referring to them as:

- 1 **INPUT:** Sensations received through eyes, ears, nose, tongue, skin and proprioception
- 2 **PROCESSING:** The reasoning process as the result of an interplay between thoughts (left and right brain), emotions and the body
- 3 **OUTPUT:** Application and expression of knowledge through muscular use (speaking, writing, moving).

Hannaford and Dennison (Hannaford, Dennison & Dennison, Metcalf, McGee, Miekka, 2000:1) subsequently developed a comprehensive learning style instrument that accommodates and describes the diversity within the three stages of the learning process called The Dominance Profile.

This instrument represents a complex system of interconnectedness between the dominant parts of the brain, the senses and the limbs, which forms the neurological basis of learning styles and the learning process (Hannaford *et al.*, 2000:1). Dominance Profiles clarify the differences in learners' receptive abilities, learning styles and learner needs, as "a hypothetical explanation of noticed strategies that can assist any learner – and especially the challenged learner – to reach a fuller potential" (Hannaford *et al.*, 2000:1).

Dennison describes these profiles as an invitation to understand the uniqueness of learners and to assist them to develop their "weaker areas as they benefit from their own resources" (Hannaford *et al.*, 2000:1). Dennison's term "benefit from own resources" (Hannaford *et al.*, 2000:1) implies that learners have more resources available than is indicated by the Dominance Profiles. These resources can become available when learners move and integrate, changing their profiles into whole-brain learning patterns (Hannaford *et al.*, 2000:1).

1.1.2 Whole brain state

Hannaford (1997:34) expanded on the potential of learners being able to move

beyond their profiles (or any other learning style or learning style instrument) by describing the optimal learning state as a stress-free whole brain state. In this whole brain state both the left and the right hemispheres are equally active (PROCESSING) all the time, thus accessing all sensory information available (INPUT) and effectively communicating, moving and acting on this information (OUTPUT).

“**The whole-brain state**” is not available to some learners, but is potentially inherent in and available to all learners (Hannaford *et al.*, 2000:1; Kruger, 1999:20; Jensen, 1994:17). Furthermore the whole-brain a state can be stimulated (Hannaford *et al.*, 2000:1; Shaw & Hawes, 1998; Dryden & Vos, 1994:97) and thus can potentially turn limited frames of reference, sensory integration and learning failure, into learning effectiveness and learner independence.

The whole-brain state meets both criteria when considering it as the common denominator that was searched for amongst all learners – it is available to all and it can be stimulated. The opposite of whole brain functioning is unilateral functioning (as illustrated by the Dominance Profiles). Learners often function in a unilateral state due to a lack of stimulation and integration as well as stress. Negative stress or distress (Musikanth, 1996: 13) **decreases** whole-brain functioning and **increases** unilateral functioning (Hannaford, 1997:34) by closing down higher order functioning and activating the reptilian brain (Shaw & Hawes, 1998: 11). When learners are stressed, adrenalin and cortisol are secreted which negatively impacts on learning (Hannaford, 1995:169), further leading to learning blockages and resulting in learners being limited by accessing only their Dominance Profiles (Kruger, 1999:3) and not their whole brain state.

1.1.3 Dominance Profiles vs. whole brain state

As these Dominance Profiles refer to the dominant functions of the brain, senses and limbs that normally take the lead and determine personality (Kruger, 1999:3),

they can also be used to explain why many learners are not experiencing learning effectiveness. Understanding the diversity of learning styles as the result of differences in learners' Dominance Profiles are not sufficient to address the crisis in learner success and independence. Learners' innate learning potential needs to be stimulated and optimised to enable all learners to benefit from formal learning, achieve learning effectiveness and become independent and self-supportive adults.

The question arises how to optimise learner potential in the classroom to address learning style differences while enabling learners to simultaneously learn successfully. Hannaford (1997:34) suggests that there is a greater chance of matching all learner's learning profiles and thus creating a common denominator when learners are offered a broad spectrum of multi-sensory opportunities like when they can see visual representations, hear auditory explanations and touch and take part.

Paul E. Dennison, an educator and director of the Valley Remedial Group Learning Centres, addressed this need through his research in effective ways of promoting learning ease through stimulating whole brain learning, while looking critically at the relevance of Dominance Profiles to learning style preferences. Dennison's research led to **Learning Through Movement**, which was formalised in a programme called **Brain Gym**. Brain Gym is a learning style enhancement technique consisting of 26 simple physical movements (De Jager, 2001:9) to promote whole brain learning (Dennison *et al.*, 1989). These movements are similar to the movements children naturally do during the first three years of life as they complete important developmental steps to promote the integration of eyes, ears, hands and the body in whole-brain performance.

1.1.4 Brain Gym – claimed to be a tool to stimulate whole brain state

Brain Gym is the registered trademark of a learning-readiness programme for learners of all ages, focusing on the movement and mechanics of the human body as it relates to learning and life skills (Edu-K Foundation, 2000:1). Brain

Gym is part of Educational Kinesiology (Edu-K). The word education stems from the Latin word **educare** that means “to draw out” and kinesiology is derived from the Greek root **kinesis**, meaning motion. Brain Gym is thus a process of empowering learners of all ages to access their latent whole-brain potential, by “drawing it out through movement” (Dennison & Dennison, 1994:i).

According to Dennison, Hannaford and Brain Gym consultants worldwide, Brain Gym is holistic and improves the quality of the learning process by addressing learning difficulties irrespective of culture, age and background. The 26 Brain Gym physical movements are founded on Hannaford and Dennison’s Dominance Profiles, which forms the neurological basis of learning styles and the learning process.

Brain Gym is claimed to neurologically stimulate and integrate all learning styles to promote whole brain learning (Dennison *et al.*, 1989; Edwards, 2000: 6; Hannaford: 1995:11; Hannaford 1997: 34; Promislow, 1998). Brain Gym movements can thus be defined as whole-brain learning activities (Kruger, 1999:6) and termed a technique that stimulates the common denominator (whole brain learning).

Many claims have been made about the effectiveness of these whole brain learning activities. Claims such as :

- 1 When learners regularly do Brain Gym, they tend to be more relaxed and positively involved with the learning process (Dennison and Hargrove, 1991:24).
- 2 The implementation of these whole-brain learning activities improves the integration of all the parts of the brain and body through accelerated impulse conduction resulting in optimal learning.
- 3 Some of the skills claimed to be improved and enhanced by Brain Gym are related to learning effectiveness i.e. crossing the visual, auditory and kinesthetic midlines for increased left and right brain integration, eye-muscle coordination and reading comprehension,

skills involving hand-eye coordination and penmanship, spelling and maths abilities, focus and concentration as well as social behaviour and self concept (Dennison *et al.*, 1989:1-33; De Jager, 2001:9; Edwards, 2000: 6; Hannaford: 1995; Hannaford 1997; Promislow, 1998).

- 4 If Brain Gym is done regularly learners develop skills to master learning content more rapidly, apply it to their living and working environments, experience learning effectiveness and acquire life skills such as stress management and self motivation (Kruger, 1999: 8).

In the current South African educational context, the potential value of Brain Gym is inestimable as a technique to stimulate whole-brain learning - irrespective of learners learning styles, age, language, level of development and background. Whole brain learning through Brain Gym movements could thus enable learners to benefit from formal learning, achieve academic and personal success and become independent and self-supportive adults.

The problem is that even though Brain Gym poses as a potential solution to promote whole brain learning and alleviate learning difficulties for learners in South Africa, it is not a well-known concept and due to the simplicity of Brain Gym and the range of claims made about Brain Gym successes, Brain Gym is often perceived to be unscientific.

1.2 FOCUS OF STUDY

In the light of the current situation in education the focus of this study is to scrutinise Brain Gym as a technique that promotes whole brain learning and contributes to learner success and independence. Brain Gym has two supporting facets: Dominance Profiles (DP) and Brain Gym movements.

Dominance Profiles (DP): An understanding of diverse learning styles as described through DP is helpful in gaining insight into individual learner behaviour as well as in designing effective and inclusive educational and training programmes to optimise learning effectiveness. Understanding diverse DP may also result in a change in the attitude of learners and educators to foster inter and intrapersonal relationships.

As **Brain Gym movements** are claimed to be effective in addressing learning blockages and promote whole brain learning, it- could impact positively on both learners and educators. Brain Gym could enable learners to manage their own learning styles and in so doing promote independence and success on inter and intra personal levels. Brain Gym could also enable teachers to create a common denominator in classrooms, ensuring that all learners can learn and benefit simultaneously from the same learning experience by the same teacher.

Both facets of Brain Gym will thus be scrutinised to determine if gaining insight into the profiles and doing Brain Gym movements will enhance whole brain learning and improve academic performance.

1.3 DELIMITATIONS OF RESEARCH

As the learning process is a complex phenomenon and the scope of a study is focussed, the researcher recognises the influence of many other factors on learner success, but will not include discussion thereof in this study. To name but a few factors influencing the learning process but not included within this study are parental stability, school readiness, diet, illness, medication, conditioning and music.

1.4 MOTIVATION OF STUDY

The motivation for attempting this study on Brain Gym is born from the researchers' experience as a Brain Gym consultant and workshop facilitator where learning difficulties were addressed in one-on-one therapeutic sessions and in workshops for educators. Through 10 years of experience in Brain Gym and 20 years as an educator/facilitator, she is convinced of the potential value of Dominance Profiles and Brain Gym movements as practical, affordable and effective ways of optimising learner potential and stimulating whole-brain learning.

Notwithstanding the potential value of Brain Gym, it is generally unknown and where it is known, viewed by some as unscientific. It is *unknown* due to the fact that the researcher and other qualified Brain Gym consultants have only done Brain Gym on a small scale in South Africa and little was published on the topic. Brain Gym is perceived to be *unscientific* due to the simplicity of Brain Gym, the range of claims made about Brain Gym successes and the lack of accessible scientific research done on Brain Gym. As a result of Brain Gym generally being an unknown concept and perceived as unscientific, it has hampered its availability to educators and learners.

The researcher is therefore motivated to subject Brain Gym to scientific scrutiny and should Brain Gym stand up to scientific scrutiny, to develop a programme for educators to effectively implement Brain Gym in the classroom. Such a programme will have as its main objective to provide learners with Brain Gym tools to stimulate equality in learning receptive abilities and in so doing, growth towards independence and self-mastery, irrespective of learning style, frame of reference or knowledge base.

The programme will also equip educators with the knowledge and practical application potential of Brain Gym to guide learners to manage their own levels of sensory acuity, whole brain integration and motor control, resulting in self-management and independence. Once a state of self-management is achieved, learners and educators will be empowered to move away from external locus of

control and the victim mode to internal locus of control - taking charge of and mastering their lives (Covey, 1992:31, 42, 54; Robbins, 1992: 237-414) and their own learning.

1.5 RESEARCH QUESTIONS

In the light of the potential value of Brain Gym, the question arises if Brain Gym can promote whole brain learning and in so doing contribute to learning effectiveness and independence in South African schools? Due to the scope and practical implications of such a study, the research study needs to be narrowed down to focus on one school that would be representative of the spectrum of grade one learners attending a large percentage of South African schools.

The primary research question thus is: Can Brain Gym can promote whole brain learning and in so doing contribute to learning effectiveness and independence in a South African school?

The sub-questions supporting the primary research problem is:

- 1 What is the current situation in South African schools in terms of academic achievement?
- 2 What are the most prevalent learning difficulties and factors contributing to these learning difficulties?
- 3 What is learning?
- 4 What is Brain Gym?
- 5 What is a Dominance Profile?
- 6 Can Dominance Profiles and Brain Gym potentially be mental and emotional self-management tools for educators and learners to overcome barriers to learning?

1.6 RESEARCH OBJECTIVES

The primary objective of this study is to ascertain and evaluate the potential value of Brain Gym to promote whole-brain learning in a South African school.

The following secondary objectives will be pursued:

- 1 To investigate the current situation in education in South African schools as pertaining to learning effectiveness
- 2 To identify learning difficulties and describe factors contributing to learning difficulties
- 3 To define learning and describe the learning process
- 4 To undertake a disciplined, precise and systematic description of Brain Gym
- 5 To undertake a disciplined, precise and systematic description of the Dominance Profiles
- 6 To determine if Dominance Profiles and Brain Gym can potentially be mental and emotional self-management tools for educators and learners to overcome barriers to learning.

1.7 RESEARCH STRATEGY AND RESEARCH METHODOLOGY

Research involves the application of a variety of standardised strategies, methods and techniques in the pursuit of valid knowledge. A research strategy is that which directs the study and determines the methods to be used (Smith, 1993:19). For the purposes of directing this study, an empirical research strategy will be followed to explore the unity between educational research and the value such research can add to enhance educational practices in a practical and empowering manner.

The purpose of this research study is to address the research question through a multi-layered approach incorporating both an empirical and a non-empirical research strategy.

1.7.1 Non-empirical strategy

The non-empirical strategy incorporates a descriptive and analytical literature study and concept analysis utilising the phenomenological method.

This descriptive and analytical literature study will follow the criteria for a logical, systematic and accurate account of the current situation in education in South Africa, as well as the scientific scrutiny of concepts such as: learning, barriers to learning; the learning process, whole brain learning, Brain Profiles; Brain Gym and the claims made about its effectiveness in promoting whole brain learning.

The researcher's unique contribution to the body of knowledge through a description of the flow of information through the three dimensional profiles called: Mind Dynamix Profiles will also be indicated. The literature study will further serve to scrutinise the objections (scientific as well as religious) as to the reliability and validity of these claims, to deepen the theoretical framework of the study.

Relevant publications, dissertations, books and articles will be sourced nationally and internationally and used as resources to the study, which will assist the researcher in gaining the necessary background information as to meet the study's objectives.

Concepts will be analysed utilising the phenomenological method, which is a pattern of thought followed to discover and express the core characteristics of a phenomenon by means of certain steps (Smith, 1990:6-7). Since the phenomenon cannot express itself, the researcher acts as an intermediary to interpret and express the phenomenon as objectively as possible (Marshall and Rossman, 1995 in Kruger, 1999:56; Smith, 1990:6). Smith (1990:7) further states that one of the aims of the phenomenological method is to distinguish between that what is essential and that what is coincidental to a matter. Determining what

is essential and what is coincidental to the selected concepts would provide a scientific framework for evaluating Brain Gym and the claims that it is a technique that address learning difficulties by promoting whole brain learning.

Once the theoretical framework has been completed, the next phase in the research strategy will be **programme development**. A training programme for educators will be developed on *How to implement Brain Gym in the classroom*. The purpose of the programme will be to equip educators with the necessary background information and knowledge on how to use Brain Gym in the classroom. The programme will be informative, motivational, practical and simple in nature, with the aim to ensure minimal impact on a normal school day in terms of the time spent on Brain Gym while effectively optimising whole brain learning.

1.7.2 Empirical research strategy

An empirical research strategy will also be undertaken combining qualitative and quantitative methods in an attempt to address the research question. The ability to solve problems and address questions is enhanced by the fact that research is a systematic and logical enterprise. Empirical research is chosen because it is a disciplined process of implementing a programme to evaluate (validate or falsify) the hypothesis. The empirical research process includes the design, implementation, data collection, processing of data, analytical investigation and the disclosure of the findings.

In this study the claims regarding the scientific validity and effectiveness of Brain Gym in stimulating whole brain learning (as represented by a selected number of academic skills) are to be validated or falsified. The claims to be empirically investigated will be selected according to the following criteria: the academic skills must easily and accurately be evaluated pre and post the intervention within a group context in a six-week time frame.

The results and implications of the qualitative and quantitative research will be compiled, documented and recommendations given.

1.8 PERSPECTIVE OF STUDY

This study will be conducted from the broad paradigmatic perspective of Personal and Professional Leadership (PPL). PPL is the collected work of Professor D.P.J. Smith of RAU and focuses on a scientific study of the concept leadership in a personal, interpersonal and professional context. According to Cashman (1998:18) "leadership is an expression of who we are. It is our being in action. We lead by virtue of who we are. To invest in leadership development is to invest in personal and interpersonal growth".

Cashman (1998:19) also stated that leadership is authentic self-expression that creates value. This implies that leadership is that what comes from within to lead and influence what is without. In accordance with Cashman, Covey (1995: 59-60) states: "If you do not know yourself, if you do not learn to control yourself, if you do not have mastery over yourself, you are not a leader. If your motives, words and actions do not come from your inner core, you simply will not be able to create and sustain effective relationships". PPL is thus not just about personal leadership but also about interpersonal relationships, because to become more effective with others, you need to become more effective within yourself.

This inside-out approach to leadership "is about our ongoing journey to unfold and to express our purposeful inner life to make a more positive impact on the world around us" (Smith, 2003:2). The phrase 'world around us' does not only relate to interpersonal relationships, but also to professions. From a PPL perspective *professions* do not refer to jobs, but to behaviour and caring attitudes in the place of work anchored in the natural laws that govern human growth and progress focusing on the continuous process of renewal and growth coined as CANI (Constant And Never-ending Improvement) by Robbins (1992:97).

PPL can thus be defined as the scientific study of the ongoing commitment and guidance of the human being towards "knowing who you are", "finding your purpose" and "realising your potential" through designing and developing personal, interpersonal and professional growth strategies, that will lead to progressively higher forms of responsible independence and effective interdependence.

A PPL perspective is relevant for this study as all concepts scrutinised in this study are aligned with the PPL domain of amongst others, the values of interdependence, self-mastery and in so doing purposefully empowering learners and educators to become masters of their own destiny resulting in self actualisation. Promislow (1998:11) enhances the relevance of a PPL approach

when she refers to Brain Gym as “a user-friendly model for effective personal change and state management”.

Add Dennison and practitioners' claims that Brain Gym is a mental and emotional state management tool and the researcher's experience of Brain Gym enhancing not only the cognitive, but also the emotional (intra-personal) and social (interpersonal) facets of the learner, it follows that the PPL perspective is appropriate for this study.

If the claims are validated in this study that Brain Gym empowers learners in self-mastery, which leads to learning effectiveness and independent and self-supportive adults, Brain Gym can potentially become a valuable PPL tool. Such a tool would enable learners and educators to overcome their challenges, develop the skills and abilities to take personal responsibility for the management and outcomes of their own lives in realising their full potential, living a meaningful life while contributing to the lives of others.

1.9 OUTLINE OF STUDY

This study will be conducted in three phases. The three phases are 1) a literature study, 2) research design and implementation and 3) compiling the findings and making recommendations.

PHASE 1

The literature study will be documented in chapters 2, 3 and 4. In **chapter 2** the first phase of the study will be commenced with a description of the current situation in South African schools in terms of academic achievement. An evaluation of the effectiveness of the academic achievement in South Africa will be conducted as indicated by the grade 12 results, perceptions of educators and

media reports. Following on the results of academic achievement, the most prevalent learning difficulties experienced by learners will be indicated and some of the reasons for these difficulties will be discussed.

In **chapter 3** the first phase of the study will continue and serve to describe the scientific framework for this study by defining learning and the learning process. This chapter will be concluded with a description of whole brain learning.

Chapter 4 serves as the last of the three chapters representing the literature study and will conclude the first phase of this study. In this chapter the scientific basis of Brain Gym will be investigated by defining Brain Gym and describing the theories and disciplines Brain Gym was gleaned from. The concept Brain Gym will be analysed and described with reference to Dominance Profiles, Brain Gym movements and whole brain learning. The concept Mind Dynamix Profiles will also be introduced to contribute to the body of knowledge. Describing Dennison's claims about Brain Gym's effectiveness as a technique to enhance whole-brain learning and mentioning the scientific studies that were conducted internationally on Brain Gym will conclude chapter 4.

PHASE 2

The second phase of this study will focus on the research design and implementation. The empirical research design will be presented in **chapter 5**, which would include a description of the programme design for *How to implement Brain Gym in the classroom*; the target population and the selected qualitative and quantitative measuring instruments. The focus of this chapter is to develop a research design to evaluate the claims regarding the causality of Brain Gym on learning effectiveness and learner independence by stimulating whole brain functioning.

Chapter 6 concludes the second phase of this study and has as its focus 1) the

implementation of the Brain Gym intervention and 2) a description of monitoring the programme implementation and the data collection, as well as a description of the results and methods utilised to obtain these results.

This chapter thus serves to examine causality by systematically altering a set of variables and examining the resultant changes in or consequences for another set of variables.

PHASE 3

In **chapter 7** the findings will be interpreted and conclusions drawn to ascertain whether the research question has been addressed. In an attempt to meet this objective, the essence of the research will be summarised as well as the subsequent findings and conclusions thereof. This process will thus evaluate claims that Brain Gym is a technique that promotes whole brain learning.

This chapter will also include a brief discussion of the limitations and shortfalls of the study, prior to making recommendations for future research possibilities, which would conclude the third phase of this study.

CHAPTER 2

THE CURRENT SITUATION IN SCHOOLS

2.1 BACKGROUND

In chapter one it was stated that humans are born with the urge to grow, to develop and optimise their potential (Louw, 1987:193). It was also stated that humans are biologically designed to survive and their single competitive advantage is their ability to learn (Jensen, 1994:i). Contrary to the above, indications are that many learners are not succeeding academically resulting in a greater demand for remedial teaching, therapy and strategies to accommodate special needs.

The discrepancy between humans' natural ability to learn or *learning potential* (Engelbrecht, Kriegler & Booyesen, 1996:x) and their current academic performance or *actual achievement* (Engelbrecht, *et al.*, 1996:x) poses a problem. In chapter 2 this problem will be addressed by determining the current reality in schools regarding learners' ability to learn naturally and effectively.

The aim of chapter 2 is to describe the grade 12 results, media report and feedback by educators as indicators of the current success rate of learners' ability to benefit from non-private schooling in South Africa. A brief summary of the relevant points from the joint report of The Commission on Special Needs in Education and Training and the Committee for Education Support Services in South Africa will indicate further barriers to learning (NCSNET & NCESS 1997) and will conclude the section on the currently reality.

Chapter 2 will also serve to describe the most prevalent learning difficulties currently experienced relevant to this study and identify possible reasons for

these difficulties.

The term *learning difficulties* form part of the broader field of specialised education, and according to Engelbrecht *et al.*, (1996:5) “refers to all forms of assistance rendered to learners who require additional educational assistance. This includes the education of learners with disabilities (traditionally offered in special schools), remedial teaching for children with learning difficulties, compensatory or additional programmes for children who are at risk of becoming underachievers and even the enrichment programmes for gifted and talented learners”. For the purposes of this study, learners who are experiencing learning difficulties would refer to and include mainstream learners in government schools and exclude learners with impairment such as blindness, deafness, cerebral palsy, apraxia or who are gifted.

The descriptive analysis of the current reality in education will provide the context to address the research question: Can Brain Gym promote whole-brain learning and in so doing contribute to learners success and independence.

2.2 A DESCRIPTION OF THE CURRENT REALITY IN EDUCATION

The current reality in schools regarding the effectiveness of learning will be illustrated through the grade 12 exam results; the opinions of the general public as expressed by the press; feedback from educators and the joint report from the NSCNET & NCESS (1997).

2.2.1 The grade 12 exam results

Learners’ ability to learn and schools’ ability to provide learning are nationally measured by the grade 12 exam results and thus serves as a standardised criterion for determining the quality and effectiveness of learning. Even though the grade 12 results are claimed to be standardised, the credibility and standards of the grade 12 exams are often a point of contention and hence the drive of Mr.

Kader Asmal, Former Minister of Education, to implement a system of continuous assessment and to measure key subjects against the Scottish Qualifications Authority (Die Burger, 1 January 2000). His drive followed in the wake of the national grade 12 results in 1999 where 48,9% of grade 12 learners experienced academic success. In the same article it was indicated that of the 67,6% of learners who had aspired to matric exemption, only 18,4% were successful. These results indicate that during 1999 less than 50% of all learners were successful at learning effectively.

In an effort to address the poor grade 12 results, the MEC (Member of the Executive Committee) for education in the Eastern, Cape, Mr. Stone Sizanne issued a strongly worded statement. He said principals who fail to improve their performance, will be fired (Die Burger, 15 January 2000). This comment was made after it was announced that 351 of the schools in the province had a pass rate of below 30%. Sizanne indicated that poor attendance and performance would no longer be tolerated in an effort to curb academic failure.

The poor pass rate was not restricted to the eastern Cape. According to a document circulated by the Free State Department of Education “it was encouraging that the overall percentage for the province has improved from 52,7% in 2000 to 59% in 2001” albeit a pass rate ranging between 100% and 13.51% (Department of Education Free State Province, 2001: 1).

Due to focussed initiatives and the extensive training of educators, the pass rate has improved substantially since 1999 resulting in a 68% pass rate in 2003. Not with standing this improvement when considering the number of learners entering grade one and comparing it with the number of learners completing grade 12, it is self-evident that a substantial percentage of learners are dropping out of school and not learning naturally and effectively.

Not only the grade 12 results, but also the opinion of the public as reflected by

the press is a measure to evaluate the level of success and excellence in academic learning in non-private schools in South Africa.

2.2.2 The opinion of the public as reflected in the press

Articles and letters in the press reflect the opinion of the public on the situation in schools in terms of the grade 12 results and the situation in general. Articles reflect that the results of the grade 12 exams are a constant point of contention and viewed with scepticism and disbelief. An article published in Die Burger (10 May 1999) stated that true marks achieved by learners are often adjusted up to 20%. These marks can be adjusted upwards or downwards which is viewed as discrimination.

According to an article in Die Burger (18 October 2000), 25% of the learners' final promotional marks are compiled through continuous evaluation. Adding test scores and marks from projects and group assignments calculate this percentage, which is then statistically moderated. The problem with these marks is that it is the direct result of learners' own work drawn from available resources. The article was concluded stating that resources available to many learners in South Africa are far removed from computers, libraries and the Internet and as such these learners are currently being discriminated against.

The lack of a fair evaluation system and comparative resources and are not the only challenges facing learners. They also face the threat of striking educators and thus the inability to complete the syllabus and have educators' support and guidance (Burger, 5 October 2001).

Not only are educators threatening to strike or often away on courses to be up skilled and empowered, educators are also expected to teach in a language that is often their third language, which exacerbate the existing problems in the classroom. "We all know that learning can only happen when children and educators are communicating with one another. It is very difficult for educators who do not know English well, to be adequate English language role models so that other language-speaking children learn effectively. Often both the learning of English and the learning content is compromised" (Lund, 2002:29).

The current situation is not only complicated by a discriminatory system (as claimed above) and language challenges, school rage is also at the order of the day. Mr. Don Pasqualie, provincial secretary of the SA Democratic Educators Union, is quoted in the Burger (29 October 2001) saying that they have pleaded with educational authorities to take action due to the increase of incidences of violence in the classrooms.

The implementation of Curriculum 2005 is said to have complicated the situation in South African schools even more. This radically new approach to education was implemented impulsively without having the resources or training the educators sufficiently (Rapport, 28 October 2001).

As the grade 12 results and the opinions of the public have indicated, the majority of learners do not currently experience learning effectiveness due to numerous challenges.

“In a democracy, the function of the leadership is to alert the public to the existence of any serious threat, define it, develop a strategy for dealing with it and seek to mobilise and focus energies of the people to meet it” (Basson & De Jager, 1994:1). Hence with the insight and vision of The Northern Freestate Department of Education, a project was launched in the dysfunctional schools to up-skill, empower and motivate the educators to broaden their understanding of the learning process and produce better results.

The project was named “Optimising Learning Effectiveness Workshops” and presented during 2001 and 2002. Feedback from educators attending these workshops further serves to clarify the current situation in non-private schools in the Northern Freestate. These educators also indicated that their perceptions and feedback is not only relevant for their province, but also representative of the situation in South Africa as discussed with colleagues from other provinces.

2.2.3 Feedback from educators

Educators attending these workshops were facilitating learning in schools that were termed dysfunctional based on their grade 12 exam results being less than 40%. Their results for the year 2001 ranged between 13,51% and 31,03% (Department of Education Free State Province, 2001: 10).

The educators' feelings and views of the current situation in schools were elicited focusing on the classroom situation and their duties as educators. The overall views of the educators are described in their own words in terms of their view of OBE, learners, parental involvement, language of instruction and management.

First factor contributing to current situation in schools: OBE (Outcome Based Education)

The radically new approach to learning called OBE is described as frustrating and confusing due to the fact that "a lot of administrative work has to be done, which gives more pressure and this affects my teaching and will also lead to poor results". Another teacher with 21 years teaching experience views OBE and the changes it brings as frustrating saying: "We are prepared to learn the latest methods utilized and undergo informative changes, but the facilitators delivering these changes do not have a thorough knowledge about their stories. This really frustrates me and makes me vehemently abhor teaching. "

"The new approach of OBE is a very good approach. The problem with the system is the paperwork. I have to focus more on recording than making proper planning for the class".

"I am fully enjoying my career. The only problem is the introduction of OBE. Really, with only 40 hours of training I find it difficult to cope with the demands of

the new system”.

Second factor contributing to current situation in schools: the learners

The way in which educators view the learners are expressed in their own words in the following statements:

“Learners are reluctant to play a part in their own education. They are dependant on us for most of the learning”. Another educator states that: “Learners are no longer prepared to work hard as nothing is done to them. We are denied the power for example corporal punishment, now a days educators don’t have a criteria for discipline of pig-headed learners” and “Learners are over-aged, stubborn and without aim or purpose on why they are at school”. Another educator stated that: “Learners have poor attitude to learning and their participation is minimal. They are unwilling to commit themselves by doing their school work, being punctual and behaving.”

The educators also indicated that social-economical factors impacts on learning: “Some learners are not doing their work properly because of their background” and “Learners are not motivated to study due to social-economical factors. Factors like poverty, lack of food and clothes and absent parents, are evident where most learners drop out of school”.

To expand on the comment of Mr. Don Pasqualie, provincial secretary of the SA Democratic Educators Union on school rage (Burger, 29 October 2001), educators also expressed concern for their safety and the safety of learners. According to the educators stabbing often takes place in overcrowded and dilapidated classrooms.

The views of educators on the attitude and abilities of learners are summarised by the final comment: learners are viewed as lazy, unmotivated and grossly undisciplined.

The above comments as well as the views of the educators indicate clearly that many learners attending school have a limiting attitude towards learning, which impacts on their ability to experience learning effectiveness.

Third factor contributing to current situation in schools: parental involvement

The educators expressed concern not only for the OBE system and the attitude of learners, but also for the lack of parental involvement in the academic performance of their children, by stating that: “Parents only become interested when a learner fails a grade.” “Parents have not yet accepted responsibility to education” and Parents are not committed “and give us problems”.

The comment made most often is that: “Parents are often completely absent and young learners are left in charge of the siblings with little food, no electricity, water and little blankets. These learners need to look after the little ones, go to school, complete portfolios without libraries or computers and cook for the family after they have fetched water and wood”.

Fourth factor contributing to current situation in schools: language of instruction

The fourth factor commented on by the educators of dysfunctional schools refer to language of instruction, stating that: “Instruction in English is problematic. Many educators are required to teach in a language that they are not fluent in”. They also state that: “Language of instruction is English and I must say it is very difficult. They (the learners) don’t understand a thing and they will keep on staring at you”.

General comments on the current reality in schools regarding academic learning

In concluding the description of the current reality regarding the effectiveness of learning, general comments were made that present an indication of the moral and motivation of these educators. The level of frustration, de-motivation and even depression is clear from the following comments: “We are pressurised but without support. The department are looking at pass rates but not availing resources to schools”.

“Management does not recognise effort. We are heavily burdened without enough support”. “The learning facilitators confuse us because they don’t teach the same thing to the educators. Every time everything is new”. “Today there is not enough teaching that takes place in some schools particularly those which are platooning”. “The learning content is often not relevant for learners who come from disadvantaged communities” and “The problem is that many of our learners can not read. They can not progress and then take their refuse in alcohol and drugs”.

The grade 12 results, media reports and feedback from educators drew a rather negative picture of the current reality. A substantial part of this feedback was based on opinions and perceptions. For purposes of scientific validation of the current situation a brief description of the report (NCSNET & NCESS 1997) from the National Commission on Special Needs in Education and Training (NCSNET) and the National Committee for Education Support Services in South Africa (NCESS) will follow.

2.2.4 Feedback from The National Commission on Special Needs in Education and Training and National Committee for Education Support Services in South Africa

The National Commission on Special Needs in Education and Training (NCSNET) and the National Committee for Education Support Services in South Africa (NCESS) were appointed by the Minister and Department of Education to investigate and report on *special needs* and *support services* in education and training in South Africa (NCSNET & NCESS 1997:2). This investigation covered all levels of education: early childhood education, general education and training, further education and training, higher education and adult education, and as such adds credibility and validity to the current reality in education in South Africa as described in this study.

In their joint report the NCSNET and NCESS identified and listed “some of the

barriers to learning and development that commonly occur in our society” (Donald, Lazarus & Lolwana, 2002:30). These barriers to learning can be located within the learner, within the centre of learning, within the education system and within the socio-economical and political context. These barriers contribute to learners experiencing learning difficulties and become obvious when a breakdown in learning occurs, when learners drop out of school or “when the excluded become visible” (NCSNET & NCESS 1997:11). These barriers were identified as: socio-economical factors such as poverty; violence; discriminating against people who are perceived to be different; inflexibility in the curriculum not making provision for diverse learning needs; inadequacy of educator training; unsafe schooling environments; lack of parental involvement; inadequate support services to schools; language and communication challenges; disabilities or impairments that require specific support and drop-out rate and the role of drugs.

Each of these barriers will briefly be discussed to clarify the current reality in education in South Africa.

1 Socio-economical factors such as poverty

The effect of sustained poverty caused by unemployment and other economic inequalities causes an inability for families to meet their basic needs such as nutrition and shelter. Learners who are raised under such circumstances are subject to increased emotional stress, which affects learning and development. “Poverty-stricken communities are also poorly resourced communities which are often characterised by limited educational facilities, large classes with high pupil/teacher ratios, inadequately trained staff and inadequate teaching and learning material (NCSNET & NCESS 1997:12)_

2 Violence

Effective learning is directly related to the social and emotional well-being of the learners (NCSNET & NCESS 1997:12). Learning is

undermined when the environment is unsafe due to high levels of violence and crime. Abuse is one of the results of a violent environment. Abused learners may miss school and drop out of school or become involved in substance abuse increasing a break down in learning and stress.

3 Discriminating against people who are perceived to be different

Negative and harmful attitudes towards differences remain a critical barrier to learning as noticed in discriminatory attitudes and labelling resulting from prejudice against race, class, gender, culture, disability, religion, ability, sexual preference and other traits (NCSNET & NCESS 1997:13).

- **Inflexibility in the curriculum not making provision for diverse learning needs**

This is viewed as one of the more serious barriers to learning due to the inflexible nature of the curriculum which prevents diverse learning needs for example learning styles and learning pace to be met (NCSNET & NCESS 1997:14).

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4 Inadequacy of educator training

Inadequate educator training often results in educators using teaching styles, which may not meet the needs of some learners (NCSNET & NCESS 1997:14).

5 Lack of parental involvement

Uninvolved parents are found not to take ownership of the fact that they are the primary care givers of their children and as such a critical component for effective governance of centres of learning (NCSNET & NCESS 1997:16). Active parental and community involvement is central to effective learning and without involvement leads to a barrier to learning.

6 Inadequate support services to schools

Support mechanisms through training educators to deal with diverse learner need and professional services are needed to address diversity especially in poor rural areas (NCSNET & NCESS 1997:15). A further reason for barriers to learning is often fragmented and unsustainable (NCSNET & NCESS 1997:16).

7 Language and communication challenges

For many learners teaching and learning takes place through a language that is not their first language or mother tongue. “Second language learners are often subjected to low expectations, discrimination and a lack of cultural peers” causing barriers to learning (NCSNET & NCESS 1997:14).

8 Disabilities or impairments that require specific support

For most learners with disabilities, learning breakdown occurs when their particular learning needs are not met for example severe autism and multi-disabilities due to an inability to engage continuously in structured learning (NCSNET & NCESS 1997:16).

“It is universally recognised that the main objective of any education system in a democratic society is to provide quality education for all learners so that they will be able to reach their full potential and will be able to meaningfully contribute to and participate in that society throughout their lives” (NCSNET & NCESS 1997:10). The report identified four key areas of concern preventing the education system from achieving its main objective (NCSNET & NCESS 1997:35):

- 1 Access for all learners, adults and children to a lifelong learning process
- 2 Massive historical inequalities in the provision of education
- 3 Equity in the provision of state resources
- 4 The provision of quality education.

2.2.5 Summary of the current reality

The diversity in the grade 12 results; media reports; feedback from educators and the joint report have separately identified barriers to learning resulting in learning difficulties. A strong correlation has been found between these identified barriers to learning, which have been obtained from different sources. Despite these barriers some learners are learning effectively and becoming successful life long learners and as a result of these barriers the majority of learners in South Africa are not learning effectively.

This study will not focus on those learners who have developed the skills to master the learning content; apply it to their living and working environment; who are experiencing academic and personal success and are becoming life long learners. The focus of this study is only on those learners who are experiencing difficulty in learning and are not experiencing learning effectiveness due to the discrepancy between their learning potential and their actual achievement. Those are the very learners that Brain Gym practitioners are claiming to support by doing Brain Gym to improve their ability to learn.

To provide a thorough framework against which to address the research problem of this study, the most prevalent learning difficulties need to be described.

2.3 BARRIERS TO LEARNING

The complexity of the current reality is clear given the rate of academic performance, the diversity of challenges facing education authorities and the need for learners to be able to learn and experience learning effectiveness. As this study is undertaken from a PPL perspective, the focus of this study will only be on those aspects that learners have control over. Learners have no control over the choice of educational system like OBE, they have no choice regarding

the language of instruction or their parents' involvement and therefore these aspects will be excluded from further discussion in this study.

The learners do have control over their attitude and their ability to learn. The ability to learn promotes self-mastery, self-empowerment and personal leadership, while the inability to learn result in failure, dependence and a lack of personal leadership. As discussed in 2.2 the grade 12 results indicated that many learners are not learning effectively or experiencing learning effectiveness and spend hours after school at remedial teaching and extra lessons in an attempt to master learning and the learning content. As the majority of learners who do not learn effectively have little learning support or cannot afford extra lessons, they simply fail or drop out of school.

This reality necessitates a deeper understanding of the most prevalent learning difficulties to evaluate whether Brain Gym can alleviate learning difficulties by promoting whole brain learning. The list of prevalent learning difficulties is extensive, but compiled from 2.2 includes: poor reading and writing skills, incomplete sentences, poor spelling, misreading questions, cryptic answers, a lack of comprehension and depth of insight, illegible handwriting, poor attitude, inability to complete tasks within a given time frame, a lack of number concept and abstract reasoning abilities.

On closer inspection, many of those learning difficulties are the result of a few basic but essential challenges. It logically follows that should the essential challenges to learner success be identified and addressed, many of the sub challenges will automatically be addressed. For example challenges like misinterpreting exam questions and answering questions in a cryptic manner can indicate an essential learning challenge like the lack of vocabulary and linguistic agility. It would follow that expanding learners' vocabulary (essential challenge) would then improve learner's ability to read questions accurately and answer questions in more detail (sub challenges).

The most essential learning challenges selected for this study are: language of instruction, literacy, maths, concentration and motivation. These challenges will be mentioned briefly in 2.3, but the reasons for these challenges as well as the relevance of these challenges to this study will be described in more depth in 2.4.

2.3.1 Barriers to learning as a result of the language of instruction

Many learners do not comprehend the language of instruction and do not benefit from teaching as a result thereof (NCSNET & NCESS 1997:14). Research conducted by the University of Cape Town (PRAESA - Project for the Research of Alternative Education in South Africa) supports this notion stating that “South African matric examination based on an average of 50 percent matric failure rate in schools since 1992 concludes that some R3 billion in educators salaries is being wasted annually, because children are not being taught and assessed in their mother tongue” (Lund, 2002:29).

Mother tongue refers to a language other than a learner’s first language, which is the language of their homes, social interaction and culture and in which learners feel confident and competent (Donald, *et al.*, 2002:219).

Engelbrecht, *et al.* (1996:334) reason that learners who grow up speaking their mother tongue and whose home background, neighbourhood and wider community do not provide opportunities to hear or practice English, may learn English, but it may not be standard English; they may not be sensitive to the nuances of the different vowel system in English and mistake “ship” for “sheep”; mother tongue speaking parents may be unable to assist with homework and read important communications from school.

In addition to speaking their mother tongue and challenges in acquiring English, many African learners have “a kind of multilingualism, often accompanied by semilingualism in these additional languages, which further complicates the effective teaching and learning of English” (Engelbrecht, *et al.*, 1996:334-335).

As a result many learners may reveal language disorders due to the interference of other languages and may thus experience difficulties in learning in English.

2.3.2 Barriers to learning as the result of a lack of literacy

Literacy refers to the ability to read and write (Hawker & Hawkins, 1998: 184). From 2.2 it is clear that many learners are not able to read or write. Freire (1989) in Engelbrecht, *et al.* (1996:390) poignantly describes the dilemma of a lack of literacy when quoting a man saying: "I am not angry at being poor, but at not knowing how to read". Failure to read and write effectively results in failure to learn academically, because "reading is an act of communication. The reader's goal is to achieve an active reconstruction of the author's message" (Dennison, *et al.*, 1990:7) If the learners do not comprehend the language of instruction no meaning can be given to the symbols on paper and thus reading difficulties abound.

"Writing skills must keep pace with reading skills" (Dennison, *et al.*, 1990:11), because children must understand that writing is meant to be read (Engelbrecht, *et al.*, 1996:417).

If learners do not comprehend English and cannot read, it logically follows that they cannot write.

The act of writing not only requires appropriate vocabulary but co-ordination between eye and hand as well. Poor co-ordination results in difficulties with letter formation, pressure on pens, letter size, spacing, keeping letters regular, stay on the line and speed (Donald, *et al.*, 2002: 345), which may culminate in difficulty to learn and study.

Learners' inability to read and write thus results in the high levels of illiteracy in South Africa.

2.3.3 Barriers to learning as indicated by maths marks

Problems with math abound, as among things mathematics requires a basic vocabulary on which to build abstract thoughts (Engelbrecht, *et al.*, 1996: 426). This specialised vocabulary has a characteristic system of symbols and “certainly forms no part of the ordinary person’s everyday vocabulary” (Engelbrecht, *et al.*, 1996: 438). As the result of not forming part of everyday vocabulary, mathematical vocabulary must be taught and includes concepts like number, colour and shape; first; last; the same; greater or less than and “element; set; function” (Donald, *et al.*, 2002:344).

Not only vocabulary, but also concrete experiences are necessary to build a firm basis for understanding mathematics. Dennison, *et al.*, (1990:16) indicate the need for concrete experiences in everyday life to form the foundation of vocabulary and concepts necessary for mathematical computation, by stating: “learners must have a solid understanding that numbers are names of real things. With it learners carry the language of arithmetic into their daily lives, communicating about money, time and space, economics, ecology, music, computers and even language skills like spelling”. Mathematical gaps and inadequate insight can develop when teaching is too abstract and does not link up with the learners’ relatively concrete formal mathematical experiences (Engelbrecht, *et al.*, 1996: 440).

As indicated in 2.3.1 language of instruction poses a problem, in 2.3.2 literacy is posing a problem and in 2.3.3 that the lack of specialised mathematical vocabulary and concrete experiences poses a problem, it is therefore clear that the very skills required for mathematical computation are lacking, which contributes to learning difficulties.

2.3.4 Barriers to learning as the result of a lack of attention, concentration and motivation

As indicated by the educators in 2.2 many learners have short attention spans and lack concentration and motivation. According to Engelbrecht, *et al.* (1996:336) motivation is an emotional state that causes an individual to learn and make the effort to achieve. The word *emotion* has as its root the Latin word *movere*, which means to mobilise or move. Emotion can thus be described as the driving force that energises and motivates learners to learn. Learners who feel emotionally insecure and lacks a positive attitude may fail to learn despite valuable input (Engelbrecht, *et al.*, 1996:336-337), because they may lack the driving force to do so.

Emotional factors such as attitude, self-image and self-concept play a major role in the ability to pay attention and concentrate on the acquisition of any learning content. According to Engelbrecht, *et al.* (1996:336), many learners suffer from severe emotional trauma as a result of violence; frustration from not having adequate vocabulary and “the bewilderment from being thrust into an alien environment”. These learners normally react to learning either by trying to escape from their unfavourable, negative circumstances by working hard and doing well at school, or sadly more common, tend to lower the level of aspiration and self-realisation that they are capable of (Engelbrecht, *et al.*, 1996:440).

The lack of attention, concentration and motivation can also be the result of a lack of relevance of the learning content. Geoffrey Caine (Weiss, 2000:6) states that when learners can connect new learning with ordinary experience, they understand and make sense of things and remember it more easily. If the learning content is not relevant or understood, learners will find it difficult to concentrate and be motivated to learn (Donald, *et al.*, 2002:219).

Low attention, concentration and motivation as a result of emotional factors and a lack of content relevance thus present as barriers to learning.

The essential challenges that have been identified are difficulties with: language

of instruction, literacy, mathematic or numeracy and concentration and motivation. The statement has been made that should reasons for the essential challenges be identified, it would follow that addressing these challenges would remove barriers to learning and promote learning. The possibility of 'removing the barriers to learning' necessitates an investigation of the reasons for these essential challenges.

2.4 REASONS FOR THE ESSENTIAL CHALLENGES THAT LEAD TO BARRIERS TO LEARNING

As the learning process is a complex phenomenon and the scope of a study is focused, the researcher recognises the influence of many other factors on learner success, but will not include discussion thereof in this study. To name but a few factors influencing learning success but not included in this study is parental stability, school readiness, diet, illness, medication, conditioning, the learning environment and music.

The factors that influence the essential challenges and lead to barriers to learning as described in this study are:

- 1 Diverse socio-economical backgrounds / frames of reference
- 2 Varying levels of sensory stimulation and sensory integration
- 3 Language of instruction differs from thinking language
- 4 Diverse learning styles.

Engelbrecht, *et al.* (1996:427) recognise that the interplay between the diverse frames of reference, levels of sensory integration, thinking language and diverse learning styles are some of the factors that constitutes the basic building blocks and foundation of the learning process. To enable the researcher to evaluate Brain Gym as a technique to promote whole brain learning and enhance learning effectiveness and learner independence the identified crucial factors need to be explored further.

2.4.1 Learning difficulties and diverse frames of reference

The challenge with learning, like in life, is not how to stamp in more information, but to access and make use of what is already known. “What is already known” is also known as a person’s frame of reference. Garbers (1972:20) states that early life experiences form the basic frames of reference against which all-later experiences are evaluated and which is cumulatively enhanced. Bernard Schlink (1999:215) describes the relevance of life experience, saying that “the geological layers of our lives rest so tightly one on top of the other that we always come up against earlier events in later ones, not as matter that has been fully formed and pushed aside, but as absolutely present and alive”.

The development of a frame of reference is a life-long process “ by which every person acquires and accumulates knowledge, skills, attitudes and insights from daily experiences and exposure to the environment – at home, at work, at play; from the examples and attitudes of family and friends; from travel, reading newspapers and books; or by listening to the radio or viewing films and television. It is in the informal and unstructured learning that goes on daily that a learner’s frame of reference is constituted. What a learner can learn from the environment is confined to what the environment has to offer” (Coombs, 1985:92).

In terms of this study, the statement from Coombs (1985:92) can be interpreted that learning difficulties abound due to the diversity in learners’ frame of reference as can be observed from comparing the lives if a protected, stimulated and advantaged learner learning in his mother tongue with the life of a learner living in a squatter camp, fending for himself and learning in a second language. In the event that these two learners attend the same class, the educator would assume that all learners share a similar frame of reference, resulting in the disadvantaged learner not being able to access the necessary knowledge, which could lead to difficulty learning.

Engelbrecht, *et al.* (1996:440) elaborate on this by stating that poverty, parents with marital problems and the absence of the parents are among the conditions that constitute undesirable socio-economical backgrounds. The NCSNET and NCESS (1997: 12) also support this notion by reporting that effective learning is directly related to and dependent on the social and emotional well-being of learners and learners may experience problems with their subjects at school due to undesirable socio-economical conditions.

2.4.1.1 Learning difficulties – frame of reference and early childhood stimulation

There is a growing recognition that the kind of experiences the brain is exposed to in the first few years dramatically influence how it operates for the rest of its life. According to Engelbrecht, *et al.* (1996:175), educators have come to realise that the preschool years are most important for the learners' intellectual development.

Historical educators like Grove (1979:18), Rossouw (1988: 2) and Bloom (1964:204) are in agreement, stating that the first years of life are critical developmentally and hence the most formative years of a child's life. The role of the care giver is important during these formative years because “ the person who cares for the young child has a vital task in moulding the child's thinking, intelligence and even the quality of his or her mental functioning” (Engelbrecht, *et al.*, 1996:176).

The work of Feuerstein (1980) further supports the importance of early childhood stimulation and the role of caregivers as he has found that a major inhibiting factor in respect of learners with barriers to learning is poor pedagogical input and stimulation during the learners' first years of life. These learners appeared unintelligent and dull because they lacked high quality 'early mediated learning experiences'. Mediated learning takes place when a caregiver places him/herself between the child and the world and systematically but playfully explains the

young learner's experiential world to him. The caregiver "teaches the child to observe and interpret and elicits language usage and concentration from the child at a very early age" (Engelbrecht, *et al.*, 1996: 177-178).

Piaget's well-respected theory on cognitive development is also based on the importance of early childhood stimulation and development. Piaget was interested in the universal features of development – the milestones that characterize every child and build the foundation of all learning (Gardner, 1997:18). This foundation forms the data bank that learners draw from to build their abstract thoughts and concepts on.

From the above research it is clear that early childhood stimulation is critical in building a frame of reference and develop vocabulary to draw from when constructing concepts and abstract thought. Unfortunately educators often take life experiences for granted in their discussions, which some learners from disadvantaged communities may be lacking. If the learners lack the experience they invariably also lack the vocabulary to describe the experience. Therefore they are at a loss of words and concepts to relate to the learning content resulting in an inability to learn effectively.

In contrast to supportive parents, early childhood stimulation and extended frames of reference many South African learners raise siblings in rural areas without any adult supervision. A comment by an educator describes this situation clearly when stating that "parents are often completely absent and young learners are left in charge of the siblings with little food, no electricity, water and little blankets. These learners need to look after the little ones, go to school, complete portfolios without libraries or computers and cook for the family after they have fetched water and wood".

A frame of reference characterised by the lack of sufficient clothing, food, protection, stimulation and emotional nurturance in such households' impact on a learner's ability to learn as is illustrated by research by Saul Schanberg, Duke &

Tiffany Field of the University of Miami. Schanberg and Fields' research on the effect of touch on brain development is relevant to indicate the effect of these learners' frame of reference on their learning ability. They found that newborn mice separated from their mothers stop growing. The researchers found that the mother's licking was the cue that they were safe and could continue their development. Without licking the brains of the pups went into survival mode and the feeding response shut down to conserve energy. The feeding response could be restored when licked – the stress hormones declined and the pups doubled their growth rate (Lucia & Candler, 2002:7). This research clearly indicates the effect of scarcity or poverty consciousness on learners' frame of reference, brain growth and subsequently the ability to learn.

2.4.1.2 Learning difficulties – frame of reference and inappropriate learning

Not only is there concern that the lack of appropriate stimulation may be limiting brain growth, the same may be true of too much exposure to the wrong kind of stimulation, such as violence. A recent report by the influential Carnegie Corporation of New York indicated that exposure to violence during the first three years is highly inappropriate learning and “that society needs to invest adequate resources in helping these children at this critical period in their lives if we are to stem the growing epidemic of violence (Anon, 2000:1). The brains of young learners exposed to violence adapt to the environment to protect themselves by preparing to fight or to run away and thus “cells rewire trillions of connections that create the chemical pathways of aggression (Anon, 2000:5).

Millions of South African learners are raised in menacing and hostile environments and the result can be noticed as there has been a doubling of the rate of crimes of violence, depression, suicide and drug and alcohol abuse” (Anon, 2000:1).

Thus not only can a lack of stimulation result in learning difficulties, but too much inappropriate stimulation can also result in learning difficulties.

2.4.1.3 Learning difficulties - frame of reference determines memory bank

The effect of learning difficulties as a result of limited frames of reference and high stress levels are compounded because these learners also need to work harder to be successful. This can be seen from research by Jensen in (Weiss, 2000:4) where PET scans indicated that novice chess players burn more glucose (has to work harder) compared to master chess players that uses less glucose and engages larger patterns from the brain drawing from memory (Weiss, 2000:4). The master chess players had extended frames of reference to draw from and as such learners with extended frames of reference learn with greater ease drawing from an extensive memory bank.

A stimulating and experience rich environment benefits learners' memory capacity and therefore their capacity to learn in two fundamental ways: biologically and behaviourally. Biological stimulation develops more connections between brain cells building a greater frame of reference, which is recorded in an expanding memory. Stimulating and experience rich environments contribute to behaviour by promoting positive values, higher self-esteem, effective coping skills, which improves inter and intra-personal relationships (Engelbrecht, *et al.*, 2002:176; Anon, 2000:9).

2.4.1.4 Learning difficulties - frame of reference determines language acquisition

“Words are just man-made symbols for things in our sensory three dimensional reality. In fact, all symbols must be matched to what they represent in order to be useful, and we do this through a process of defining and labelling” (Sunbeck, 1991: 11). Words replace direct experience and sensory intuition in stimulating the brain to develop habitual beliefs and behaviours.

These symbolically derived beliefs and behaviours are needed for survival and acceptance (Sunbeck, 1991: 12), but experience / frame of reference determines vocabulary. Without the experience, there is no need for a vocabulary to describe the experience and thus no comprehension of the concept.

A prime example of the lack of vocabulary was described by educators in rural areas where a question in a grade 12-exam paper required learners to write an essay on the life of a traffic officer. Due to limited traffic in rural areas, there are few road signs, stop streets and often no traffic lights. There are no pavements, no parking meters and thus no traffic officers. They did not know the word “traffic officer” and therefore they could not answer the question. Their frame of reference thus directly impacted on their ability to develop appropriate vocabulary and thus impacted on their ability to achieve learning effectiveness.

2.4.1.5 Learning difficulties - summary of frame of reference

A learner’s frame of reference can be summarised as that what they know. What they know is the direct result of what they have experienced in their living environment and have labelled (in words). These experiences are recorded in memory for future reference and enable them to communicate with others and experience acceptance and a sense of belonging.

As diverse life experiences result in diverse frames of reference and language proficiency, learners from disadvantaged backgrounds are at a loss in class. To learn effectively the learners have to expand their frames of reference while learning in class to accommodate the concepts being taught. The inability to expand their frame of reference due to a lack of experiential knowledge, vocabulary and a nurturing environment thus lead to many learners experiencing learning difficulties in schools.

2.4.2 Learning difficulties - varying levels of sensory stimulation and sensory integration

“Everything we know is a function of experience, either through sense perception or reflection upon that experience. What we know is not the world, but our sensory processing of its waves and junctions. It is our culturally derived representations of what we have experienced. When an infant is born and commences interacting with all about, its nerves are sparked into commencement of maturation” (Anon, 2000:1). The outside world thus shapes the brain’s architecture by coming in through the senses teaching the brain what to become. Therefore the interaction between a learner and their environment stimulates their senses and in so doing develops the brain and sensory-motor system. A lack of sensory-motor stimulation and integration results in learning difficulties (Donald, *et al.*, 2002:205) and therefore a brief discussion on the development of physiology through sensory-motor stimulation is necessitated.

2.4.2.1 Development of physiology through sensory stimulation

Torsten Wiesel & David Hubel sewed shut one eye of a few newborn kittens to illustrate the effect of stimulation on the development of the brain (Anon, 2000:4). Two weeks after birth the kittens’ eyes were opened. Though anatomically perfect, the eyes that had been closed could not see. This experiment provides evidence that there are critical stages of development in which the brain needs appropriate stimulation to arouse the brain cells to function optimally. Engelbrecht, *et al.* (2002:176), supports the importance of critical stages of development by stating: “it is extremely necessary for those who look after young children to realise how important their task is”. The critical stages for development will be discussed in more depth in chapter 3.

Learners' interaction with the environment does not only determine their frames of reference as discussed in 2.4.1, but according to Hannaford (1995:12) also determines the development of their physiology, as sensations received through the senses are the foundation of knowledge. It is the body's senses that feed the brain environmental information with which to form an understanding of the world (frame of reference) and from which to draw when creating new possibilities (Hannaford, 1995:12).

Learners are not born with fully developed senses - there is a specific hierarchical process in the development of the senses, which is referred to as reaching milestones. Learning depends on the adequate development of this hierarchical process of sensory integrative functioning. Gagne (1968: 181) states that, "learning is a cumulative process where a learner progresses from one stage to the next as a result of acquiring an organised set of skills and competencies. These skills and competencies develop cumulatively through the sensory and mental processes of differentiation, recall and transference, of which sensory stimulation is the first step (Gagne, 1968: 181). Cumulative development refers to what has happened in previous stages for example Piagetian theory (Donald, *et al.*, 2002:84).

Sensory stimulation begins in utero and is normally well developed at age six when it culminates in school readiness or learning readiness (Grove, 1979; Grove & Haupfleisch 1992; De Jager, 1993: 5). According to Edwards (2000: 9) the primary senses are fully functional by the age of two months; perceptual motor foundations are laid down when child is one year old; perceptual motor skills are developing by the age of three and academic readiness at the age of six.

Hannaford (1995: 129) refers to the importance of cumulative development and use crawling as an example saying: " infant crawling has long been known to be crucial for activating full sensory functioning and learning. Crawling involves cross-lateral movements that cross the body's midline and use both sides of the

brain. Our cross-lateral movements help us to build the capacities that allow full sensory access (visual, auditory and proprioceptive) from both sides of the body”.

The sensory systems are the building blocks for all other development and if any of the sensory systems are hampered in their development, further learning takes place in a vacuum and results in learning difficulties.

2.4.2.2 The function of sensory integration

According to de Jean (<http://sensoryintegration.org>, 2001:2) the function of sensory integration is to:

- 1 Create a sense of alertness to attend to new and/or important stimuli
- 2 Protect and defend from over stimulation if the stimuli are overwhelming.
- 3 Select what is appropriate and filter out non-essential input.
- 4 Organise the stimuli into meaningful perception.

With too much unmodulated (unintegrated) information a learner may feel overwhelmed and become over stimulated (hyper active) or so over stimulated that they shut down (hypo-active) (Dejean, 2000:1; Anon, 2002:1). Thus without proper sensory stimulation and sensory integration learners do not perceive and interpret the world correctly, while when incoming sensory information is efficiently integrated, modulated and regulated, efficient learning takes place. Therefore it can be concluded that sensory stimulation and integration are two of the primary building blocks required to acquire academic skills.

2.4.2.3 Sensory integration presenting as learning difficulties

Disorders in the integration of the senses, brain and limbs can greatly influence a learner’s ability to function, but can be so subtle that it can be undetected.

According to Matties & Quirk (2002:1) typical behaviours exhibited by learners who have sensory integrative dysfunctions is:

- 1 Clumsiness in falling off a chair or knocking objects off the desk or table.
- 2 General disorganisation.
- 3 Clumsy, awkward and uncoordinated movements.
- 4 Distractibility and short attention span.
- 5 Daydreaming or inattentiveness.
- 6 Irritability.
- 7 Frequent mood changes.
- 8 Aggressive behaviour – pushes or bumps others.
- 9 Aversion to touch.
- 10 Avoidance of messy activities.
- 11 Hyperactivity – in constant motion without purpose.
- 12 Hypo activity – slow moving.
- 13 Speech and language problems.
- 14 Poor fine motor coordination.
- 15 Normal intelligence but trouble reading and doing maths.

Many of the learners who experience learning difficulties as described in 2.2.3 are said to exhibit some of the above-mentioned behaviours. It can thus be concluded that many learners are experiencing learning difficulties as the result of inadequate sensory stimulation and integration.

2.4.2.4 Summary of sensory integration and learning difficulties

According to Matties & Quirk (2002:2) academic skills are the result of the process of sensory stimulation and integration, which forms the neurological foundation of learning. Under-developed neurological networks through inadequate stimulation and integration indicate that learners are capable of far more, but the “underlying connections and wiring is missing” (De Jager 2001: 15). Insufficient development of the sensory system is a key concept in this study and will be discussed in more detail in chapter 3, but it can be concluded here that learners’ abilities to achieve learning effectiveness and independence is

limited by insufficient sensory development.

The most prevalent learning difficulties are not only the result of diverse frames of reference and different levels of sensory integration, but also the result of learning in a language other than learners' first language.

2.4.3 Learning in a second language

Most educators agree that a major challenge facing South African schools in the new millennium is the education of a culturally and linguistically diverse population of learners. The importance of language development "lies in the fact that there is a high correlation between verbal ability and measured intelligence" (Engelbrecht, *et al.*, 2002:177).

Despite a considerable body of research on first and second language acquisition, and the role of language in the academic performance of the learner, many misconceptions still prevail (Rossouw, 2001:1). Before a look at the influence of language on academic achievement can be undertaken, language needs to be defined.

According to Rossouw (2001:1) language is a means of communication, of socialisation, of exploration, of learning, of thinking, of expression, of actualising intelligence and is culturally bound. According to Vygotsky in Cooke (1998:7) "the child's intellectual growth is contingent on his mastering the social means of thought, that is language."

According to Rossouw (2001:1) adequate development of language in the early years is imperative for the development of cognitive skills that are necessary for learning effectiveness. The small child first learns that words are names for concrete objects, later on words represent meaningful experiences and concept formation is starting to commence, e.g. supertime (has a particular meaning/concept for the individual). The cognitive skills such as defining, analysis, comparison, classification, categorisation, organisation, memorisation,

inferring, evaluating, problem solving etc. are dependent on the development of concepts. Adequate language development is the cornerstone of concept formation.

For the purposes of understanding how inadequate language ability can create learning difficulties, a brief overview on the development of language is necessary. Language development can be divided into 5 steps: receptive language development, (understanding the spoken word), expressive language development (using language verbally), symbolic receptive language development (reading and understanding symbols), symbolic expressive language (writing) and finally creating in language (writing /poetry/ public speaking) (Rossouw, 2001:1).

According to Jim Cummings in Cooke (1998:6) language development culminates in language competence when both Basic Interpersonal Communication Skills (BICS) and Cognitive Academic Linguistic Processing (CALP) are mastered. BICS refers to the everyday social communication language of the playground and dinner table. CALP refers to the language of the classroom or academic learning. English second language learners (ESL) will acquire fluency in BICS in a relatively short time (one to two years), while the acquisition of proficiency in CALP may take between seven and nine years (Cooke, 1998:12).

Language proficiency depends on regular exposure to the second language through an appropriate role model in relating everyday experiences (frame of reference) in that language. As in 2.2.3.4, one educator expressed the concern that they are required to teach in a language that they are not fluent in. “Educators are expected to teach in a language that is often their third language which exacerbate the problems. It is very difficult for educators who do not know English well to be adequate English language role models so that African language speaking children learn effectively” (Lund, 2002:29).

2.4.3.1 Difficulties experienced by the second language learner (ESL)

According to Rossouw (2001:2) ESL often reveal fluency in BICS and educators and parents judge that the learners are fluent in English. The lack of learning effectiveness is then often ascribed to a lack of “intellectual brightness” rather than a lack of experience in dealing with CALP, which IQ scores reinforce (Cooke, 1998:14).

“The ESL is daily forced to learn through a language in which he feels inadequate and begins to doubt his own competence” (Rossouw, 2001:2). This has far reaching psychological effects on the child’s self concept and sense of self worth. Liddacoat in Rossouw (2001:2) states that it can have a detrimental influence on the psychological process of identity formation, which is crucial between the ages of nine and 15 years.

When addressing the audience at a conference on: Needs of English–Language Learners in Science and Math Classrooms, C. Mc Cargo stated that international research in more than 40 countries (about Mathematics and Science performance in schools) revealed that South African learners were listed near the bottom. Dr. Rudolf Stumpf of the H.S.R.C. also reported in parliament that the reason for this poor performance of South African learners could be directly linked to language deficiencies (Rossouw, 2001:3). He reported that Afrikaans and English first language learners revealed no difficulties. But where English was the learner’s second language, difficulties with the academic concepts and comprehending the context of the questions were clearly noticeable.

The Department of Education recently held a colloquium to present research findings about “Language in the classroom” (Rossouw, 2001:3). This feedback correlated with the remarks discussed in 2.2.3.4 on feedback from educators. According to Rossouw (2001:3) it was indicated that difficulties were experienced by educators in teaching in the language that they are not familiar with; difficulties

were experienced by learners learning in a language foreign to them; the inability of educators to support learners whose home language is not the Language of Learning and Teaching (LOLT) and the difficulties brought about by the mismatch between the educators' and the learners' languages, result in a serious barrier to learning.

2.4.3.2 Summarising language difficulties

From the above it is clear that language difficulties contribute to learning difficulties, because insufficient development of BICS (Basic Interpersonal Communication Skills) and CALP (Cognitive Academic Linguistic Processing) result in an inability to think, read, write and communicate in the second language. If the second language is the medium of evaluation and assessment, it is clear that it would impact on academic success and learners' ability to learn independently.

Three challenges contributing to learning difficulties have been discussed in this chapter, namely diversity in learners' frames of reference, diverse levels of sensory integration and learning in a second language. The fourth aspect contributing to learning difficulties in the classroom is the uniqueness of each learner's learning style.

2.4.4 Learning styles

Prior to describing how learning style diversity impacts on learning and leading to learning difficulties, the term **learning style** needs to be defined.

According to Ellison (1993:38) learning style is the interplay between the brain (the hardware) and the frame of reference (the soft ware). He defines learning style as "that consistent pattern of behaviour and performance by which an individual approaches educational experiences.

It is the composite of characteristic cognitive, affective and physiological behaviours that serve as relatively stable indicators of how a learner perceives, interacts with and responds to the learning environment. It is formed in the deep structure of neural organization and personality which moulds and is moulded by human development and the cultural experiences of home, school and society”

MacLean (1990:575) commented on the uniqueness of how humans learn and how their learning manifest in their learning style by saying: "because of the infinite variations in the way individuals are assembled, it must be assumed that the sentient properties of any one person, like his or her fingerprints, could never be identical with those of another. It is probable, therefore, that there does not exist or ever will exist one person exactly like another”.

In research by Edelman (Jensen, 1994:8), the uniqueness of individuals as pointed out by MacLean was elaborated on, by stating that as with fingerprints, no two brains are alike. “The huge variability of retinotectal maps is emphasized. These maps are not fixed and moreover - each individual map is unique. The variability of maps depends on signal input”.

From the above it is clear that each learner has a unique way of learning, which is called a learning style. For the purposes of this study, learning style can be defined as the way in which a learner prefers to approach new information and influences the way learners learn and communicate.

A deeper look at the components of a learning style is necessitated to enable the researcher to evaluate the effectiveness of Brain Gym to promote whole brain learning and therefore to enhance all learning styles.

Educators and psychologists have recognized differences in the way in which learners assimilate and process learning content and have developed systems for identifying and generalizing the diversity in learning styles.

Contemporary systems such as the Meyers-Briggs Type Indicator (MBTI), The Kolb Experiential Learning Model, Honey & Mumford's Learning Style Questionnaire, Dunn & Dunn's Learning Style Model, Howard Gardner's Multiple Intelligences and Kobus Neethling's Neethling Brain Instrument are examples of useful instruments to generally type human nature and intelligence.

Each of these well known learning style systems approach learning from a different perspective and therefore describes different aspects affecting learning style preferences. These systems will be discussed briefly to illustrate learning style diversity and indicate why learning style diversity can lead to learning difficulties.

2.4.4.1 Learning styles - The Meyers-Briggs Type Indicator (MBTI)

The purpose of the Myers-Briggs Type Indicator (hereafter referred to as MBTI) is to make the theory of psychological types described by Carl G. Jung (1921/71) understandable and useful in people's lives. (Myers & McCaulley, 1985:1). It is based on the fact that people have preferences that are neither good nor bad in and of themselves (Bester, 2001:56). Most of the existing personality instruments measure personality traits that indicate strengths and weaknesses. Personality types as measured by the MBTI, only measure differences of preference.

The four basic preferences or psychological dimensions are the following (Hirsch & Kummerow, 1989:4):

Energising - how and where to get your energy.

Attending - what you pay attention to when you gather information.

Deciding - what system you use when you decide.

Living - what type of lifestyle you adopt.

Where people get their *energy* from indicates whether they have extroversions (E) or introversions (I) preference. People draw their energy either from the external world of people, activities and things, or from the inner world of ideas,

emotions, and impressions (Hirsh & Kummerow, 1989:5; Myers & McCaulley, 1985:2).

The *attending preferences* are referred to as sensing (S) and intuition (N) (Bester, 2001:56). With a sensing preference, a person gathers information by the five senses. The person tends to be more idealistic, giving attention to the practicalities of the here and now. With an intuition preference a person gathers information through his “sixth sense”, which deals with meaning, relationships and possibilities that go beyond the information of his senses (Myers, 1987:6).

The third category of preferences is the *deciding preferences*, referred to as either thinking (T) or feeling (F) (Bester, 2001:56). “Thinking is the preference that relates to organising and structuring information to decide in a logical and objective way. Feeling is related to the preference for organising and structuring information to decide in a personal, value-oriented way” (Hirsh & Kummerow, 1989:6).

The fourth category of preferences is the *living preferences*, referred to as judgement (J) and perceiving (P). Judgement does not refer to being judgemental. The judging types seek to deal with their world in a decisive, planned and orderly way, aiming to regulate and control events (Bester, 2001:56). Perceiving types deal with their world in a spontaneous, flexible way, aiming to understand life and adapt to it as they go (Oswald and Kroeger, 1988:17; Myers & McCaulley, 1985:14).

Thus the MBTI describes the components of learning styles as a choice between each of the four preferences:

- Energising - through extroversion (E) or introversion (I).
- Attending - through sensing (S) or intuition (N).
- Deciding - through thinking (T) or feeling (F).
- Living - through judging (J) or perceiving (P).

2.4.4.2 Learning styles - The Kolb Experiential Learning Model

One of the most influential information-processing models in higher and

professional education is the Experiential Learning Model of Kolb (Wolfe & Kolb 1984:128 – 133).

This model posits that knowledge results from the combination of two dimensions, namely the dimensions of

- 1 Grasping information or perceiving
- 2 Transforming information or processing (Osland, Kolb & Rubin, 2001: 43; Malan, 1998:30).

According to this model, learners may either grasp information through direct here-and-now-experiences, or transform the information they have grasped through reflective thinking, active experimentation or application of the information (Osland, *et al.*, 2001: 43; Malan, 1998:30). By combining the two dimensions, Kolb views learning as a four-stage cycle, which is a simple description of how experiences are translated into concepts (Osland, *et al.*, 2001: 43; Bester, 2001:40).

This cycle involves four different learning modes – concrete experiences, reflective observation, abstract conceptualisation and active experimentation (Osland, *et al.*, 2001: 45-46; Wolfe & Kolb 1984:128; Lewis 2000:83). Each of these four stages represents a particular way of grasping or transforming information. Lewis (2000:83 – 86) explains the learning cycle of David Kolb as follows:

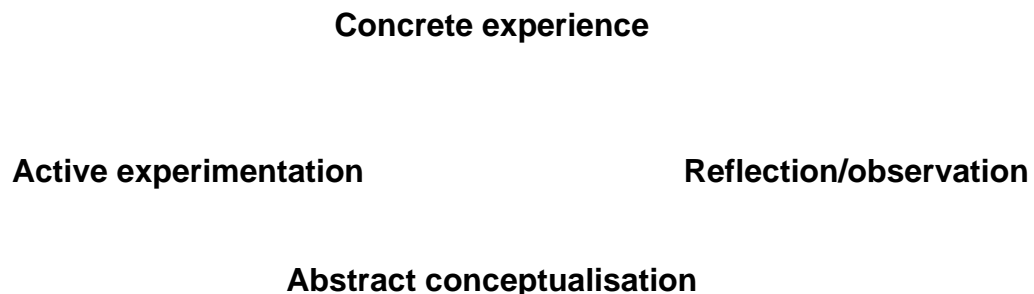


Figure 2.1 Learning Cycle by Kolb

According to Wolfe & Kolb (1984:130 – 131); Kolb, Rubin, and McIntyre (1979) in Schmeck (1988:277), as well as Wolfe and Kolb (1980) in Rademeyer (1990:83 – 86), learners can develop learning styles that emphasise some learning abilities over others. These styles are divided into four categories, resulting in four types of learners, namely those who learn through convergence, assimilation, divergence and accommodation Osland, *et al.*, 2001: 46-47. The learning cycles used in each of Kolb's four learning styles, are briefly described below.

Convergers are learners that have strengths in abstract conceptualisation and active experimentation. These learners perform well with the type of reasoning evaluated through intelligence tests and can concentrate on one specific problem by means of hypothetical-deductive reasoning (Osland, *et al.*, 2001: 47; Wolfe & Kolb, 1980).

Assimilators are characterised by learning based on strengths in abstract conceptualisation and reflective observation. As Kolb *et al.* (1979) in Schmeck (1988:277) put it: they think and watch. These learners are good at creating theoretical models (Osland, *et al.*, 2001: 46). They perform well in inductive as well as deductive reasoning and are extremely proficient in assimilating divergent observations into one explanation (Wolfe & Kolb, 1980).

Divergers learn best through concrete experiences and reflective observation (Osland, *et al.*, 2001: 46). They approach concrete situations from a variety of perspectives and organise various relations into a coherent whole (Wolfe & Kolb, 1980).

Accommodators learn effectively when presented with concrete experiences and opportunities for active experimenting (Osland, *et al.*, 2001: 47). They eagerly involve themselves in new experiences and tend to rely on trial and error, intuition and other people for information (Wolfe & Kolb, 1980).

2.4.4.3 Learning styles - Honey and Mumford's Learning Style Questionnaire

Honey & Mumford (1982) developed a 'Learning Style Questionnaire' (LSQ) to determine preferred learning styles. The LSQ is ideally designed to probe the relative strengths of four different learning styles, based on the stages of the Kolb learning cycle (Honey & Mumford, 1982:10 – 15).

Theorists learn best by adapting and integrating observations into complex, but logically sound theories. They think problems through in a vertical, step-by-step and logical way. They tend to be detached, analytical and dedicated to rational objectivity, rather than anything subjective or ambiguous (Honey & Mumford, 1982:13, Lewis, 2000:87).

Pragmatists are described by Honey & Mumford, (1982:14) and Lewis, (2000:88) as positively searching out new ideas, theories and techniques to see if they work in practice. They are essentially practical, down-to-earth learners who prefer making practical decisions and solving problems.

Activists operate optimally during the experience stage of the learning cycle, involving themselves fully and without bias in new experiences. They are open-minded, not sceptical, and this tends to make them enthusiastic about anything new (Honey & Mumford, 1982: 10 – 11, Lewis 2000: 87).

Reflectors, according to Honey & Mumford (1982:11 – 12) and Lewis (2000:88), like to stand back to ponder on experiences and observe it from many different perspectives. They collect data, both firsthand and from others, and prefer to reflect thoroughly on it before reaching any conclusions.

2.4.4.4 Learning styles – Dunn & Dunn's Learning Style Model

According to R. Dunn & K. Dunn (1993) learning style is the way that learners

begin to concentrate on, process, internalize and remember new and difficult academic information. “Many people can learn things that are easy for them without using their learning styles, but all people can learn new and difficult information better when they capitalise on their styles” (Dunn & Dunn, 1998:3).

Dunn & Dunn’s Learning Style Model works from the premise that a learning style is composed of biological and developmental characteristics that make identical instructional environments, methods and resources effective for some learners and ineffective for other learners.

Learning style inventories were developed that indicates individual elements in the five basic stimuli that affect a learner’s ability to master new information and skills (Dunn & Dunn, 1978:4).

The first stimulus strand - biologically imposed environmental elements

These elements include preference for sound versus quiet, low versus bright light, warm versus cool temperatures and formal versus informal seating (Dunn & Dunn, 1978:5-8).

The second stimulus strand - emotional elements

The preference for persistence as apposed to needing breaks while concentrating appears to be biologically imposed, whereas the other three elements in this strand are developmental varying with experiences and situations. These three elements include high or low academic motivation, conformity versus non-conformity and internal versus external need for structure (Dunn & Dunn, 1978:8-11).

The third stimulus strand - sociological elements

These elements are developmental and include preferences for working alone, in pairs, with peers, as part of a team or with an adult that who is either authoritative or collegial. The preference for working in a sociological pattern or routine as opposed to learning in a variety of ways is also considered a learning style trait

(Dunn & Dunn, 1978:12).

The fourth stimulus strand - physiological elements

“Perceptual preferences may be the most important aspect of learning styles”, as it either enables or prevent learners from learning easily (Dunn & Dunn, 1999:15). The four modalities of perceptual preferences are: auditory, visual, tactual (handling manipulative instructional resources) and kinesthetic (active participation in learning while standing or learning). The other elements part of physiological strand includes time of day preferences, the need for intake through snacking and mobility while learning (Dunn & Dunn, 1978:13-17).

The fifth stimulus strand - global versus analytical

The last strand composes of the global versus analytical processing style preferences (Lovelace, 2005: 3).

No person is said to be affected by all the learning style elements, but each preference that is revealed is “likely to increase the ease with which that person concentrate and his or her enjoyment of doing so” (Dunn & Dunn, 1998:8).

2.4.4.5 Learning styles - Howard Gardner’s Multiple Intelligences

“One position in psychology holds that there is just a single language of the mind – this language even has a name, *mentalese*” (Gardner, 2004: 27). As a result of interdisciplinary research Gardner came to the conclusion that *mentalise* is not the answer (Gardner, 2004: 28) and formed a definition of intelligence as: “a biopsychological potential to process specific forms of information in certain kinds of ways” (Gardner, 2004: 29). Professor Howard Gardner & Professor Robert Ornstein proceeded to determine that there are multiple intelligences that play a role in a human being’s IQ (Moreo & Carmichael, 2002:40). Learners have a preferred combination of intelligences, which constitutes their learning styles and include the following:

Verbal/linguistic intelligence is the processing of information through written and spoken words (Gardner, 2004: 31; Moreo & Carmichael, 2002:40). Learning best occurs through stories, debate, speech, humour and reading (Gardner, 2004: 31; Smith & De Jager, 2002: 17).

Visual/spatial intelligence is the ability to form mental pictures and images (Gardner, 2004: 34; Moreo & Carmichael, 2002:40). Learning best occurs through uses of mind maps, movement, drawings and poster charts (Gardner, 2004: 35; Smith & De Jager, 2002: 17).

Logical/mathematical intelligence is the capacity to recognize patterns, find connections, separate pieces of information and work with abstract symbols, numbers and shapes (Gardner, 2004: 31; Moreo & Carmichael, 2002:40). Learning best occurs via analysis, prediction, reasoning, problem solving proving and looking at cause-effect (Gardner, 2004: 31-32; Smith & De Jager, 2002: 17).

Bodily/kinesthetic intelligence is the ability to use the body to express emotion and ideas as well as practice hands-on activities (Gardner, 2004: 35-36; Moreo & Carmichael, 2002:40). Role-play, exercise, drama, mime, activities, games and sports are preferred methods of learning (Gardner, 2004: 35-36; Smith & De Jager, 2002: 17).

Musical/rhythmic intelligence is the capacity to recognize and use rhythmic and tonal patterns (Gardner, 2004: 33; Moreo & Carmichael, 2002:40). Learning best occurs through rhymes, music, songs, listening and humming (Gardner, 2004: 33; Smith & De Jager, 2002: 17).

Interpersonal intelligence is the ability to communicate well with people (Gardner, 2004: 38-39; Moreo & Carmichael, 2002:40) and learning best occurs when learners are through cooperation, teams, meta-cognition, journal writing, group work and win-win competition (Gardner, 2004: 38-39; Smith & De Jager, 2002: 17).

Intrapersonal intelligence is the ability to understand one's own thinking and feelings, to view oneself objectively (Gardner, 2004: 338-39; Moreo & Carmichael, 2002:40). Learning best occurs through reflective thinking, visualization and self-discovery (Gardner, 2004: 38-39; Smith & De Jager 2002: 17).

Gardner also determined that real intelligence means using all of the brain to engage all of these types of intelligence to live life completely and fully (Moreo & Carmichael, 2002:40). The importance of these different intelligences is that each learner possesses different abilities and talents that determine how they learn (learning style) and what they excel at.

Subsequently to the above research, Gardner has added two more intelligences to his list – naturalistic intelligence and existential intelligence (Gardner, 2004).

Naturalistic intelligence “entails the capacities to make consequential discriminations in the natural world Gardner, 2004: 36-37).

Existential intelligence is the ninth intelligence and “ponders the biggest questions: Who are we? Why are we here? What is going to happen to us? Why do we die? What is it all about in the end?” Gardner, 2004: 40-41).

The systems of Kolb, Honey & Mumford, Butler and Gardner are helpful in determine learning styles, but for the purposes of this study on evaluating Brain Gym, the Neethling Brain Instrument (NBI) is a more appropriate system to describe learning style differences. The Neethling Brain Instrument (NBI) provides a framework for evaluating Brain Gym, as it differentiates between the left and the right brain as well as the rational and limbic parts of the brain.

2.4.4.6 Learning styles - Kobus Neethling's Neethling Brain Instrument

Neethling (1997) based his work on the whole brain model of Nedd Herrmann (1990). This model is built on two paired structures, namely the two halves of the cerebral system (left and right brain) and the two halves of the limbic system. This model does not only allow for differences between the left and right brain, but also for the more sophisticated notions of the cognitive/intellectual cerebral preference and the visceral structured and emotional limbic preferences. This model is a metaphoric interpretation of how learners think and what their preferred ways of knowing are.

Neethling (1997; Neethling & Rutherford, 1996) described learning styles in a four-quadrant model, indicating four preference groups:

- 1 Exact, precise, accurate thought preferences.
- 2 Organised, planned, structured thought preferences.
- 3 Person and feeling-oriented thought preferences.
- 4 Experimental, change-oriented thought patterns.

The four-quadrant summary explains the different characteristics that suit each quadrant according to the left and right brain hemispheres as well as the rational and limbic parts of the brain (Neethling & Rutherford, 1996:87-98).

Table 2.2 A four-quadrant summary of the NBI

<p>LEFT BRAIN FRONT QUADRANT (L1) ANALYTICAL <i>Wanting preciseness & accuracy</i> <i>Analysing</i> <i>Assimilating logically</i> <i>Collects & memorises facts</i> <i>Looks for objectivity</i> <i>Diagnosis</i> <i>Looks deeper</i> <i>Prefers quantifying</i> <i>Things must be proven</i> <i>Compares</i> <i>Feelings should not confuse matters</i></p>	<p>RIGHT BRAIN FRONT QUADRANT (R1) HOLISTIC <i>Wanting alternatives</i> <i>Bringing thought together</i> <i>Exploring</i> <i>Likes flexibility</i> <i>Looks for opportunities to experiment</i> <i>Wants variety</i> <i>Linking loose concepts</i> <i>Prefers the whole image, not detail</i> <i>Enjoys involvement, rather than doing one thing at a time</i> <i>Appreciates change and new things</i></p>
<p>LEFT BRAIN HIND QUADRANT (L2) STRUCTURED <i>Step-by-step planning</i> <i>Regards experience as important</i> <i>Respects punctuality</i> <i>Prefers an organized milieu</i></p>	<p>RIGHT BRAIN HIND QUADRANT (R2) EMOTIVE / FEELING <i>Prefers co-operation</i> <i>Shows empathy</i> <i>Enjoys working with others</i> <i>Enjoys interaction</i></p>

2.4.4.7 Summarising learning style differences

Learning style was defined as the way in which a learner prefers to approach new information and influences the way learners learn and communicate. Systems were described that indicate the diversity in learning styles. Systems such as the Meyers-Briggs Type Indicator (MBTI); The Kolb Experiential Learning Model; Honey and Mumford's Learning Style Questionnaire; Kathleen Butler's Style Differentiated Instruction; Howard Gardner's Multiple Intelligences and Kobus Neethling's Neethling Brain Instrument were discussed as examples of useful instruments to determine learning style preferences.

Each of these well-known systems described different aspects of learning style preferences and was discussed to illustrate diversity in learners' learning styles. If the purpose of education "in a democratic society is to provide quality education for all learners so that they will be able to reach their full potential and will be able to meaningfully contribute to and participate in that society throughout their lives" (NCSNET & NCESS 1997:10), it follows that educators are obliged to provide quality education. A method of providing quality education can be through accommodating learning style differences in class through the implementation of diverse teaching methods for each period of each day.

If the need for quality education is compared to the current reality in schools in South Africa as described in 2.2, where amongst others educators facilitate the learning of learners with diverse frames of reference, levels of sensory integration and varying levels of language proficiency with learner : educator ratios of 90:1 and even 165:1 (NCSNET & NCESS 1997:23), accommodating learning style differences as well as the above, poses a tremendous challenge to educators._

Therefore the discrepancy between the need for quality education and the reality of the classroom situation makes it very difficult for educators to implement

different teaching methods to address different learning styles and thus indicate why learning style diversity can lead to learning difficulties.

2.5 FINDINGS AND CONCLUSIONS

Jensen (1988: 1) summarised the current situation in schools accurately when stating that when thinking about learning, “instead of conversations about the joy of learning, education has become a conversation about dropouts, low test scores, teenage pregnancy, vandalism, AIDS, teenage drunken driving, violence, drug abuse and suicides”.

Chapter 2 served as background to this study by gathering information to evaluate learners’ ability to learn effectively as indicated by the grade 12 exam results, media reports on the opinion of the public, the perceptions of educators teaching at dysfunctional schools and the joint report by the NCSNET & the NCESS.

The diversity in the grade 12 results, media reports and feedback from educators indicate that some learners are learning effectively and becoming successful life long learners, but without moderating the grade 12 results, the majority of learners are not learning effectively.

To gain insight into the possible causes for the high failure rate, the most essential barriers to learning experienced by unsuccessful learners were identified as language of instruction, literacy, math, concentration and motivation. As the scope of this study is not to model learning excellence, but to evaluate the claims about Brain Gym effectiveness in enhancing whole brain learning, it was indicated that this study will not focus on those learners who have developed the skills to master the learning content; apply it to their living and working environment; who are experiencing academic and personal success and are becoming life long learners.

The focus of this study will be on learners who are experiencing learning difficulties and are not achieving academic success, as those are the learners that Brain Gym practitioners are claiming to support by doing Brain Gym.

To enable the researcher to evaluate Brain Gym, some of the crucial factors resulting in language and literacy difficulties, math difficulties as well as difficulties in concentration and motivation were identified and explored. The crucial factors that were discussed are: learners' frames of reference, levels of sensory stimulation and sensory integration, language of instruction and learning styles.

Figure 2.3

Interdependency between the four factors affecting effective learning.

From figure 2.3 and the descriptions and discussions in chapter 2 it is clear that the interdependence between the above factors constitutes the basic building blocks and foundation of effective learning. It can be concluded that due to the diversity in learner's frames of reference, levels of sensory integration, language proficiency and learning styles, the current reality in schools are that many learners start school at a disadvantage and stay at a disadvantage.

Thus the disparity between the competency level of learners from affluent social and economical environments with enriched frames of reference, sensory acuity and who are writing exams in their mother tongue compared to the competency level of disadvantaged learners with a lack of relevant life experience, vocabulary, poor sensory integration and therefore poor conceptualization abilities being taught and assessed in a language other than their thinking language – is apparent.

The implications of the current disparity in schools as illustrated in chapter 2 are that a need exist for a new approach to learning. Such a new approach must enable disadvantaged learners to become empowered, achieve learning effectiveness and become independent and self-supporting adults, without impacting aversely on the competent learners. Bearing in mind that the research question of this study is: Can Brain Gym promote whole brain learning and in so doing contribute to learner success and independence in South African schools, the following chapter will systematically define learning and describe the learning process to provide a framework against which to evaluate whether Brain Gym is a possible new and inclusive approach to learning.

CHAPTER 3

WHAT IS LEARNING?

3.1 BACKGROUND

In chapter 2 the current situation in schools was evaluated and it was indicated that many learners are not experiencing academic success. The contributing reasons for learning failure in schools was ascribed to the diversity of learners' frames of reference, diversity in their levels of sensory integration, diversity in their thinking languages and diversity in their learning styles. The level of diversity amongst learners creates immense challenges in facilitating the learning process. The problem is how to facilitate the learning process within such diversity enabling learners to learn simultaneously and effectively from the same learning situation.

The aim of chapter 3 is not to focus on the diversity in learner make-up, but to identify a common denominator amongst all learners, which when developed would enhance learners' ability to learn and therefore promote the facilitation of learning, learning effectiveness and independence.

A common denominator amongst all learners is their ability to learn. Chapter 3 will thus serve to define and explore the concept of **learning** and the **process of learning** through concept analysis and a descriptive literature study. Defining these two concepts will narrow down the elements affecting the learning process to those essential elements that constitute the basic building blocks of learning. Once those essential elements are identified and described, there will be a framework, which can address the research question whether Brain Gym is a technique that promotes whole-brain learning and in so doing contributes to learner success and independence.

3.2 DEFINING LEARNING

Defining **learning** has been an elusive quest, in part due to the complexity of the concept and in part due to different disciplines studying the same phenomenon, but not combining the research findings. Both these aspects will be discussed briefly as an introduction to a discussion on learning theory.

3.2.1 Complexity of the concept *learning*

The following quotes illustrate the scope and complexity of interpretation of the concept learning: “Man’s power to change himself, that is to learn, is perhaps the most impressive thing about him” (Howe, 1984: 9). The ability to change and learn is a prerequisite for the ability to survive. According to Gagne (1985:2): “learning is a change in human disposition or capability that persists over a period of time and is not simply ascribable to processes of growth”. Bruner (1961:33-49) stated that “children could learn if taught appropriately” and Butler (1962:10) contributed by saying that learning should be “ incidental, not accidental”. Rossouw (1988: 2) expanded on the definition and importance of learning by referring to learners’ receptive abilities as their mental, emotional and physical ability to learn.

Super (1992:155) says humans are born with potential and this potential is the capacity for existing, but which has not been realised as yet Feuerstein, Rand, Hoffman and Miller (1980:2) indicate that the concept of learning and learning potential implies that nearly all people possess a far greater capacity for thinking and intelligence than what actually manifests in behaviour. Everybody has a hidden capacity that needs to be unlocked.

Roussouw (1995:17) expands on the need to unlock potential saying that learning as an inherent part of the educational situation that is a given with

childhood. “Omdat die kind nog nie ken of kan nie, moet hy deur die volwassene as opvoeder geleer word om te ken en te kan. Dit is trouens die uiteindelijke doel van die opvoeding om die kind se spontane leer te rig in die rigting van volwassenheid”.

Poplin (1988:404) adds to the importance of a knowledge base saying learning is “. A process whereby new meanings are created (constructed) by the learner within the context of her or his current knowledge”.

Dennison is heard to have said: “learning is the ability to build memories; intelligence is the ability to develop and act on those memories”. Memories are built according to Jensen as “a distinctively categorised and long term stored visual, auditory and kinesthetic **representation** (picture, sound and feeling) of an experience/conclusion/fact or feeling. It is the one that can be retrieved and acted upon when needed (Jensen, 1988:19).

Hannaford (1995:11) expands on the concept of learning and building memories to develop a knowledge base explaining that learning and growing is a multi-faceted process where learning, thought, creativity and intelligence are not processes of the brain alone, but of the whole body. She states that sensations, movement, emotions and brain integrative functions are grounded in the body and can never exist separate from the body. Therefore learning is not just in the learner’s head; it is the sensations received through the eyes, ears, nose, tongue, skin and proprioceptors that are the foundation of knowledge

Not only is defining learning an aspiring and complex endeavour, learning is no longer the sole domain of the Educational Sciences, but the domain of many other sciences.

3.2.2 Different disciplines defining the same phenomenon *learning*

Currently it is most striking that the variety of research approaches and

techniques that have been developed and the ways in which evidence from different branches of science are beginning to converge, result in a far richer definition on learning. For example according to Brandsford, Brown and Cocking (2001: 4) cognitive psychology, developmental research, research on learning transfer, social psychology and neurosciences have lead to an era of “new relevance of science to practice”.

Hresko & Parmer (1991:22) define learning from a cognitive psychological perspective stating, “Learning involves the active participation of the learner, is dependent upon the learner, results in long term changes in the individual's knowledge base and is internal to the learner”.

According to Brandsford *et al.* (2001:4-5) where (in the past) learning was focused on the acquisition of literacy skills (reading, writing and calculating), learning can now be defined as the ability to read and think critically, solve complex problems and express ideas with clarity and persuasion.

The previous quotations indicating various definitions of the concept *learning* necessitates a discussion of learning theories, because as opposed to ‘loose’ definitions and perspectives, “the beauty of theories is that they can organise our thinking about a wide range of specific facts or events” (Sigelman & Rider, 2002: 24).

3.2.3 Learning theory

According to Sigelman & Rider (2002: 24) “a theory is a set of ideas proposed to describe and explain certain phenomena”. It also serves to make clear what is important and what can be predicted. In the light of the research question: Can Brain Gym can promote whole brain learning and in so doing contribute to learning effectiveness and independence in a South African school, it is imperative to consider learning theories in building a scientific framework to address the research question and thus evaluate the validity of the claims made

about the value of Brain Gym.

Learning theories are part of the body of scientific knowledge that deals with the development of the human being. Development can be defined as “systematic changes and continuities in the individual that occur between conception and death” (Sigelman & Rider, 2002: 2). Two important processes underlie development: maturation and learning. *Maturation* is the biological unfolding of the learner according to a plan (Sigelman & Rider, 2002: 3), while *learning* is the process through which experience brings about relatively permanent changes in the thoughts, feelings and behaviour of learners (Sigelman & Rider, 2002: 4).

The researcher takes cognisance of the process of maturation and will especially refer to it in terms of the empirical research in chapter 5. For the purposes of this literature study though, a framework is being built around the process of *learning* to scientifically evaluate Brain Gym based on the fact that Brain Gym would be classified as a *learned* skill. It can therefore be stated that should Brain Gym be in accordance with the theoretical framework presented through the various definitions of learning and learning theories, it would follow that a scientific basis for Brain Gym exists.

As with the attempt to define *learning* in 2.2.1 and 2.2.2, diverse theories on learning exist such as Watson’s: Classical Conditioning, Skinner’s: Operant Conditioning, Bandura’s: Social Learning Theory, Piaget’s: Constructivist Approach, Vygotsky’s Sociocultural Perspective and the Information-Processing Approach. For the purposes of this study the Information-Processing Approach will briefly be discussed.

According to Howard Gardner (1985), the “cognitive revolution in psychology generated the Information-Processing Approach as the result of the inadequacies of the behaviourist approach and the rise in computer technology”. Influenced by the rise in computer technology, cognitive psychologists began to think of the brain as a computer that processes input and converts it to output (Sigelman &

Rider, 2002: 192). The computer provided a good analogy to the way a learner's mind work - the mind's hardware is the nervous system (including the senses, nervous system and neural connections) and its software is the programmes used to manipulate received and stored information (rules and strategies that indicate how information is being received, interpreted, stored, retrieved and analysed) (Sigelman & Rider, 2002: 192).__

The Information-Processing Approach describes the flow of information through the brain starting with a **sensory register** that receives information from the environment. If the information may be needed in future, it moves the information into **short-term memory** where limited amounts of information is held for a few seconds for awareness purposes or to be worked on (working memory). For information to be remembered for a longer period it needs to move to **long-term memory** (Sigelman & Rider, 2002: 192-3).

To be able to store information in memory information first needs to be encoded to get 'into' the brain. "If it never gets in, it can not be remembered" (Sigelman & Rider, 2002: 193). Memories are then stored in long-term memory to be retrieved when it is needed. Retrieval is accomplished through recognition memory, recall memory or cued recall memory. Breakdowns in memory may be as the result of difficulties in encoding, storage or retrieval (Sigelman & Rider, 2002: 193) as can be noted when considering the model of Richard Atkinson and Richard Schiffrin figure 2.1.

Figure 3.1 A Model of the Information-Processing Approach

The Information-Processing Approach to learning can be summarised as the way in which information enters the sensory register, is stored in memory for later retrieval to be used in solving problems (Sigelman & Rider, 2002: 215).

For the purposes of this study and based on learning theory *learning* can thus be defined as the ability to receive sensory input, process the input for optimal storage and retrieval with the purpose of solving problems.

The logical next step is an in-depth discussion of how learning takes place on the basis of Information-Processing Approach to assist in the scientific evaluation of Brain Gym in chapter 4.

3.3 DEFINING THE PROCESS OF LEARNING – HOW DOES ONE LEARN?

According to Jensen (1994:Introduction) one learns best the way the brain learns best - easy, fast and enjoyably. The brain prefers learning with optimal challenge, a sense of curiosity, full attention, relevant content, little stress and intrinsic motivation. Dennison (1989: 2) also stresses the enjoyment of learning by stating that learning is a natural, joyous activity that continues throughout life. He expands on this statement by saying that there are no lazy, aggressive or withdrawn learners, only learners who ask for help by means of their behaviour because they are “denied the ability to learn in a way that is natural to them”. Learner behaviour is thus seen as the **end result** of the learning process, as learning is a process and not an event.

The different aspects of the learning process can be defined as the relationship between the learner and the environment, the learner and an adult (primarily the parent and later the educator) and the learner and the learning content. All these

relationships serve to develop the child physically, emotionally, socially, linguistically, cognitively and spiritually.

For the purpose of this study the learning process is defined as the learner's ability to learn and develop physically, emotionally, socially, linguistically, cognitively and spiritually based on their ability to register sensory information (input), assimilate and store information (processing) and apply information (output) for the purpose of solving problems (Sigelman & Rider, 2002: 215;_De Jager, 2001:17; Fourie, 1998:25; Hannaford, 1997:16).

Figure 3.2 The learning process

3.3.1 Information intake - input

It is a general misconception that one learns with the brain, but “the brain, as marvellous as it is, cannot learn all by itself. It needs information” (Hannaford, 1997:16) and therefore **INPUT** is the first step in the three step learning process. When people take in information, they rely on their senses. “Our sensory experiences (both external and internal) shape our way of imaging, and therefore, our thinking” (Hannaford: 1995: 31). Edwards (2000:23) is in

agreement with this stating that the senses provide the information that is needed to function in the world.

Table 3.1 Input – the first step in three step learning process

Information intake	Information assimilation	Information application
Input	Processing	Output

“The senses receive information from inside (near senses) and outside our bodies (far senses) and to do their job right, the senses must work together” (Edwards, 2000:23).

The far senses are those senses that respond to external stimuli in the environment and are the senses of sight, vision, taste, smell and touch. (Edwards, 2000:23; Matties & Quirk, 2002:2).

Near senses are those senses that respond to what is happening inside our bodies and are crucial to survival (Edwards, 2000:16). The near senses include the proprioceptive system (muscles and joints which supply feedback regarding position of body parts and how they are moving in relation to each other), the vestibular system (senses where one is in relation to the world) and the kinesthetic ability (Bush, 2002:22 and 23). As these near senses provide feedback on what is happening inside the body, it is crucial for learning as “most learning and attention deficits can be traced back to inefficient functioning of the near senses” (Edwards, 2000:23; Bush, 2002: 22).

The senses are linked into a sensory system, which consists of a set of accessory structures, transducers or receptors and nerve tracks (Ruch, 1984:669). For learners to function with effortless ease, be truly independent and experience learning effectiveness, their senses need to be well stimulated and integrated. Stimulation and “movement activates the neural wiring throughout the body, making the whole body the instrument of learning” (Hannaford, 1995: 13). When learners are functioning optimally, clear messages are fed from all parts of

the body to the brain and back again to the body “in a loop” (Promislow, 1998: 16).

According to Bandler and Grinder, developers of Neuro Linguistic Programming (NLP), each learner takes in and accesses information in a particular manner. Learners process and make sense out of information differently depending on the sensory modality through which they receive it (Bandler & Grinder, 1982). This is based on their preferred sensory modality being more visual (V), auditory (A) or kinesthetic (K).

Learning style specialist Dawna Markova (Smith & De Jager, 2001:2) takes it one step further stressing that all three senses (VAK) are used, but in different sequences. The effectiveness of a learner's thinking therefore depends on the representation (VAK) that was created in the brain, which in turn depends on the acuity of the learner's senses.

When considering the first step of the learning process and relating it to learners' diversity in information reception via preferred sensory modalities (visual, auditory or kinaesthetic) instead of identifying a common denominator amongst learners, it seems to compound the learning difficulties described in chapter 2. When relating the diversity in learners' INPUT, to the research question of this study, it becomes all the more important to stimulate and integrate all the senses simultaneously for optimal learning and thus to investigate Brain Gym and the claims about it enhancing learning effectiveness.

3.3.2 Information assimilation - processing

The second step in the learning process is the processing of the sensory input.

Table 3.2 Processing – the second step in the three step learning process

Information intake	Information assimilation	Information application
Input	Processing	Output

“A person doesn’t learn simply because someone puts information into the brain. It is in how a person receives and processes information, in addition to other physical and emotional factors that helps determine what is retained” (Johnson, 1998:1). To elaborate on this statement, a brief description of information processing will follow to illustrate the different aspects that contribute to effective processing and which subsequently result in learning success.

Information is assimilated in the brain, which receives, processes and interprets all information. The brain has “a vast ability to take in enormous amounts of peripheral as well as directed information and employ all the richness of the senses creating complex patterns representing the original experience” (Jensen, 1994: Introduction). The purpose of information processing is to convert the raw sensory data and in so doing make sense of and give meaning to the world (Dejean, 2000:1).

The brain is a part of the central nervous system and develops when receiving stimulation from the environment as well as “from our bodies” (Edwards, 2000:8) in the form of “pulse trains from the primary sensory cortices that are sent to sites of convergence to be bound into precepts by locking or other forms of neuronal integration. The sites of integration are assigned to the thalamus (Baars, 1996), the cerebellum (Eccles, Ito and Szentagothai, 1967) or frontal lobes (Fuster 1994) and parts of the higher cognitive structures of the brain.

The brain filters the millions of sensory sensations that bombard it and which are most irrelevant to the current situation. The brain therefore inhibits the irrelevant information to focus and concentrate on relevant information (Edwards, 2000:8).

The process of **inhibition** reduces neural connections between sensory input and motor and behavioural output to modulate appropriate output (Dejean, 2000: 2). If the connections between sensory input and motor and behaviour output need to be enhanced to produce improved output, a process called **facilitation** or strengthening is needed. “If you are doing something that feels good, the brain gives you the go-ahead to keep doing it, like when being stroked gently on the back. If the something doesn’t feel good like a hard scratch or clap, the brain registers discomfort and takes action to avoid the discomfort” (Edwards, 2000: 8).

When the processes of inhibition and facilitation are in balance, smooth transitions from one physiological, mental, emotional, spiritual state to another can be made. How effectively these states change, depends on how effectively

the nervous system is modulating / processing the information.

The effective completion of the second step of the learning process depends on:

- 1 Sensory integration
- 2 The development of perceptions
- 3 The development of cognition
- 4 Emotional development
- 5 Language development.

These five sub-steps will be discussed briefly to provide a theoretical framework to address the research question of this study and evaluate Brain Gym effectiveness.

3.3.2.1 Information processing through sensory integration

In her book *Sensory Integration and the Child*, Jean Ayres (1994:51) compares the brain to a large city with traffic consisting of the neural impulses. She states: “Good sensory processing enables all the impulses to flow easily and reach their destination quickly. Sensory integrative dysfunction is like a traffic jam in the brain. Some bits of the sensory integration information get tied up in traffic and some parts of the brain do not get the sensory information they need to do their job”.

Without adequate sensory information the brain becomes disorganised because the brain needs stimulation and without it, it will create its own (Dejean, 2002:1). Information processing is also called sensory integration and defined as the “organisation of sensory input for use. The ‘use’ may be a perception of the body or the world, or an adaptive response, or a learning process, or the development of some neural function” (Ayres, 1994: 184). “Sensory integration occurs in the primitive lower centres of the brain and mostly does not reach consciousness – in other words we are not actually aware of this happening” (Bush, 2002: 8).

The main task of the brain is to integrate the senses and the motor responses, as over 80% of the nervous system is involved in processing, organising or storage of sensory input. Therefore the brain is primarily a sensory processing machine (Edwards, 2000: 8). Sensory integration can be defined as the neurological process of organising the information taken in through the senses and put together with prior information stored in the brain to make a meaningful response (Dejean, 2000:1; Edwards, 2000: 8; Stephens, 1997:1) during the OUTPUT stage.

3.3.2.2 Information processing and the formation of perceptions

As indicated in the introduction to 3.3.2 and 3.3.2.1 sensory stimulation and sensory integration are prerequisites for the formation of perceptions, because according to Silverman (1974: 712) perception is “the process of becoming aware of and interpreting objects or events that stimulate the sense organs”. Ruch (1984: 663) describes perception as “the additional processing and adding of meaning to sensations, drawing on memories, predictions and information from more than one sense”. Sigelman & Rider (2002: 139) defines perception in simple terms by stating that, “perception is the interpretation of sensory input by recognising what you see, understanding what is said, “knowing that the odour that you are detecting is a sizzling steak, and so on”.

Perception can thus be defined as the process of attaching meaning to well-organised sensory information resulting in accurate feedback and additional input. Perception includes skills such as discrimination, comparison, separation, generalisation and communication, and forms the basis of any form of learning (Stachel, 1986:15).

In the quest to understand the learning process and in so doing identify a common denominator amongst all learners, the question “What influences perception” can be asked. Rosner (1972:11) stated that perception is influenced by innate and environmental factors.

Through the ages perception and learning effectiveness have been linked and given rise to the debate on the importance of the influences of environment versus hereditary influences. Empirists focused on the importance of the environment on learning and claimed three centuries ago that all knowledge is acquired through experience (Kantor, 1959: 27). The nativists, on the other hand, postulated that perception is innate and cannot be learned (Pronko, Ebert & Greenberg, 1966:59).

Later research clearly indicated that it is not a case of either the environment or hereditary influences that develop perception, but the interdependence between the two that form perceptions. Fantz (1965:400) illustrated this interdependence by stating, “perception is innate in the neonate, but largely learned in the adult”. Rosner (1972:11) expands on this interdependence, saying that all learning is the result of perception and that the perception that is required to experience success as a learner is largely a learned process.

In summary, perception is the interpretation of high quality sensory input as a result of the integration of well-stimulated visual, auditory and kinesthetic senses. Because perception is a learned process the implication is that if it was possible to stimulate and integrate the senses, learners’ preferred learning styles (visual or auditory or kinesthetic) would be expanded and therefore impact positively on the formation of perceptions and thus enhance learning.

3.3.2.3 Information processing and the development of cognition

Sensory stimulation, sensory integration and perceptual development are prerequisites for cognition. Sutherland (1989: 77) defined cognition as the mental processes concerned with the acquisition and manipulation of knowledge, including perception and thinking. Bruno (1986: 41) describes cognition as the processing of thoughts and images at a conscious level. Gouws *et al.*, (1986: 181) defines cognition as “denke, begripsvorming en intelligensie”. Nelson

(1996:5) defines cognition as the ability to make sense of the world (through contemplation or thinking) “in order to take skilful part in its activities”,

Cognition therefore means *thought* and according to Ruch (1984: 24) *thought* is what

separates the human species from others species. It is the ability to think, to solve problems and be creative. “Cogito, ergo sum” (Gaarder, 1995: 198) refers to “I think and therefore I am”.

According to Markova (Smith & De Jager, 2001:2) how learners think depends on their learning styles and according to Sperry and associates also on which part of their brains are dominant. The last statement is based on the split-brain research of Roger Sperry and associates in the early 1960s (Bester, 2001: 11; Dennison *et al.*, 2000: 2). Sperry’s research resulted in identifying fundamental differences between the left and right halves of the brain indicating that the left brain excels at factual details, convergent thoughts and language, while the right brain excels at divergent thoughts and is at ease with emotions, pictures and rhythm (Dennison & Dennison, 2000: 5; Fourie, 1998: 19; Hannaford, 1995: 79; Putter, *et al.*, 1996:15).

The differences between left-brain and right-brain thinking will be discussed in greater depth in chapter 4, but the implications of these differences are that learners do not process information in the same manner and therefore it leads to diversity in learning style preferences as discussed in chapter 2. This diversity compounds the need to stimulate the non-preferred parts of the brain and thus the need to evaluate Brain Gym as a technique that claims to stimulate all the parts of the brain.

Irrespective of a left or right brain preference, Piaget considers all cognition as a process in which a learner masters certain mental operations and in so doing perceived relationship amongst stimuli (Silverman, 1974: 692). He postulated that there is a fundamental difference between the manner in which an adult and

a child thinks, as an adult's knowledge base and view of the world is not simply the result of environmental experience, but constructed through "a kind of natural logic" that knows how things are supposed to be. (Ruch, 1984: 373). This adult logic / cognition is developed gradually through life experiences. The purpose of "adult logic" or cognition is to understand the underlying stability of the world despite varying sensory input from the world (Elkind 1974 in Ruch, 1984: 373).

A sense of stability creates confidence and security Jensen (1995:6) states, "No intelligence or ability will unfold until or unless given the appropriate environment". This is understood to mean a stable environment promotes the unfolding of cognition. Seen in the light of the environment in which the majority of learners who are not experiencing learning success are raised, it is little wonder that they do not optimally develop their cognition.

This situation is further illuminated in the following paragraphs as cognitive development is the result of logical and structured cognitive processes that are built one on top of the other (Glover & Bruning, 1990:119). Piaget stated that children naturally aspire to make sense of the world (Bell-Gredler, 1986: 213), via the processes of **assimilation** and **accommodation**.

When new perceptual information can be fitted into an existing mental structure (frame of reference), the process is called assimilation (Ruch, 1984:375; Glover & Bruning, 1990: 131; Geer, 1993: 59; Piaget, 1977: 6). When new perceptual information cannot be assimilated, existing mental structures (frames of reference) are reorganised and expanded to accommodate new information (Ruch, 1984:375; Glover & Bruning, 1990: 131; Geer, 1993: 59; Piaget, 1977: 6-7), the new information is absorbed and learning has occurred. Should learners not have the ability to expand their existing mental structures, learning has not occurred resulting in learning difficulties as described in chapter 2.

Cognition presupposes cognitive growth, which, according to Piaget (Gardner, 1997: 18-19; Geer, 1993, 55-58; Ruch, 1984: 374-375), is divided into four major

stages:

Table 3.3 Piaget’s four stages in cognitive growth

Sensorimotor (birth – 2 years)	The infant is born with certain innate reflexes, which form the basis of his exploration of the physical world. He begins with a totally body-centred view but through use of the senses, gradually becomes aware of the external world beyond his body.
Preoperational (2 – 7 years)	The young child acquires language, which permits symbolic representation of objects and events. He makes progress towards a less self-centred view, but concepts of space and time remain centred on the child and the present. In examining objects, he focuses on one property at a time: height or width, for example, but not both.
Concrete operational (7 – 12 years)	The older child begins to use logical reasoning based primarily on “concrete”, or realistic physical relationships. He becomes able to classify and number objects and arrange them in a series. He also achieves conservation, including number, mass, and weight.
Formal operational (12 – 15 years)	The adolescent begins to think in abstract terms, being able, for example, to consider complex issues of right and wrong or to discuss hypothetical events. He can solve a problem by systematically investigating a series of possible relationships and can work with a variety of subtle relationship, such as probability.

The process of progressing from one cognitive stage to another involves managing new perceptual input into a context. Weiss (2000:3) quotes Jensen stating: “Without context, emotions or patterns, information is considered meaningless. There is a tendency to try to form some kind of meaningful pattern out of learning – this process seems innate”. The brain constantly integrates the senses and emotions to create new associations (Hannaford, 1995: 71). It is thus the combination of sensory information, cognition and emotion that constitutes

control feelings; to communicate in terms of thoughts and emotions and to use the information to direct thoughts and actions to be motivated to live effectively and goal oriented (Le Roux & De Klerk, 2003: 9).

From the work of Damasio (1994) and Le Roux & De Klerk (2003) it is clear that emotions impact on thought/cognition - Damasio by stating that emotions are involved with the “deployment” of logic and Le Roux & De Klerk by stating that emotions “direct” thoughts._

Gelernter (1994: 35) is also in agreement with this and states that emotions are inseparable from thought as well as inextricably linked to physical states. The physical state is part of the emotion and thus one ultimately thinks with both the brain and body. Therefore as one experiences the world, the impressions are processed through an emotional filter and the intensity of emotion determines the value, meaning and memory potential of the experience in relation to past experiences. The way the information is perceived, coloured by emotions, determines the response to it and the potential to learn from it (Hannaford, 1995:54).

The role of cognition and emotion was also illustrated in chapter 2 by Neethling’s differentiation between the rational and limbic learning styles preferences. The implication of learners being more rational or more limbic in their learning style preferences, for this study, indicates the need to stimulate and integrate not just the parts of the brain that learners naturally favour, but the brain as a whole.

3.3.2.5 Information processing and language development

Information processing through cognition and emotion, but without language development, is incomplete. “Language is the source of thought. When the child masters language he gains the potentiality to organise anew his perceptions, his memory; he masters more complex forms of reflection of objects in the external world; he gains the capacity to draw conclusions from his observations, to make

deductions, the potentiality of thinking” (Luria, 1968:85).

Language is the natural progression from the sense of vibration and rhythm in-utero to tone and hearing in the child. As the child experiments with sound, it develops the nerve networks and myelinates the fibres to control the muscles of the larynx (speech box).

Babbling is the first stage of speech development and differs from other noises made, in that it is characterised by repetitive sounds of an immense variety (Silverman, 1974:52). The child’s ability to match what it is hearing with the sound it is producing is the beginning of communication (Hannaford, 1995:88). The child soon learns that certain sounds mean certain objects and that sounds are meant to communicate a request (Silverman, 1974: 53). As their words produce the desired outcome, so their vocabulary expands.

According to Gardner (1997:20) by the end of the first year, most children are already capable of “mundane symbolisation” as they recognise a few words in their own language, can orient properly when they hear known words and utter a few words.

Gardner further states that: “the domain – crafts and disciplines of our adult world – are constructed on the basis of symbols; and our capacity to master them and to invent new systems, also presupposes the symbolic fluency that is launched in the years after infancy”. It is these symbol-using cognitive capacities that allow the child to learn about experiences that are unfamiliar and to create output that make sense to him and clear to others (Gardner, 1997: 25).

Information processing (as the second step in the learning process) can be summarised as the integration of sensory input and the development of perceptions, cognition (left or right brain), emotions and language as a means to label experiences. The complexity of the processing step results in an awareness of the importance of early childhood stimulation and integration in order to gain optimal benefit from the learning experiences provided by the learners’ living

environment.

Failure to receive adequate sensory input, impacts on the efficiency of the processing of information, resulting in learning difficulties both in school and learning from life experiences in general. It is clear that without all the senses and all the parts of the brain (left, right, cognition, emotion) being stimulated and interconnected, effective information application and output is not possible.

3.3.3 Information application - output

Table 3.4 Output – the third step in the three step learning process

Information intake	Information assimilation	Information application
Input	Processing	Output

The information application or OUTPUT stage is the third stage in the three step learning process and is based on the successful completion of the reception and processing stages.

Learning effectiveness is measured by the output produced. OUTPUT (like the grade 12 exam results) indicates if the learning process was completed according to standard. Failure to produce satisfactory output may be the result of a breakdown during the INPUT or PROCESSING steps, but generally only OUTPUT is measured.

Output refers to verbal, written or active motor involvement, because it is only once information is organised and processed, that it produces a motor or behavioural output (Dejean, 2002:1). Learning involves the building of skills and skills are built through the movement of muscles like in the physical skills of artisans, athletes, dancers and the intellectual skills utilised in the classroom and workplace. “Muscles are no less important to skills development than any other component” because movement is a sensory-motor event (Hannaford, 1995:98) that completes the learning process.

Gardner (1997: 1) emphasises the importance of output in stating that “in every age a tiny percentage of individuals stand out by virtue of their achievements, only a few are distinguished because of their prodigiousness and quality output, those are people like Mozart, Freud, Goethe, Curie and Mandela”.

Output does not only refer to motor acts, but also to higher level cognitive abilities such as communicating, reading and writing (Hoehn & Baumeister, 1994: 2). It is already visible in the early months of childhood when children engage in amazing nuanced exchanges of smiling, cooing and rocking back and forth in an effort to establish and maintain communication (Gardner, 1997:20).

The process of producing output relies on the ability to recall perceptions and apply them through speech, gestures, writing, body language, awareness or behaviour (Fourie, 1998:32). Silverman (1974:52) describes speech as output, in terms of systematic behaviour that develops only through learning and maturation and thus is a disciplined approach to vocal expression with the intent to convey a message.

According to Hannaford (1995:89) speech is the result of thoughts that are expressed when the motor cortex stimulates the muscular movement of the larynx, tongue, mouth, jaw, facial muscles and eyes that form and give expression to words. “Muscular memory of how to form the words appears to be housed in the basal ganglion of the limbic system. Within the basal ganglion is a specialised area called the substantia nigra, which connects the basal ganglion with the frontal lobes – the areas that control vocalisation and thought” (Hannaford, 1995:89).

Hannaford further states that the connections between the motor cortex and the formal reasoning area of the frontal lobes indicate the importance of movement to thought processing. It is this connection that necessitates most learners to draw, write or discuss their thoughts and where words become playthings to label

the world with (Hannaford, 1995:91).

Translating thoughts into speech or written words is a complex task. It involves sensory areas, primary auditory, auditory association, primary vision, visual association, motor speech and Gnostic areas of the neo cortex. (Blakeslee, 1991:1). Output becomes a vital part of language as integrated thought patterns are transmitted to the vocalisation areas of the motor cortex and the basal ganglion of the limbic system to manifest thoughts into words and writing (Tortora & Anagnostakos, 1990:403).

Talking and signing (for deaf people) is essential to language development and thinking (Hannaford, 1995:92). Poor language abilities thus result in poor output as Hannaford indicates that incomplete language development “shows up graphically in students ability to think and write” (Hannaford, 1995:94).

Inner speech or self talk (as an output) only develops once Broca’s area of the frontal lobes are developed, allowing a person to process internal information more rapidly than verbalisation would allow. Inner speech develops in the same area of the brain that controls skilful movements of the hand. “As the human has evolved into a problem-solving tool using animals, the frontal lobes became the centre for fine motor coordination (writing, typing and drawing), pattern recognition, simultaneous processing of information, high level planning and global thinking” (Fuster, 1980:255).

A lack of frontal brain stimulation (thinking skills, cognition, fine motor and inner speech) results in inappropriate behaviour as inner speech controls social behaviour by considering the consequences of actions before acting (Hannaford, 1995:95). Learners with under stimulated frontal brains thus often exhibit the kind of behaviour described in chapter 2 that is both disruptive and not conducive to learning. Typical behaviour is for example: clumsiness, disorganisation, awkward and uncoordinated movements, distractibility, daydreaming, irritability, aggressive behaviour, hyperactivity, hypo-activity, speech and language problems and

difficulty with fine motor coordination.

Behaviour can then be viewed as an indication of a breakdown in the three step learning process.

The info-out or motor stage may have a breakdown due to poor physical coordination resulting in the inability of the muscles to represent and carry out the message received from the brain (Sunbeck, 1991:123). If the sensory input is not processed and organised accurately, the result is abnormal / inappropriate motor output. The consequences of a disorganised central nervous system, poor perception and the resulting inappropriate motor response are developmental lags, behavioural, emotional and barriers to learning (Dejean, 2002:2).

3.3.4 Summary of the learning process

Sunbeck (1991:123) summarises the learning process as “all of our senses work together to provide us with the best possible sensory information available at any given situation. Our brains carefully consider our senses’ combined awareness of a given situation. They also quickly check our past memories for similar situations, looking for additional insight. Ideally, these immediate sensory impressions will be crosschecked with sensory memories that have accumulated through past experiences leading to important internal questions such as: Have I experienced (sensory base) this before? Is it applicable here and now? Are any of the senses being negatively biased by a specific past memory? Etc. If any response is needed based on the sensory input, the decision is handed over to the motor system. The accuracy of the execution of the action depends on the closeness of the relationship between the whole brain and the muscles”.

The question can be raised whether the three-step learning process naturally unfolds or if it needs to develop? The answer seems to lie in the fact that learners are not born completely developed, but are born with the potential to be fully developed (De Jager, 2001: 13). Ruch (1984:651) defined development as “the

aspects of the process of going from genetic potential to being some particular adult”.

In her book *Molecules of Emotions*, neuroscientist Candace Pert (1997:146) explains that the interaction between genes and the environment is a chemical process, which results in thoughts, emotions and sensations. Due to the biomolecular basis of thoughts and emotions “there is always a biochemical potential for change and growth” thus indicating the potential in all learners to change and grow irrespective of their frames of reference.

Molecules therefore create thoughts and molecules are manipulated by experiences. Every new experience is recorded in the brain in a new “configuration, but if it is not laid down in memory, the pattern degenerates and the impression disappears like buttocks-shaped hollow in a foam cushion after one stands up. Patterns that linger may in turn connect with and spark off activity in other groups – forming associations (memories) or combining to create new concepts” (Weiss, 2000:5).

A comprehensive developmental model addressing the physical, emotional and cognitive aspects of the child was sourced. Various models exist to describe human development, models such as Freud’s Psychoanalytical Theory, Erikson’s Neo-Freudian Psychoanalytical Theory, Piaget’s Constructivist Approach, Vygotsky’s Sociocultural Perspectives (Sigelman & Rider, 2002) and MacLean’s Triune Brain Theory. The various models and theories indicated different aspects of human development, but MacLean’s Triune Brain Theory was the most compatible with the Information -Processing Approach to illustrate the development of three-step learning process. A discussion of the Triune Brain is therefore relevant for this study to determine whether the development of the brain is open ended or not and thus if Brain Gym can influence the learning process.

Should the development of the brain be open ended, it would follow that learners

who are currently experiencing learning difficulties due to limited frames of reference, language difficulties and poor sensory acuity would benefit from a stimulation programme. Should that be possible, it would assist in addressing the research question of this study to evaluate whether Brain Gym can contribute to whole brain learning and enhance learning effectiveness and learner independence.

3.4 DEVELOPMENT OF THE LEARNING PROCESS – THE TRIUNE BRAIN

As chief of the laboratory of brain evolution and behaviour at the National Institute of Mental Health in Washington, DC, MacLean developed a theory on development, by differentiating between three distinctive areas of the human brain - the reptilian / survival brain, the limbic / emotional brain and the neo-cortex / thinking brain (MacLean, 1990: 15-18; Hermann, 1990:31; Jensen, 1994: 21) and called it “A mind of three minds” (Hannaford, 1995:31).

According to MacLean’s Triune Brain theory, the human brain is in reality three brains -each brain superimposed over the earlier, in a pattern of brain within brains (Hermann, 1990:31; MacLean, 1990:8). According to his Triune Brain Theory, the three parts are delineated biologically, electrically and chemically and are based on the developmental patterns and evolved functioning of the human being (Hannaford, 1995: 31).

These developmental patterns are relevant for learning and as such will further be explored. The development of the Triune Brain and the learning implications thereof will be described with the intent to make sense of the behaviour of learners with learning difficulties as described in chapter 2. The Triune Brain will also be described with the aim of establishing a model against which Brain Gym effectiveness can be evaluated.

The triune model is not a structural model, but a functional model. Each of the

three areas of the brain (or three brains) influences the other, but the part of the brain with the highest priority for behaviour is the reptilian part of the brain (Jensen, 1994:22).



Figure 3.3 Triune Brain Theory

3.4.1 Reptilian brain development

The reptilian brain or brain stem is the first to develop (Hannaford, 1995: 32; Silverman, 1974: 85; Fourie, 1998: 14; Jensen, 1994:22). Structures of the reptilian brain include the medulla, which controls respiration, digestion and circulation; the cerebellum, which governs balance, posture and muscular coordination; and the pons, which appears to contain nerve fibres from both sides of the cerebellum as well as the sensory and motor nerve networks that connect the upper brain to the spinal cord (Hannaford, 1995: 32; Silverman, 1974: 85).

The inner core / reptilian brain evolves from conception until 15 months (Smith & De Jager, 2001: 38) and is behaviourally primitive. This first layer is a survival machine without consciousness but with a few standard responses to situations (Ruch, 1984: 54). The reptilian brain monitors the environment through sensory input and then physically responds to ensure survival (Hannaford, 1995: 32).

Typical behaviour patterns are focussed on physical safety, territoriality, enough food, shelter, self- defence, ritualistic displays and reproduction (Smith & De Jager, 2001: 38; Jensen, 1994:22). It is instinctive, fast acting and survival-orientated. According to Hooper and Teresi in Jensen (1995: 14), the reptilian brain is wired to respond to archetypes, partial representations and the responses are reflexive. The brain stem area will tend to dominate behaviour under negative stress and is responsive to any threat. It wants to ensure that with intense negative stress, higher-order thinking skills are set aside in favour of rote and tried and tested behaviours, which will reflexively ensure survival (Jensen, 1994: 23).

Physical development is critical during this developmental phase (Smith & De Jager, 2001: 38) as the reptilian brain forms nerve networks encoded with sensory-motor based patterns on which life long learning will expand (Hannaford,

1995: 32). These forming nerve networks originate from billions of neurons in the central nervous system. They link all the senses (sensory) and muscle movements (motor) to “give us an understanding of the material world and our safety in it” (Hannaford, 1995: 32). Thus the reptilian brain links the input stage with the output stage in the three-step process creating an instantaneous feedback loop without focussing on the processing / cognitive stage. When learners are functioning optimally, clear messages are fed from all parts of the body to the brain and back again to the body “in a loop” (Promislow, 1998: 16).

Sensory stimulation and integration therefore forms the basis of the learning process.

3.4.1.1 The reptilian brain and near and far sensory development

The senses receive information from inside the body (near senses) and outside the body (far senses). The near senses include the proprioceptive system (muscles and joints, which supply feedback regarding position of body parts and how they are moving in relation to each other), the vestibular system (gauges where one is in relation to the world) and the kinesthetic ability (Bush, 2002: 22 and 23). The far senses include the sense of sight, vision, taste, smell and touch. (Edwards, 2000:23; Matties & Quirk, 2002:2).

To establish strong neurological networks to support the reptilian brain’s survival needs, the near and far senses must work together (Edwards, 2000:23) as stimulation and movement activities trigger the growth of the neural wiring throughout the body, “making the whole body the instrument of learning” (Hannaford, 1995: 13). A knowledge base or frame of reference depends on these intricately woven, yet separate multi-sensory percepts that are fused and utilised over and over again based on the sensory experiences. New learning occurs as new sensory experiences modify, change and expand creating ever more complex images of the world (Hannaford: 1995:31) and the self.

As stated earlier, when a baby is born it is not fully developed - movement and motor control is undifferentiated. During the early months of reptilian brain dominance, the baby is supported by reflexes to promote adaptation and learning through reflexive movement (Edwards, 2000: 16).

3.4.1.2 The reptilian brain and reflexes

Dennison (Dennison & Dennison 1985: 98) defines a reflex as the ability to act without conscious thought and with self-preservation as the primary motivation. Basson (2001: 9) defines a reflex as an involuntary or instinctive movement in response to a stimulus with the purpose of guiding the child through the developmental phases. Reflexes are essential for the baby's survival (primitive reflexes) and development (postural reflexes) (Edwards 2000: 16).

Primitive reflexes are automatic, stereotyped movements, directed from the brain stem and executed without cortical involvement making them essential for the baby's survival in the first few weeks of life (Edwards, 2000:26) The primitive reflexes only have a limited life span and having enabled the baby to survive the first hazardous months of life, they should be inhibited or controlled by higher centres of the brain. This allows more sophisticated neural structures to develop which then allows the infant control over voluntary responses (Edwards, 2000: 16; Basson, 2001: 16).

The primitive reflexes therefore lay the foundation for all functioning later on and the postural reflexes form the framework within which other systems can operate effectively. The transition from primitive reflex reaction to postural control is not an automatic one (Basson, 2001:11). There are no set times at which the later reflexes assert control over the earlier ones. It is a gradual process of interplay and integration during which both reflexes operate together for a short period of time. As certain movement sequences are performed over and over again, more mature patterns of response can supersede primitive reflexive response.

Inhibition of a reflex frequently correlates with the acquisition of a new skill. Thus knowledge of reflex chronology and normal child development may be combined, to predict which later skills may have been impaired as a direct result of retained primitive reflexes (Basson, 2001: 12). Detection of uninhibited primitive reflexes can help to isolate the cause of barriers to learning so that remedial training can be targeted more effectively.

If the reflex profile is only marginally abnormal, teaching strategies alone will usually be sufficient. Learners with a moderate degree of reflex abnormality may benefit from a combination of specialised teaching and motor training designed to improve balance and coordination. However, if a cluster of reflex abnormality exists, the learner will only be able to sustain long-term improvement after following a reflex inhibition programme designed specifically to treat the aberrant reflexes still present (Basson, 2001: 13).

Primitive reflexes thus provide rudimentary training for many later voluntary skills, but if these primitive reflexes remain active beyond six - 12 months of life, they are aberrant (not inhibited) and are indicators of a structural weakness or immaturity within the central nervous system. Depending on the degree of aberrant reflex activity, this poor organisation of nerve fibres can affect one or all areas of functioning, not only gross muscle and fine muscle coordination, but also sensory perception, cognition and avenues of expression (Basson, 2001:10).

Prolonged primitive reflex activity may also prevent the development of the succeeding postural reflexes, which should emerge to enable the maturing child to interact effectively with his environment. Primitive reflexes, retained beyond six months may result in immature patterns of behaviour or may cause immature systems to remain prevalent, despite the acquisition of later skills (Basson, 2001: 17-19).

Thus the fundamental equipment essential for learning will be faulty or inefficient

despite adequate intellectual ability. It is as if later skills remain tethered to an earlier stage of development and instead of becoming automatic, can only be mastered through continuous effort. This period of growth, change and elaboration operates rather like an interweaving spiral, through which nature ensures that primitive survival patterns are still accessible until such time as more postural reactions become automatic.

In summary, when a learner with poor sensory stimulation and integration perceives a threat, the body reflexively reacts releasing the hormone adrenaline from the adrenal glands. The adrenal glands are above the kidneys and adrenaline is immediately injected into the bloodstream, which speeds up the heart rate, depresses the immune system and prepares the body for flight or fight (Jensen, 1994:24; Hannaford, 1995: 54; Promislow, 1998: 45-46).

According to Meaney (1993: 332), increased adrenalin production causes the neurotransmitter cortisol to be secreted, which in turn decreases the ability to learn and remember. Survival reflexes thus always override pattern detection and problem solving, which has tremendous implications on learning. Survival reflex reactions result in “down-shifting” or “minimised” brain function (Jensen, 1994: 24), where all the areas of the brain are still used but there is a difference in the degree of involvement. The brain is then less capable of planning, judgement abilities, receiving information and other higher order skills and this holds many implications on learning as survival is the most important function of the brain. The reptilian brain dominates “our everyday lives in more ways than we can imagine” (Jensen, 1994: 26).

3.4.1.3 The reptilian brain and its implications on learning

Each time a learner reacts earlier stored reactions are actually being “re-triggered”, meaning that the survival brain has enormous implications on learning. Taking into account that the reptilian brain’s sole intention is survival - reaction is reflexively based on the neurological networks linking the acuity of the

senses with appropriate motor movement. In the reptilian brain these neurological networks lead to the reinforcement of typical behavioural patterns that are focussed on physical safety, territoriality, enough food, shelter, self-defence ritualistic displays and reproduction (Smith & De Jager, 2001: 38; Jensen, 1994:22).

Let us explore the learning implications linked to these behaviours:

Physical safety and self-defence

Defensive and aggressive behaviour are aimed at keeping people (Jensen, 1994: 22) and situations at bay. This state can be characterised by withdrawal / hypo-activity and a passive, lethargic and under-focused attitude. Alternatively it can be typified by uncontrolled behaviour like hyperactivity and an inability to focus and concentrate, which is also called Attention Deficit Disorder (ADD) (Smith & De Jager, 2001: 40) or more recently Attention Deficit Hyperactive Disorder (ADHD).

Real life sensory experience (the real thing) is conducive to learning from a survival brain perspective. In touching, exploring and discovering for themselves rather than sitting still and listening, learners are better able to build the sensory connections to enable them to learn and experience learning effectiveness and learner independence (Jensen, 1994: 26; Smith & De Jager, 2001: 40).

Reptilian brain response is also typically observed in the tendency to make plans to obtain food and shelter (legally or illegally) (Smith & De Jager, 2001: 40), rather than to concentrate on world history for example. The relevance of learning content is of importance here, as a learner will learn if it will impact on the ability to survive, as the human being depends on learning for survival. "If something will help you to survive you are motivated to learn" (Weiss, 2000: 6).

Territoriality

Territoriality refers to defending 'my stuff, my desk and my thinking'. It also refers to not allowing anybody to come near or touch the individual or his stuff. The

need for a safe environment leads to formation of groups with a clearly defined leader to intimidate others that are not “like them” (Jensen, 1995a: 22; Smith & De Jager, 2001: 40).

Ritualistic displays

Learners will focus on trying to gain the attention of peers (Jensen, 1995a: 22) to build their power base and sphere of influence. In the classroom learners functioning from the reptilian brain also prefer routine and rituals. Routine provides a secure and predictable environment in which they can develop the necessary skills to master the situation and experience success (Smith & De Jager, 2001: 40). An appropriate role model is also part of establishing a routine, creating security for the learner (Fourie, 1998: 14; Smith & De Jager, 2001: 40).

Reproduction

Mating rituals like flirting, touching and attracting others are another implication on learning (Jensen, 1995a: 22). The hormones are abundant and the sexual behaviour is reflexive. If an individual cannot read, write or remember the facts, they can still experience success on a physical level.

3.4.1.4 Summary of the reptilian brain

In summarising the reptilian brain, it is clear that the survival focus of the reptilian brain depends largely on the sensory integrative and reflex inhibiting functions of the input stage. The stimulation of the survival brain through interaction with the self, others and the world is primarily responsible for the physical, neurological, structural and muscular development of the child. When the physical body and all its substructures are sufficiently mastered, the focus shifts to mastering the three-dimensional world by establishing emotional relationships (limbic system) and developing abstract cognitive thought (neo-cortex) (Smith & De Jager, 2001: 38). Both the limbic system and neo-cortex depends on the reptilian brain for expression and thus the reptilian brain is called the action brain (Smith & De Jager, 2001: 40) linking the input and output stages of the learning process.

3.4.2 Limbic system development

The second layer superimposed on the reptilian brain is called the limbic system and develops between 15 months and four years (Smith & De Jager, 2001:38). It represents the evolved changes that mammals, unlike reptiles share (Ruch, 1984: 54) and acts as an intersection where the body and the mind meet (Hannaford, 1995: 53). The limbic system is thought to be the centre of emotion (Ruch, 1984: 659) and the “seat of emotions” (Pert, 1997: 134).

Pert (1997: 131) describes the term **emotion** as familiar human experiences of anger, fear, sadness; joy, contentment and courage as well as basic sensations such as pleasure and pain and the basic states that drive a person like hunger and thirst.

3.4.2.1 The structure of the limbic system

The limbic system is composed of several related areas like the amygdala, hippocampus, thalamus, hypothalamus and the pineal gland (Jensen, 1995a: 27). The structure of the limbic system is, according to Smith & De Jager (2001: 40) and Hannaford (1995:53), the amygdala, hippocampus, thalamus, hypothalamus and the basal ganglia.

The thalamus acts as the relay station for all incoming sensory input (Hannaford, 1995: 53; Ruch, 1984: 672) and relays the motor impulses from the cerebral cortex, via the brain stem to the muscles. It also interprets pain, temperature, touch and functions in emotions and memory.

The hypothalamus controls the pituitary gland, food intake, thirst and the body clock determining waking and sleeping states. It is also called the ‘mind-over-matter’ phenomenon allowing for unusual feats during emergencies (Hannaford, 1995: 53). The hypothalamus is involved in rage, aggression, pain and pleasure

and is central to the direction of motivated behaviours (Ruch, 1984: 656). The amygdala has links to the areas of the brain involved in sensory and cognitive processing (Hannaford, 1995: 54). According to Damasio (1994) in Hannaford (1995:54) the amygdala “allows us to assess a situation by coordinating bodily reactions that serve as internal warnings so we respond appropriately”. It is also involved in the patterning of aggressive behaviour and therefore sometimes surgical lesions are performed to reduce violent outbursts (Ruch, 1984: 646).

The hippocampus utilises sensory input coming through the thalamus and hypothalamus to form short-term memories and according to Ruch especially verbal memories (Ruch, 1984: 656). Short term memory with nerve connections in the hippocampus, can enter permanent stage in long-term memory throughout the brain (Hannaford, 1995: 54)

The basal ganglion connects impulses between the cerebellum and the frontal lobes, thus helping the body to control movements and therefore facilitate fine motor control (Hannaford, 1995: 54). It is also one of the structures that coordinate thought involved in planning the order and timing of future behaviours.

During the critical emotional developmental phase, between 15 months and four years (Smith & De Jager, 2001:38), the entire spectrum of emotions is developed through experience (Smith & De Jager, 2001:38). As with sensory development, humans are not born into the world with their emotions fully formed.

The neural networks supporting emotional processing are developed through social experience and expression (Hannaford, 1995: 57). Emotional bonds are thus formed that later serve as a basis for relationships and interaction. Therefore the limbic system can therefore also be called the relationship brain (Smith & De Jager, 2001:38).

3.4.2.2 The limbic system and its implications on learning

Typical behaviour patterns of this developmental phase are intense emotional responses, self-centredness, the development of “I”, daydreaming, neediness and dependency (Smith & De Jager, 2001: 40). The developed limbic system initiates the process of adding emotion to the patterns for sensory input and motor output, as developed in the reptilian brain and thus create first short and then long-term memories (Hannaford, 1995:57).

The combination of sensory-motor patterns and emotions (thus memories) provide the essential criteria on which rational decision-making is based (Damasio, 1994:199). When planning, strategising and reasoning, learners rely on stored knowledge (memories) which carries with it an emotional content, this enables an individual to firstly promote their own survival and secondly the survival of their society. “Without healthy emotional development of individuals, humans could not adequately become socialised and the values, rules and wisdom of the society would become lost” (Hannaford, 1995: 53).

Research in the neurosciences is assisting in explaining the importance of emotional development in understanding relationships, rational thought, imagination, creativity and even physical health (Hannaford, 1995: 50). According to David Gelernter in Hannaford (1995:50) “emotions are not a form of thought, not an additional way to think, not a special cognitive bonus, but are fundamental to thought”.

Learning occurs best when information is experienced in context, in relationship to everything else, and the emotions mediate this process. Emotional intensity assists in determining the priority focus, for example in favour of the individual’s needs or the group’s needs. Emotions assist the individual to become aware of what is personally important or of value and thus foster an intra personal relationship. In terms of interpersonal relationships, Hannaford (1995: 54) says socially everything one does stems from the basic need to be accepted. Emotions thus interpret experiences and shape perceptions of the world and the

individual's place in it. The development of the limbic system is therefore crucial for inter and intra personal relationships based on emotionally charged memories.

The limbic system is not only the catalyst in transferring sensory experiences to memory, or a barometer for determining importance to establish values and make choices, it is also a crucial component in motivation. The human being depends on learning for survival. If something will help the learner to survive they are motivated to learn. According to Caine in Weiss (2000: 6) "when rote memory can be connected with ordinary experience, learners understand and remember more easily". To transfer information effectively, learners need to see the relevance of what they are learning.

Motivation

The word motivation is derived from the Latin word *e movere* where the "e" means out/ out of and "movere" to move (Venter, 1989: 752). Motivation is thus a driving force resulting in behaviour, motion and action (Nel, Sonnekus & Garbers, 1965: 379; Venter, 1989: 752). According to Houston (1985: 6), motivation does not only initiate and direct behaviour, it also determines intensity and resilience. Ruch (1984: 661) describes motivation as the "forces or processes that initiate the behaviour, direct it and contribute to its strength".

Geoffrey Caine is quoted by Weiss (2000:6) as saying that when learners can connect rote memory with ordinary experience, they understand and make sense of things and remember them more easily. In order to transfer information from a perception to a memory, learners need to see the relevance of what they are learning. "Think of the brain as a machine for not merely filtering and storing sensory input, but for associating it with other memory events or stimuli occurring simultaneously along the way – that is learning" (Pert, 1997: 142).

The limbic system can therefore be seen as the glue that holds the entire system together from the bottom or reptilian brain, up towards the neo-cortex, as there is

a far greater number of neural fibres extending from the limbic system into the neo-cortex than there are from the neo-cortex into the limbic system. From this it can be deduced that the brain places priority on emotions over any other information and thus emotions are more important to the brain than higher order thinking skills (Jensen, 1995a: 27).

Smith (1999:26) expands on Jensen's notion that it is emotion filled experiences rather than logic that determine behaviour. If what is logically believed to be true does not correlate with what life experiences have taught the individual, the individual's behaviour will be directed by life experience and not by logic (Smith, 1999: 27).

This is due to the fact that behaviour is influenced and limited to what is stored in the mind and according to MacLean in Jensen (1995a: 29) that means that a learner must feel that something is true before it is believed. MacLean further states that "the limbic system, this primitive brain that can neither read nor write, provides us with the feeling of what is real, true and important". In the learning process, the engagement of emotions help the brain to know what it knows – which is true learning (Jensen, 1995a: 31).

Typical learner behaviour of an individual functioning from the limbic system is a highly emotional, self-centred and subjective individual who prefers learning through experiences and a sensory-motor / hands-on approach. Like the neurological structures supporting the senses, the emotions are developed through repetitive experiences of the same emotion (Smith & De Jager, 2001: 40) hence learners' preference for a relaxed, safe and nurturing environment in which to discover the relevance of the new information for themselves. They want to discover the learning embedded in the experience, not be told of such learning. "Increased learner self-confidence follows along with intrinsic motivation for future learning" (Jensen, 1995a: 32).

3.4.2.3 Summarising the limbic system

The limbic system and the development of emotions are the bridge between the reptilian brain and the neo-cortex. It forms the relationship between the reptilian brain's ability to receive input, the neo-cortex's ability to form and process cognitive thought and the reptilian brain's ability to apply / implement knowledge as an output by providing an emotional evaluation. This emotional evaluation determines if the new information has meaning, is important and relevant enough to be transferred to memory. The role of the emotions accounts for the times when the brain seems to fail to respond to new learning because of attending to a real or survival need.

When an individual learns naturally, the senses create emotions like curiosity and excitement that act as an electrical catalyst to the brain, causing the brain to respond by creating whatever mental capacity is needed to be successful at the new interest (Sunbeck, 1991: 9). A learner will thus be more motivated to learn and remember what was learned if the learning content has direct relevance to their short and long-term survival. "It is our innate drive to not only survive, but to thrive, prosper and be loved and accepted by other people, that charged our brains with all the electro-chemical energy needed to propel us into the third reality" (Sunbeck, 1991: 10). This third reality is MacLean's third part of the brain called the neo-cortex.

3.4.3 Neo-cortical development

According to Plato "We can only have opinions about things that belong to the world of senses. We can only have true knowledge of things that can be understood with our reason" (Gaarder, 1995:73). Our reason is the greatest gift of all and generally refers to the third superimposed layer of the brain called the neo -cortex. It is also called the cerebrum and is the part of the brain most often referred to as "THE brain" (Ruch, 1984:55).

The reptilian brain and limbic system are not replaced by the neo-cortex but

enhanced by it, leaving the reptilian brain and limbic systems functional. The neo-cortex is the last to develop and the critical development time is between four – 11 years. The neo-cortex is primarily responsible for systematic perception and interpretation that results in the forming of concepts, abstracts, intellect and cognition (Smith & De Jager, 2001:39).

The neo-cortex constantly integrates the senses, emotions and movement to create new associations and thus the neo-cortex is called the novelty part of the brain (Hannaford, 1995: 71). It is the part of the brain that thrives on input and variety. It is the communication amongst the sensory/emotional/motor areas of the brain that creates meaning from life experience.

3.4.3.1 The structure of the neo-cortex

The neo-cortex is the largest part of the brain and occupies the entire upper portion of the skull. It is composed of the most complex structures of the brain namely the cerebrum (Hannaford, 1995: 71; Ruch, 1984: 55; Silverman, 1974: 88, Smith & De Jager, 2001: 37).

The cerebrum is divided into two halves or hemispheres: the logic and gestalt hemispheres – each with its own characteristics and functions ranging from logic and critical analysis to creative problem solving (Hannaford, 1995: 71; Silverman; 1974: 89). The hemispheres are separated by a straight groove along the outer layer of the brain and connected by the corpus callosum (Hannaford, 1975: 78; Promislow, 1998: 74; Silverman, 1974: 88), which is composed of myelin-sheathed axons that converge in this area from several parts of the body (Silverman: 1974: 89).

Each hemisphere of the cerebrum contains four lobes, which are involved in creating the base patterns, which organise experience. The four lobes are the occipital lobes, the temporal lobes, the parietal lobes and the frontal lobes (Hannaford, 1995: 74; Ruch, 1984: 55; Silverman, 1974: 90, Smith & De Jager,

2001: 39).

The occipital lobes are responsible for vision. They receive sensory impulses from the eyes, interpret the shape, colour and movement (Hannaford, 1995: 75), recognise what is known (Smith & De Jager, 2001:39) and associate and evaluate the past to the present visual input (Hannaford, 1995: 74; Promislow, 1998: 75; Silverman, 1974: 93).

The temporal lobes focus on what is heard, associate it with stored input (Promislow, 1998: 75; Smith & De Jager, 2001: 39) interpret speech, gravitational input and smells (Hannaford, 1995: 74-75; Silverman, 1974: 93).

The parietal lobes interpret sensations (touch, pain, pressure, cold, heat and proprioception) in the brain without visual input (Hannaford, 1995: 75; Promislow, 1998: 75). They are also linked with spatial orientation and taste (Smith & De Jager, 2001: 39).

The frontal lobes are responsible for regulating movement, converting thoughts into words and controlling behaviour (Smith & De Jager, 2001: 39) through learned motor activities. They are also involved in voluntary scanning eye movements for speed-reading and inner speech (Hannaford, 1995:75). The frontal lobes are responsible for critical thinking, problem solving, planning and rehearsal (Promislow, 1998: 75).

All these lobes accept external stimuli and input from the opposite side of the body via the brain stem and limbic system. This input is then integrated, organised and reorganised with sensory-motor memory in the association and Gnostic areas of the neo-cortex, for new input to be meaningful and understood in context of past experiences (Hannaford, 1995:75).

Dennison (Dennison & Dennison, 1987: 66-67) calls the all-important middle stage of the learning process - the processing stage - the cooperative stage

where the left and right brain ideally work together in an integrated fashion. Both hemispheres are needed because each hemisphere perceives reality in an entirely different way and were never meant to work in isolation. In reality the responsibility for most tasks are shared by both hemispheres, with integrated streams of input crossing the corpus callosum from one to the other (Promislow, 1998: 74).

It is in combining the functions of the left and right brain that perceptions are formed and expressed through language. The responsibility of the neo-cortex is thus cognition and with that, the processing of knowledge, conception, analyses and synthesis (Fourie 1998:14).

3.4.3.2 Learning implications of the neo-cortex

The learning implications of an integrated neo-cortex are that of an individual whose behaviour and attitude towards learning is rational, objective, logical and systematic and who can work independently or in groups should the situation call for it. Such an individual is able to analyse and synthesise input creatively (Smith & De Jager, 2001: 41). Even when they fail to achieve the desired outcome they remain challenged (rather than give up) to learn from their setbacks and convert defeats into opportunities (Gardner, 1997: 15). They are independent and successful in most walks of life provided that the input through the senses flows freely from the reptilian brain, through the limbic system to the neo-cortex and back to the reptilian brain for implementation and application.

3.4.3.3 Summary of the neo-cortex

According to Jensen (1995:38) the entire triune brain system works as one and is chemically and electrically fuelled to produce the illusion of one brain. He also makes reference to the work of researcher Cloninger's way of summarising that the brain "runs our lives by the neo-cortex's quest for novelty, the limbic system's for pleasure and the reptilian brain's desire for avoiding harm". Each of the brain's structures is working for the overall survival of the entire system (Jensen, 1994:38). Fourie (1998: 14) summarises the impact of MacLean's triune brain on learning by stating that ideally education addresses all three layers simultaneously – through learning skills (reptilian brain), values (limbic system) and higher cognitive functioning (neo –cortex). He elaborates by saying that the more stimulated and integrated these three parts are, the more effective the learning process will be (Fourie, 1998:14).

In chapter 2 and chapter 3 it has been pointed out that even though learners have all the near and far senses as well as all the parts of the brain available to them, some of the senses and parts of the brain tend to develop more than others. This development is said to be the result of the interplay between innate

learning style preferences and environmental stimulation, which is triggered by the reflexes to propel a learner through the natural and sequential stages of development. The purpose of the developmental phases is to develop and connect “the body’s entire wiring system through the repetition of the same movements”. This process enables the brain and body to work together more effectively (De Jager, 2001: 13-14), assisting the learning process of a learner based on physiological (reptilian brain), emotional (limbic system) and cognitive (neo-cortex) development.

All learners are therefore born with the potential to develop their whole brain and all the senses. Irrespective of the vast amount of diversity in learning style preferences, frames of reference, sensory integration and language proficiency, the common denominator amongst all learners is the potential to develop, stimulate and access the whole brain state.

3.5 WHOLE BRAIN LEARNING

Whole brain learning is called the optimal learning state. It is the state “when your skills, attention, environment and will are all matched up with the task” (Jensen, 1994:174). Kruger (1999:104) defines whole brain learning as an approach to integrate all the dimensions of a learner – the physical, cognitive, emotional, social and spiritual dimensions in the learning process. Dennison (Dennison & Dennison, 1985:11) describes whole brain learning as a state where a learner is able to process information simultaneously with both brain hemispheres and where learners can “move and think at the same time, read with the writer’s hand, speak with the listener’s ear and commit to any task and bring the whole person to it”.

In terms of this study - **whole brain learning** means receiving input equally through sight, hearing and active participation, processing the sensory input simultaneously through the left and right brain while filtering the perceptions

through the emotions for appropriate and accurate verbal or active output.

It is thus clear that all learners are born with the potential to learn from a whole brain perspective and even though there are critical stages for developing the different “layers” of the brain, the brain has an unlimited potential to grow and develop. It is thus never too late to stimulate the learning apparatus (senses and brain and motor functions) to promote learning effectiveness.

3.6 FINDINGS AND CONCLUSIONS

In chapter 3 **learning** was defined as the innate ability to develop into a competent and independent person with the aptitude to observe, think critically, solve problems, express and apply new ideas and solutions.

The **learning process** was described as learners’ ability to learn and develop physically, emotionally, socially, linguistically, cognitively and spiritually based on their ability to take in information, assimilate information (thinking and feeling) and apply information through action or communication.

The development of the **learning apparatus** was described according to MacLean’s Triune Brain Theory and chapter 3 was concluded with identifying the common denominator amongst all learners as being their potential for whole brain learning.

In the quest to evaluate the effectiveness of Brain Gym it was important to establish a scientific model of learning. The content of chapter 3 indicated that the three-step learning process is a scientific model and forms the basis of all learning. This three-step process serves as the foundation for the remainder of the study. The implication of chapter 3 is that the ability to learn can be developed if attention is paid to all three steps of the learning process and in so doing promote whole brain learning.

The ability to promote whole brain learning can thus potentially contribute substantially to support the learners who were previously not achieving academic success.

CHAPTER 4

BRAIN GYM

4.1 THE CONTEXT FOR SELECTING BRAIN GYM AS A WHOLE BRAIN LEARNING TECHNIQUE

In chapter 3 the need for an approach to promote whole brain learning was identified. Brain Gym is claimed to be a technique that promotes whole brain learning and enhances learning ease, but despite the need for whole brain learning techniques and the fact that Brain Gym has been available in South Africa since 1992, it has not been accepted widely in the educational community. Ironically one of the reasons for the past unwillingness to utilise Brain Gym in schools, is that it is a simple technique and has been mistaken for an unscientific approach to whole brain learning and because it is viewed with scepticism it has stayed relatively unknown.

As Brain Gym can be beneficial to many learners who are experiencing learning difficulties (as discussed in chapter 2), it necessitates scientific scrutiny in chapter 4 through studying relevant literature. Attention will be paid to analysing the concept Brain Gym and how it works, describing the disciplines that Brain Gym was gleaned from, summarising the underlying philosophy and presuppositions of Brain Gym, studying the brain and body connection and its relationship to Brain Gym and noting the claims Dennison and other practitioners make about Brain Gym effectiveness.

To be able to scientifically evaluate Brain Gym as a technique to enhance learning effectiveness and learner independence, Dominance Profiles will be described as well as the link between Dominance Profiles and Brain Gym movements. Clarifying Brain Gym and Dominance Profiles provide a sound basis

from which to evaluate the claims made about Brain Gym and thus the relevance of developing and implementing a Brain Gym programme in schools.

Throughout this chapter Brain Gym will be evaluated against the criteria for learning effectiveness as set out in chapter 2 and 3. This critical evaluation will then serve to address the research question whether Brain Gym can promote whole brain learning and in so doing enhance learning effectiveness and learner independence.

In chapter 3 the importance of physical development as a prerequisite for emotional and mental development was illustrated based on MacLean's Triune Brain theory. It was indicated that physical development occurred through the child's physical interaction with the environment via the learning process of receiving input, processing the input and applying learning as output. The lack of learning effectiveness (as illustrated by the grade 12 exam results, feedback from educators and media reports) indicated a grave discrepancy amongst learner's ability to experience learning effectiveness in South Africa.

The discrepancies in the current reality in education are more alarming when viewed within the context of the educational authorities' vision for learners in South Africa. According to a statement by Professor Kadar Asmal, Former Minister of Education, the purpose of the Department of Education is to "provide quality education and ensure and promote educational excellence for all learners in the General Education and Training Board" (Asmal, 2000:1).

The vision and mission statement of the Gauteng Department of Education resonates with Asmal, reading: "Our vision is a smart service delivery of quality public education, which promotes a dynamic citizenship for socio-economic growth and development in South Africa" (Gauteng Provincial Government, 2000:1). The mission statement reads: "We will be at the cutting edge of curriculum delivery and provide access to quality life long learning opportunities. This will be shaped by the principles of transformation, equity, redress and Ubuntu" (Gauteng Provincial Government, 2000:1).

The dissonance between the intention of the educational authorities, the

institutions of learning and the reality of the effectiveness of learning on offer, necessitates a plan of action to address this situation. The challenge is to identify a programme, technique or model that would address the current situation effectively while at the same time is affordable, easy to implement and not rely on electronic equipment (as many schools do not have electricity).

Such a programme would also have to be basic in nature to address the developmental deficits that exist in many of the underachieving learners. As indicated in chapter 3, a well-developed physical level is the foundation of the emotional and mental levels and therefore to promote learning effectiveness a learning enhancement programme would have to focus primarily on the physical dimension and be secondary on the emotional and mental dimensions.

As a teacher and an educational consultant with 10 years experience in working with the physical movement based programme called Brain Gym, the researcher has found that Brain Gym is perceived as a possible solution to the current situation as described above. What makes Brain Gym a desirable choice is that it answers all the criteria of being effective, affordable, easy to implement and not reliant on electronic equipment. What makes it an even more appropriate choice is that it is a movement-based programme and throughout the world, health and physical education professionals agree that school-age children are less physically active than in previous generations.

“As a society, we are leading our children - our future - to a less active, more sedentary life. In school, their physical education, music and art time is being cut to squeeze in an extra ‘academic’ class - a typical attempt of a school to improve their student body’s test scores. The irony is that the test scores are not improving. In fact, there is little change from the days when children had gym classes and then would run home to spend time playing outside, instead of sitting in front of television, computer or video game screen. Now, when these kids get a little antsy in class, we label them with a disorder and try to fix them with pills when in reality we don’t look at the underlying problem - a lack of physical

stimulation. Movement is instinctive - it is natural" (Hendy, 2000:1). Paul E. Dennison (Dennison & Dennison, 1989:1), founder of Brain Gym, expressed the very same sentiments when he said: "Movement is the door to learning. To live is to move".

4.2 WHAT IS BRAIN GYM?

To define Brain Gym, like defining learning, is no simple task. In an attempt to define Brain Gym clearly, it will be described from an educational kinesiology perspective (Dennison), from a neuropsychological perspective (Hannaford), an educational perspective (Rossouw), an occupational therapist's perspective (Edwards), a mind-body perspective (Magidson) and lastly from a layman's perspective.

4.2.1 An educational kinesiology perspective

According to Dennison (Dennison & Dennison, 1989:i): "Brain Gym is a series of simple and enjoyable movements to enhance whole brain learning. The activities make all types of learning easier, and are especially effective with academic skills". Brain Gym is the registered trademark for a developmental movement programme established by Dennison, an expert in child sensory-motor development and consists of 26 simple task-specific movements to integrate the flow of information within the brain, restoring the innate ability to learn and function at top efficiency (Dennison & Dennison, 1989:I). It is based on Educational Kinesiology, the study of movement of the human body, as it relates to learning and expressing skills (Dennison & Dennison, 1989: I) and is used to "energise and keep learning channels open".

4.2.2 A neuropsychological perspective

Hannaford (1995:110) explains Brain Gym from a neurophysiological perspective

stating: “the mind/body is a remarkable system, with all the elements present for learning. Brain Gym appears to contribute the minor adjustments necessary to enable the system to proceed with the learning process”.

4.2.3 An educational perspective

Rossouw (1995:241) defines Brain Gym in her thesis on *The optimisation of the learning potential of the school beginner*, as “met Brain Gym word beweging, wat so natuurlik by die klein kind is, benut om die leerhandeling te optimaliseer deur aktiewe gereedheid vir die kind te bewerkstellig. Tydens enkele geselekteerde aktiwiteit vind integrasie tussen die verskillende dimensies van die brein plaas om sodoende optimale integrasie van leerinhoud te bewerkstellig”. Dennison in Bester (2001:22) elaborates on this, stating that Brain Gym specialises in furthering the integration of all the various dimensions of the whole brain and the body in order for learners to develop and utilise their potential as human beings.

4.2.4 An occupational therapist’s perspective

As an occupational therapist specialising in sensory integration, Edwards (2000:5) describes Brain Gym as a practical and dynamic approach to learning using simple, yet effective, movements to integrate the brain for whole brain learning. She further states that doing Brain Gym revitalises the body’s natural learning abilities, resulting in increased self-confidence while maximizing mental, physical and creative abilities. “Brain Gym creates stress free learning for both the teacher and the learner and is applicable to all learning situations” (Edwards, 2000:7).

4.2.5 A mind-body perspective

Brain Gym is seen by Magidson (2002:1) as one of the most powerful approaches for enhancing human development as it enables people of all ages, races and sexes to “overcome limitations, conflicts, fears, anxieties and many physical problems with relative ease and achieve an increased level of personal

success". She also states that Brain Gym empowers individuals to utilise their brainpower more effectively as it balances and integrates the whole brain resulting in stress release and improved performance.

Although Brain Gym was originally developed for children with barriers to learning, it has since proven to be effective and applicable for any difficulty as posture and balance in movement reflect the way we are thinking. Magidson (2001:1) further elaborates on this by saying "when you are balanced, you have the support of the entire mind-body system so that you automatically stop trying too hard or avoiding difficulties and approach them with more creativity, ease and confidence".

4.2.6 A layman's perspective

In layman's terms Brain Gym consists of simple movements similar to the movements that children naturally do during the first three years of life as they complete important developmental steps for coordination of eyes, ears, hands and the whole body to promote whole brain learning. These movements are easy and enjoyable and "bring about rapid and often dramatic improvements in concentration, memory, reading, writing, organising, listening, physical coordination and more, because Brain Gym develops the brain's neural pathways the way nature does: through movement" (Edu-K Foundation, 2000:www.braingym.org/about.html).

The happy, healthy child is physically, emotionally and socially fit. Through movement "key cognitive and motor skills are developed and the child is better prepared for the academic world, enriching not only each individual child, but also society as a whole" (Hendy, 2000:4).

Hannaford (1995:112) sums the definition of Brain Gym up neatly by saying "every learning situation deals basically with the same steps: sensory input, integration / assimilation and action. Brain Gym facilitates each step of the process by waking up the mind-body system and bringing it to learning

readiness. It activates full mind/body function through simple integrative movements which focus on specific aspects of sensory activation and facilitate integration of function across the body mid-line”.

4.3 THE FOUNDERS OF BRAIN GYM – PAUL E. DENNISON & GAIL E. DENNISON

Paul Dennison is a professional educator, a pioneer in the field of applied brain research and the author of the system of mind-body integration - known as Educational Kinesiology (Edu-K) (Dennison & Dennison, 1989:i). His discoveries are based on his understanding of the interdependence of physical development, language acquisition and scholastic achievement. His understanding grew out of his background in curriculum development and experimental psychology, which culminated in his doctoral thesis on ‘beginning reading achievement and its relationship to brain development’. “For 19 years, Dr. Dennison directed the Valley Remedial Group Learning Centres, helping children and adults turn their difficulties into successes” (Dennison & Dennison, 1989:i).

Dennison is the author of 13 books and manuals and the President of the International Edu-K Foundation.

Gail Dennison is Paul Dennison’s wife and co-author and has an extensive background in movement, dance and the arts. She developed the Edu-K Foundation newsletter *Brain Gym Journal* and heads the publication committee for the Edu-K Foundation (Dennison & Dennison, 1989:i).

4.4 THE MOTIVATION FOR DEVELOPING BRAIN GYM

According to Dennison (1981: 10) he developed Brain Gym for the kids who are described in a poem by Digby Wolfe:

Here's to the kids who are different
The kids who don't always get "A's"
The kids who have ears
twice the size of their peers,
or noses that go on for days.

Here's to the kids who are different;
The kids who are just out of step,
The kids they all tease,
Who have cuts on their knees,
And whose sneakers are consistently wet

Here's to the kids who are different;
The kids with a mischievous streak,
For when they have grown,
As history has shown,
It's their differences that make them unique.

Dennison developed Brain Gym to draw out the hidden potential in learners and make their potential readily available (Dennison & Dennison, 1989:1). He developed the Brain Gym movement programme to address learning difficulties that traditionally were approached by programmes that "better motivate, entice, reinforce or drill and stamp in learning" (Dennison & Dennison, 1989:1), because according to Dennison barriers to learning are not diseases. It is simply "crossed wires in the communication network which connects a child to his world" (Dennison & Dennison, 1981:6).

According to Dennison some learners try so hard that they switch off the brain integration mechanisms necessary for complete learning (Dennison & Dennison, 1989:1). Their systems then jam, similar to the process described by Jean Ayres in chapter 3 where information is received in the back brain as an "impress" but is

inaccessible to the front brain as an “express”. This inability to express what has been learned, locks learners in a failure syndrome, which is further compounded by today’s high pressure, competitive approach to education (Dennison & Dennison, 1981:6).

The solution to learning difficulties is whole-brain learning that enables learners to access those parts of the brain that has previously been inaccessible to them. Brain Gym is therefore “hope for the concerned parents and frustrated teachers of the ‘unteachable’ child” as it presents a revolutionary new approach to learning (Dennison & Dennison, 1981:6).

Even though Brain Gym was originally developed to address learning challenges, internationally, educators, learners, performing artists, athletes and the general public now use it to create positive changes and free movement in their lives (Promislow, 1998: 162).

4.5 HISTORY OF BRAIN GYM

A brief overview of the history of Brain Gym is relevant to this study to indicate the scientific basis thereof and to assist in the evaluation of Brain Gym as a technique to promote whole brain learning.

Dennison developed Brain Gym over a period of 25 years as an educational specialist (Edu-K Foundation, 2000: www.braingym.org/about.html). Dennison, an educator who himself had struggled with learning difficulties as a boy, started researching new ways of learning through movement. His tireless efforts and continued research for ways to help people learn more effectively resulted in the development of a unique system called Edu-K or the study of learning through movement (Edwards: 2000:7).

Educator John Holt, author of *How Children Fail*, inspired Dennison’s search in 1968. Seeking to give more personal attention to his students, as he was able to as a teacher, Dennison became an educational therapist and established his first reading clinic: the Valley Remedial Group Learning Centre in Studio City, California. His research in *reading* was based on Dr. Constance Amsden’s Malabar Reading Project and “his own childhood struggles with learning

disabilities” (Edu-K Foundation, 2001: www.braingym.org/about.html).

After observing the innovative movement work of Ray Barsch, Dennison studied the sensory integration work of Newell Kephart and Jean Ayres and introduced the use of rebounders in his sessions.

Being familiar with the breakthroughs of Drs. Doman & Delacato with learning-disabled learners, Dennison started exploring the effect of their programme, which consisted of creeping and crawling on the floor, on first-grade public school learners. He further routinely checked eye and hand dominance and began noticing patterns related to reading difficulties, which lead to Dennison publishing his first book called *Personalized whole Brain Integration* (Edu-K Foundation, 2001: www.braingym.org/about.html).

Many of his clients at his reading centres showed signs of visual stress. Dennison started combining his use of the rebounder with other eye-motility exercises such as tracking (left to right horizontal eye movements) and the ocular motility and ocular manipulation exercises used by developmental optometrists, resulting in reading improvement (Edu-K Foundation, 2001: www.braingym.org/about.html).

Dennison learned about the effect of the stimulation of the frontal eminences (later called the Positive Points) and muscle checking (a biofeedback mechanism) from Richard Tyler (a chiropractor) after he attended a workshop by George Goodheart, father of Applied Kinesiology (Edu-K Foundation, 2001:2: www.braingym.org/about.html).

Working with Dr. Louis Jacques, a leading pioneer in vision training, Dennison studied the importance of pointing the eyes and of visual recovery. His understanding of the interrelationship between movement and learning deepened while working with Dr. Samuel Herr, a developmental optometrist, who was associated with the optometric Extension Programme. Inspired by the work of

optometrist Dr. G.N. Gettman as described in his book *How to Develop Your Child's Intelligence*, Dennison implemented bilateral drawing (later to be called Double Doodles) (Edu-K Foundation, 2001:2). Dennison also created variations on the use of the infinity sign (later to be called Lazy 8) as a vision exercise and then built on a writing exercise to develop the Alphabet 8.

Drawing on the brain research done by Sperry and Ornstein with split-brain patients, Dennison realised the impact of the neurological development of auditory, visual and kinesthetic abilities on academic achievement. He received his doctorate and the Phi Delta Kappa award for outstanding research (Edu-K Foundation, 2001:2).

Following a course for optometric vision training, assisted by Richard Sowby, O.D., Dennison explored the use of contra-lateral movements to help learners align eye, hand and body midlines whilst hitting a ball (Edu-K Foundation, 2001:1). He went on to develop a personal self-improvement programme, including body therapies, movement training and long distance running with sports kinesiologist Bud Gibbs.

Dennison introduced Applied Kinesiology at the Valley Remedial Group Reading Centres as part of a longitudinal study to note how movement interventions impacted on learning (Edu-K Foundation, 2001:3). He did a course in Jin Shin Jyutsu and discovered that focus and relaxation are possible through applying pressure on acu-points on the body.

After studying with John Thie, father of Touch For Health, and again coming in contact with muscle checking, Dennison made “an intuitive leap” to use muscle checking as a teaching tool. He taught his first workshop for beginning reading to 15 teachers and wrote *Switching On: The Holistic Answer to Dyslexia*. “The enthusiastic reception of his work by adults with learning disabilities changes his focus to education of the adult population, which can, in turn, reach children at risk” (Edu-K Foundation, 2001:3).

Dennison studied natural vision improvement with specialist – Janet Goodrich and taught his first Edu-K course, where the crowd gave him a standing ovation in support of his innovative work and novel application of muscle checking (Edu-K Foundation, 2001:4). The word spread and in 1984 Dennison began teaching Edu-K internationally. Dennison's wife, Gail E. Dennison, added a few movements: Balance Buttons, Earth and Space Buttons, The Grounder, The Footflex and Belly Breathing. The Dennisons worked together to refine the Brain Gym movements, to write *Brain Gym* and to develop the basic training material, which they taught in Europe, Australia and New Zealand.

Brain Gym spread quickly and widely across the world due to its simplicity and because it is logical and appealed to people's common sense. The growing number of Brain Gym practitioners across the globe necessitated the formalisation of a working agreement and in 1986 the Educational Kinesiology Foundation was established as a non-profit public benefit corporation (Edu-K Foundation, 2001:5). In 1991 Brain Gym was recognised by a White House Task Force on Innovative Learning, as one of 12 exemplary programmes that model excellence in the classroom and have demonstrated effective results (Edu-K Foundation, 2001:6).

The above information describes the international situation and serves to provide a broader perspective regarding the standing of Brain Gym in the international community.

Brain Gym accidentally came to South Africa in 1992 (Edu-K Foundation, 2001:6) when Carla Hannaford visited a friend in Botswana. At that time Rita Edwards, an occupational therapist in Cape Town, contacted the Edu-K Foundation to enquire about Brain Gym and was put into contact with Hannaford, who made a detour to present the first Brain Gym course in South Africa. Since then more than 500 Brain Gym consultants have qualified and are practising in South Africa (De Jager and Basson, 2002:2).

4.6 AIMS AND OUTCOMES OF BRAIN GYM

Brain Gym is a learning readiness programme that physiologically prepares learners of all ages to practice and master the skills required for the mechanics of learning (Edu-K Foundation, 2001: www.braingym.org/faq.html) and it offers learners a self-directed system with which to address individual learning needs and build self-esteem through the successful mastery of skills (Dennison & Dennison, 1989:i).

This approach is in line with the learning process described in chapter 3 by firstly addressing the reptilian brain's need for patterning and mastering the patterning spontaneously, secondly by developing the limbic system and emotional reactions which form the basis of relationship building and lastly cognition and academic learning.

These skills are not developed in isolation but as the result of whole brain learning which was Dennison's primary reason for developing Brain Gym. Whole-brain means "the ability to access the brain and total self-organising system instead of self-inhibiting and compensatory system" (Dennison & Dennison, 1989: 3). The integrated (whole brain) learner is able to process information simultaneously with both hemisphere and respond emotionally - thus "move and think at the same time; read with the writer's hand, speak with the listener's ear, and commit to any task. In fact, the integrated learner thrives on the new, the spontaneous and the creative" where even the most simple undertaking becomes a joyful opportunity for self-expression (Dennison & Dennison, 1985: 11).

Brain Gym outcomes for learners are described in the official Edu-K Foundation document (Edu-K Foundation, 2001: www.braingym.org/about.html) as achieving a whole brain learning state with:

- increased self-esteem
- the ability to harness motivation
- skills to identify and avoid stress
- increased awareness of and respect for own intelligence, body and personal space
- unique tools for team building and for developing co-operation and co-creativity
- academic success.

4.7 HOW BRAIN GYM IS DISTINCTIVE FROM OTHER APPROACHES, THEORIES AND MODELS

Brain Gym is distinctive from other approaches/theories or models in that it addresses the physical rather than the mental components of learning (Edu-K Foundation, 2001: www.braingym.org/faq.html) and therefore prepares learners to learn (Edu-K Foundation, 2002:4). “The physical components of learning - the visual, auditory, fine motor and postural skills - have been almost entirely ignored by educators as is shown by the achievements and learning effectiveness of learners who had difficulties in the early grades. They rarely do better in later grades unless the physical cause or stress is addressed” (Edu-K Foundation, 2002:4) and since learning is measured by results rather than by processing, compensations are often developed and carried throughout a learner’s life.

Other than with many traditional approaches (that presumes that learning is a mental activity), in Brain Gym there is no perceived expectation about what needs to be learned or how it should occur, only a notion that all learners have latent potential and that it will naturally unfold given sufficient physical stimulation. The learner is approached as a whole person who “at any given moment has untapped potential related to underdeveloped movement patterns” (Edu-K Foundation, 2001: www.braingym.org/faq.html).

Brain Gym is said to enhance rather than replace any curriculum or therapy by focusing on the sensory-motor substructures supporting the emotional and mental processes. “Our philosophy has been one which accepts the learner as a unique, growing person who will learn when given a nurturing environment” (Dennison, 1981:12).

4.8 CLAIMS MADE ABOUT BRAIN GYM SUCCESSES

Many claims are made about Brain Gym successes ranging from emotional

stability to

improved health and vitality to academic excellence. If these claims were to be substantiated and thus valid, Brain Gym would be an appropriate technique to use in South African schools to address the increasing number of learners who are dependent on support to be academically successful.

Some of the claims are listed below to gain insight into the range and depth of potential benefits for learners doing Brain Gym:

- Brain Gym is the whole brain answer to dyslexia, because dyslexics try too hard to succeed. In so doing they switch off their peripheral information as they concentrate too intensely. “Dyslexics are simply experts at blocking energy” (Dennison, 1981: 35-36).
- Doing Brain Gym for a specific skill will allow the learner to immediately improve their behaviour and performance (Dennison & Dennison, 1989:i).
- When learners are introduced to Brain Gym “they seem to love it, request it and teach it to their friends and integrate it in their lives without any coaching or supervising” (Dennison, 1989:l).
- Brain Gym is said to activate the brain for crossing the visual, auditory and kinesthetic midline, left to right eye movements, improved binocular vision and eye-muscle coordination (Dennison, 1989:4.), hand-eye coordination, spatial awareness and visual discrimination (Dennison, 1989:5-6). It also activates the brain for symbol recognition and discrimination (Dennison, 1989:7), short and long-term memory as well as silent speech and thinking skills (Dennison, 1989:8 and 17). Additionally Brain Gym activates the brain for further relaxation of the central nervous system (Dennison, 1989:10), skills of attention and comprehension (Dennison, 1989:11), cranial rhythms (Dennison, 1989:12), maths and the mechanics of spelling and writing (Dennison, 1989:13 and 18).

This list can still be extended to include binocular vision and binaural hearing (Dennison, 1989:15), penmanship, cursive writing and creative writing (Dennison, 1989:18) not to mention expressive speech and language skills along with the ability to “follow through and to complete assignments” (Dennison, 1989:19) also called the ability to bring processes to closure (Dennison, 1989:20).

This is not a complete list of claims about the effectiveness of Brain Gym, but a selection of the skills that are relevant for the situation in schools in South Africa as described in chapter 2.

Brain Gym does not only activate the brain for many skills, it also has implications on behaviour and posture as described by Dennison (1989:4-32). Abdominal muscles are strengthened (Dennison, 1989:13); posture, breathing and voice resonance is improved (Dennison, 1989:14); the pelvis becomes more stable enabling learners to sit squarely in a chair (Dennison, 1989:11) resulting in an overall increased whole-body coordination (Dennison, 1989:8) ultimately leading to relaxation of eyes, neck and shoulders while focusing (Dennison, 1989:5). The sense of balance, equilibrium “especially in a moving vehicle”, relaxed jaw, tongue and facial muscles (Dennison, 1989:30) are further benefits derived from Brain Gym.

Rita Edwards (2001:6), an international faculty member for South Africa, lists the benefits of Brain Gym as follows: it creates stress free learning; can be done in less than 5 minutes with no special equipment; adapts well to any curriculum or learning style; activates balance in all areas of the brain - specifically both hemispheres and the frontal lobes; results are immediate, long-term and demonstrable and it is neurologically sound in its approach. She concludes that Brain Gym “facilitates the individual taking responsibility for learning, working and playing from an integrated whole system point of view, in an atmosphere that honours each persons’ unique and powerful abilities and potential”.

Many more claims are made that result in Brain Gym sounding “too good to be

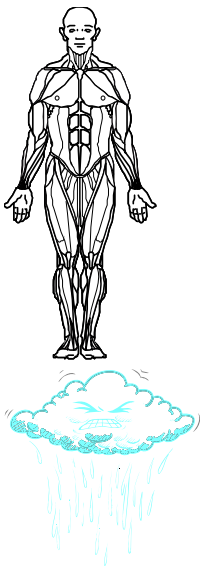
true”. The question arises that if Brain Gym is all it is claimed to be and can address the difficulties many learners are experiencing at present, why is it not used in all the schools already?

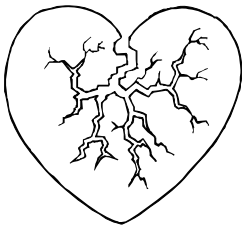
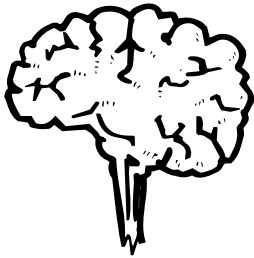
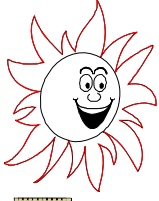
4.9 PROBLEMS IMPLEMENTING BRAIN GYM IN SCHOOLS

Implementing Brain Gym in schools is problematic due to many different reasons, but the main reason is that Brain Gym is relatively unknown. This is because those who have heard about Brain Gym often perceive it as frivolous exercises, simplistic, unscientific and New Age. Each of these reasons will be discussed briefly.

4.9.1 Frivolous exercises

The greatest obstacle to the widespread use of Brain Gym is the misconception that physical development has nothing to do with intellect, but according to Hannaford (1995: 112) “like the air we breathe, this particular misconception is taken in by nearly everyone as part and parcel of our cultural heritage. People simply find it hard to believe that physical activities can help you think”. The mistaken belief that exercises cannot improve learning has its origins in the belief that mind and body are separate, as seen in the following illustration derived from Jensen’s book *The Learning Brain* (1994:37):





$$E=MC^2$$

Figure 4.1 The old model versus the actual model of mind, emotions and body

Promislow (1998:18) addresses this misconception by stating that the actual reality of affairs regarding the mind, emotions and physiology is that mental perceptions and emotional feelings are deeply rooted in the physical body, which in turn underlies behaviour. That means that a change to any one of these three fused factors, irrevocably has a ripple effect on the other two. Change the emotion and expect a change in the physiology and perceptions. Change the perception and the emotions and the physiology follow. Re-educate the physiology and it has the power to alter emotions, perceptions and behaviour (Promislow, 1998:18).

A statement by Elmer Green, a Mayo Clinic physician, confirms the fusion of mind, emotions and body by saying that every change in the physiological state, is accompanied by an appropriate change in the mental and emotional state – conscious or unconscious (Pert, 1997:138).

Brink (1995:78) elaborates on the relevance of movement and exercise to optimise learning, when she states that exercise does not only strengthen bones, muscles, heart and lungs but also the basal ganglia, cerebellum and corpus callosum of the brain. As discussed in chapter 3 these parts of the brain are involved in the processing of information to produce appropriate learning output. “Not only does exercise stimulate different parts of the brain, it also increases the supply of blood to the brain and a coordinated series of movements produce increased neurtrophins (natural growth factors) and a great number of connections among neurons” (Brink, 1995:82).

Promislow (1998:20) further confirms the relevance of movement for learning by stating that “movement stimulates the “feel good” chemical messengers (Endorphins), which are the natural opiate manufactured by the body and of which production is stimulated by movement as the famous “runner’s high” confirms. Slow and deliberate cross-lateral movements also stimulate the production of dopamine in the frontal lobes (affecting the ability to learn faster), in

the limbic system (controlling emotional responses) and in the basal ganglia (intentional movement instead of reactional movement)". This is one of the neurotransmitters that millions of children with ADD (Attention Deficit Disorder) or ADHD (Attention Deficit Hyperactive Disorder), take Ritalin to balance. The educational implications are staggering. Targeted body movements and natural processes can be used to help enhance the manufacture, balance and transportation of informational substances (and the flow of subtle balanced energy) in the body.

4.9.2 Brain Gym is simplistic

Further hindering the promotion of Brain Gym is that the coordinated Brain Gym exercises seem too simple to do, because according to Hannaford (1995:112) "most of us put more faith in complex solutions to problems. If a programme is not hard, time consuming and costly, it seems to have less value". The problem is not that Brain Gym is not complex enough – the complexity of the substructure will be discussed in 4.10.1, the problem is that Brain Gym has been marketed internationally as simple movements that address all the results described in 4.7, without defining the supporting neurological and scientific substructure and thus the scientific validity of Brain Gym has been questioned.

4.9.3 Lack of scientific publications

Dennison, being primarily a teacher, travelled the world presenting seminars and addressing conferences. He self-published *Edu-K for Kids* (1984), *Brain Gym* (1986) and *Brain Gym Teachers Edition* (1989), which were all simple, fun books. In the words of Hannaford (1995:113) Dennison's "integrity, depth of understanding and love for children and for learning shine through in his elegant work, but unless one met and studied with Dennison, the complex substructure of Brain Gym was not perceived or understood".

Dennison did not publish further books other than workshop manuals and thus

the misconceptions about Brain Gym being too good to be true persisted in the minds of the general public.

The lack of scientific Brain Gym publications motivated Carla Hannaford and Sharon Promislow to address this problem. Carla Hannaford, a neurophysiologist, educator and Brain Gym consultant, addressed the problem regarding the simplicity and scientific validity of Brain Gym in writing *Smart Moves - why learning is not all in your head* (1995) and *The Dominance Factor* (1997). These two books were well received overseas by the scientific and academic community resulting in many studies on Brain Gym across the globe, but the problem of availability was not solved, as the books were not available in South Africa.

Sharon Promislow (1998) captured the attention of the general public in the United States and Canada with her book *Making the Brain Body Connection - a playful guide to releasing mental, physical and emotional blocks to success*. Promislow explained the brain and body connection referring to Brain Gym and Specialised Kinesiology.

The book was not widely available in South Africa and the kinesiology link bothered a meaningful percentage of the general public due to its supposed close connection with the Oriental medical practices as described by Promislow: "Kinesiology is defined as the study of the body in movement. Specialised Kinesiology teaches simple yet profound techniques from Applied Kinesiology, Acupressure, energy theory, current brain research, Neuro Linguistic Programming, chiropractic and body work, into an open-ended energy based model for re-educating the body's neural response to stress" (Promislow, 1998:17-18). Thus none of these three comprehensive books were freely available in South Africa, which compounded the misconception that Brain Gym is unscientific.

In an attempt to evaluate Brain Gym scientifically, the first experimental study on

Edu-K was undertaken by Ji Khalsa in 1986 on: *The effect of Edu-K on the static balance of learning disabled students*. Many learners undertook studies on Brain Gym worldwide and Josie Siftt, Ph.D., compiled them into a document titled *Experimental Research on Educational Kinesiology*. According to Dorothy H.L. Carroll, Ed.D. (author of the Introduction to this document) the studies included in the *Experimental Research on Educational Kinesiology* employed qualitative measures as teacher and researcher observations, language experience stories, researcher's retrospective as well as quantitative measures such as test scores, tests of visual-motor integration, etc. "Using such rich resources culled from actual learning and teaching contexts, the studies reported in this packet indicate that Brain Gym has a wide range of applications not only in the classrooms but in the wider educational community as well." (Siftt, 1992: Introduction).

A brief summary of five of the studies described in *Experimental Research on Educational Kinesiology* (Siftt, 1992), follows to indicate the scientific validity of Brain Gym / Edu-K:

1. *Effects of Brain Gym in a district wide field study, Canada* by Nancy McGovern a district physiotherapist for the Department of Special Services in British Columbia, Canada.

The purpose of this study was to determine the possible inclusion of Brain Gym movements in the curriculum for students labelled "learning disabled". Originally, nine schools, 12 teachers, 15 key learners and three "sensory-motor" groups were involved. 600 learners in total were involved. The evaluation comprised of perceptual tests, parents' feedback and teacher and learners' observations. Results indicated many improvements for individual learners and for whole classes.

2. *Effects of Edu-K on computer related eye and muscle strain* by Joan Spalding at the Mancato State University in partial fulfilment of the

requirements towards her Masters Degree.

The project was conducted over a six week period. The purpose of the study was to determine whether Edu-K, Brain Gym and Vision gym activities have an effect on eye and/or muscle strain or other physical symptoms, as generated by use of computer video display terminals. 10 subjects from age 29 to 50 years who use the video display terminal (VDT's) as a primary part of their work for four or more hours daily punctuated each hour of computer time with a five minute break of edu-K movements. Results indicated that computer breaks for Edu-k activities contributed to a lessening of visual and muscle-related stress, but had no measurable effect on other physical systems.

3. *Effects of Edu-K on academic and social skills of high school students* by Jeanette Primost, a high school teacher in Tel-Chai, Israel.

Primost undertook this study and saw pupils weekly for six or more sessions. She let the learners direct her as to what they needed, using the Edu-K balance format. Results indicated that seven out of 12 pupils benefited noticeably.

4. *Effect of combined Brain Gym and Mountaineering experiences on teen and pre-teen scholastic achievement* by George and Colleen Gardner, both teachers involved with a 14-day wilderness programme in Colorado, USA.

Pre and post test results from each two week programme suggested that most participants initially performed up to one grade level below their true potential. After learning and implementing the Brain Gym activities, participants were able to perform at an average level six to eight months higher.

5. *Effects of Edu-K in a remedial summer school programme* by Helen Cox at the Brimfield Public Grade School, Illinois funded by a Chapter 1 Federal Grant.

The programme was directed by Helen Cox, owner of Options in Health and Education Learning centre, and Dr. A. Milliren, author of reading and math programmes used. 'Results on Slossen tests showed greater increase in math and reading skills than would be expected in a six-week programme.

These studies indicated the scientific validity of the claims made about Brain Gym successes, but unfortunately this research document was not available in South Africa and hence the need for scientific research persisted.

Due to the persistent lack of scientific material in South Africa and as a result of 10 years of experience as a Brain Gym consultant who presented numerous seminars, workshops and radio talks on Brain Gym, the researcher was commissioned to write a book on Brain Gym for the South African market. The purpose of the book *Brain Gym for all* (De Jager, 2001) was to introduce the concept of Brain Gym to the general public and thus create an awareness of the potential value thereof for learners and educators.

A broader awareness was created, but the credibility of Brain Gym was still at stake due to accusations that Brain Gym is New Age, which still prevented the implementation of Brain Gym in schools in South Africa.

4.9.4 Brain Gym and New Age

The perception that Brain Gym is New Age is due to Dennison's original book *Switching On* (1981: 24) where he described Brain Gym in esoteric terms, for example: Brain Gym is about "Energy flowing in our Lifespace" and "as we learn

about Energy, active participation is mandatory. Many books have been written on the subject, yet few people understand this force. Call it Chi, Prana, Cosmic Energy or love” (Dennison, 1981:24).

This more esoteric metaphor for explaining Brain Gym was not well received by many people and gave rise to an anti-Brain Gym campaign by certain church pastors, which resulted in the misconception that Brain Gym is New Age.

In an attempt to address this misconception, the researcher published an article in the national Brain Gym Newsletter (De Jager, 2001a: 11) on *Brain Gym and new age*: “It must be stated emphatically that Brain Gym has nothing to do and can not be confused with religion. Brain Gym is simply a series of sensory-motor exercises based on the natural movements that kids do as they move through the developmental stages. These sensory-motor exercises develop the neural connections between the senses (sensory connections) and the brain and the limbs and muscles (motor connections) to perform simple tasks - the beginning of academic learning. Only once the senses, all the parts of the brain and the limbs are interconnected can a child become truly autonomous and independent”.

4.9.5 Summary of problems implementing Brain Gym in schools

Due to the perception that Brain Gym is frivolous exercises, is simplistic, unscientific and New Age – Brain Gym is viewed with scepticism, which limits its marketability. Therefore Brain Gym is unknown to the majority of educators, parents and not available to learners experiencing learning difficulties.

These stumbling blocks thus necessitated this study in order to evaluate Brain Gym scientifically within the South African context and to evaluate the claims made about Brain Gym successes prior to implementation in schools.

The logical next step in this study is to scrutinise the underlying philosophy and presuppositions of Brain Gym via a comprehensive literature study of Brain Gym.

4.10 HOW DOES BRAIN GYM WORK?

Brain Gym was defined in 4.2 as 26 exercises that activate full mind/body function through simple integrative movements, focussing on specific aspects of sensory activation and facilitating integration of function across the body mid-line.

The rationale for doing Brain Gym is based on the substructure called “Brain Organisation Profiles” by Dennison (Dennison & Dennison, 2000:ii); “Personal Brain Organisation Profiles” by Promislow (1998:33) and “Dominance Profiles” by Hannaford (1997:9). In this study Hannaford’s term “Dominance Profiles” will be used to describe the structure underlying the Brain Gym movements as it indicates a concept more comprehensive than a brain profile.

4.10.1 Dominance Profiles

A Dominance Profile is a model to describe the lateral dominance of the eyes, ears, hands and feet in relationship to the dominant brain hemisphere (Hannaford, 1997:10). Hannaford continues to state that these patterns of lateral dominance greatly influence the way that information is processed by a learner and consequently the kinds of learning styles and strategies that learners prefer. According to Dennison (Dennison & Dennison, 2000:5) “the profiles represent preferential profiles that delineate learning styles during new learning and homolateral access during stressful situations. These profiles supply us with useful information on how we initially take in, assimilate and process sensory information and then respond and express new learning”.

Dennison is emphatic that no judgement should be involved in any profile, as everyone has the capacity to learn and tends to learn in their own unique way, therefore the profile information is not useful for diagnosis, nor does it predict success, failure, or specific behaviour (Dennison & Dennison, 2000: 1).

4.10.1.1 The purpose of the Dominance Profiles

According to Dennison (Dennison & Dennison, 2000:1) the purpose of the profiles is to help learners, parents, educators and other professionals to understand behaviour that might otherwise be perceived as lazy, unskilful or unintelligent. When learners move and integrate “through the Brain Gym activities, these profiles turn into whole brain learning patterns. Then the Dominance Profile becomes of historical interest only and the organised profile now suggests giftedness”.

Therefore Dennison’s emphasis on not using profiles to label or be tempted to “simplify behaviour and name it in order to assess, quantify, and categorise”, because this kind of reductionism provides labels that tend to “describe” what learners cannot do. “I cannot justify categorisation or reductionism to explain a child’s behaviour. We must keep sight of the fact that these profiles are a construct only, useful within the context of a much broader and more intricate picture” (Dennison & Dennison, 2000:1) including heredity, frames of reference, nutrition and emotional climate.

Dennison (Dennison & Dennison, 2000:3) states clearly that the Brain Gym model (which includes the Dominance Profiles and Brain Gym movements) emphasises movement-based learning in which the sensory emotional context is more important than factual knowledge. He quotes from Daniel Coleman’s book *Emotional Intelligence* saying that: “ this new departure in bringing emotional literacy into schools makes emotions and social life themselves topics rather than treating these most compelling facets of a child’s day as irrelevant intrusions or when they lead to eruptions, relegating them to occasional disciplinary trips to the guidance councillor or the principals office” (Dennison & Dennison, 2000:3).

Hannaford (1997:10) summarises the purpose of the Dominance Profiles saying they provide constructive insight into the self and others in order to understand the unique strengths and challenges more objectively. These insights enhance

the possibility to be more successful in relationships, learning, work and play (Hannaford, 1997:11). Taking into consideration that this study is approached from a PPL perspective, it is thus clear that insight into the Dominance Profiles may contribute to improved intra and interpersonal relationships. Insight into learner differences and improved relationships can greatly influence the learning process and thus contribute to learner independence and learning effectiveness.

4.10.1.2 History of the Dominance Profiles

In 1969 Dennison began administering pen-and-paper evaluations and procedures to determine the educational profiles of adults and school age learners. He soon became aware of a great discrepancy between the standard diagnostic procedures of that time and the customary prescribed educational programmes (Dennison & Dennison, 2000:1).

Although it was standard procedure to make note of each learner's dominant hand, eye and ear, no allowance for these dominance patterns was made in the presentation of curriculum to learners and each learner, regardless of his profile, received the same programme.

Dennison knew that the greater number of learners at his centres (six of 10) were left-eyed, left-eared, or left-handed, yet no information was available from any research done on dominance, as to the significance of this (Dennison & Dennison, 2000:1).

He did some research on dominance and discovered that research had started in 1861 when Paul Broca, a French medical doctor, opened the door to studies of the brain and mind when he found that lesions, in the left hemisphere, inhibited the expressive use of speech (Dennison & Dennison, 2000:2).

In 1861 the acquisition of language was considered to be the single most important factor affecting intelligence and thus, Broca's finding was a

breakthrough in understanding the mystery of the brain. Consequently cerebral neurology was born, awakening researchers to the importance of mapping the functions of the brain by studying the effects of brain injury on performance (Dennison & Dennison, 2000:2).

The concept of cerebral dominance soon followed, describing the human brain as bi-hemispheric, while still assuming that the development of language was the dominant function that made humankind a unique species. "The dominant hemisphere was assumed to be the left one, where the speech mechanism (Broca's area) were discovered to be located. This 'left brain' was described as controlling purposeful movement as well as the development of articulated speech, while the other, 'minor' hemisphere (the right) was considered to have no significant function. Possibly this misconception was based on the fact that most research on brain organisation was limited to studies of subjects with serious disease or brain damage" (Dennison & Dennison, 2000:2).

Even though evidence was soon amassed that important qualities had to be attributed to the right hemisphere, the point of view that it is a lesser hemisphere have persisted in all but the most recent literature, as is evident by our cultural and academic emphasis on linguistic skills as opposed to those of art, music and dance (Dennison & Dennison 2000:2).

Current research shows that each brain hemisphere plays different and varied roles (Jensen, 1994: 16; Hannaford, 1997; Neethling, 1997; Fourie, 1998) in the achievement of those specialised functions that lead to higher I.Q. scores, as well as the ability to creatively apply learning to daily life skills, which is the more functional application of intelligence.

According to Dennison (Dennison & Dennison, 2000:1) there are at least three primary ways of identifying and mapping differences between the left and the right cerebral hemispheres:

- 1 The concept of hemispheric asymmetry emphasises left-and-right

cortical differences, as observed through correlated behavioural studies and through autopsies.

- 2 The idea of functional localisation focuses on areas of specialisation for specific skills, as confirmed by new science techniques such as PET (Positron Emission Tomography) scans or SQUID (Superconducting Quantum Interference Device) machines.
- 3 The language of dominance and learning styles identifies the learner's unique and preferred way of approaching new information, as mapped by educators using behavioural observation.

Dennison (Dennison & Dennison, 2000: 3) further states that: "While brain research has inspired many writers and educators to develop processes that enhance learning for children and adults, there is no universal agreement either on what constitutes optimal performance or on what role brain-organisation information, at our present level of understanding, might play in achieving such an end. Even with increasing research available to show that all functions of the brain are important to learning, an emphasis on the development of the left or language hemisphere and corresponding right-hand and right-eye dominance has held firm and still persists in the medical and educational communities. Further, the concept of dominance – that one side of the brain (the left), and corresponding physiology (the right eye and hand) ideally dominates (and even suppresses) the other side, probably remains at the core of the outmoded idea that learners must sit still and inhibit movement in order to assimilate new information".

Dennison's model of whole-brain performance – the ability to access the brain and a total self-organising system instead of a self-inhibiting and compensatory one – was developed to provide a new paradigm for understanding and interpreting brain research.

For the purposes of this study, the term "dominance" is used to refer to those patterns that have been reinforced through the learning experience and which

have become automatic over time (Dennison & Dennison, 2000:3). Until a learner discovers a more integrated whole-brain strategy, he will most likely approach any new learning experience from a one sided state – either from a logic brain or from a gestalt brain perspective.

Whether or not these dominant patterns are based on genetic tendencies or on environmental factors, they most often manifest as learned habits of compensation (Dennison & Dennison, 2000:3). “These static dominant preferences are related to unilateral functions (of the eye, ear, hand, leg, and brain) in the centrally focused state, for example, for such tasks as reading and writing. In every case, success in this one-sided approach creates poor learning habits in which automatic, bi-hemispheric function and its corollaries of mental, physical and emotional health and well being, becomes less accessible” (Dennison & Dennison, 2000:3).

Dennison’s contribution to the existing body of knowledge on dominance lies in his distinguishing between two different approaches to learning – whole-brain functioning versus logic or gestalt functioning. Dennison (Dennison & Dennison, 2000: 4) claims that when learners are integrated for whole-brain learning, they experience dramatic shifts in their functional style of learning. He also claims that they become whole-brain learners by using Brain Gym to strengthen bilateral functions and the ability to work easily in the midfield, where the two hemispheres ideally correlate left and right visual, auditory, tactile, and kinesthetic information.

According to Dennison (Dennison & Dennison, 2000:4) “in the whole-brain state, the learner approaches a new learning experience with both eyes, both ears, both sides of the brain, and the whole body in a state of learning readiness. Now the dominant specialisations that were previously developed can become truly useful in the cooperative, integrated state. The learner no longer needs to rely on learning strategies geared to his/her compensatory learning preferences. He/she is able, instead, to access with ease a full range of abilities, in many situations –

even those that emphasise the visual, tactile, auditory, or kinesthetic mode to the exclusion of the other senses”.

According to Dennison (Dennison & Dennison, 2000:4) “when learners learn from a whole brain perspective, their Dominance Profiles become a useful description of ‘how I used to learn’ or ‘how I may behave when I am under undue pressure (either internal or external) to perform’ ”.

4.10.1.3 Dominance Profiles - the model

“We are all uniquely wired. Our specific life experiences shape our perceptions, they way we learn and in essence who we are. Some of our neuronal wiring is determined by innate factors” (Hannaford, 1995:178) and constitute individual learning styles.

Dennison developed a method to gauge and characterise individual learning styles based on genetic Dominance Profiles that identify the lateral dominance of the eyes, ears, hands and feet in relationship to the dominant brain hemisphere (Hannaford, 1995: 178; Hannaford, 1997:10).

Dominance Profiles not only provide information on preferred learning styles, they also provide information on stress responses as “we rely most on our dominant senses and our preferred ways of processing” in moments of stress (Hannaford, 1995:178).

The Dominance Profile distinguishes between information reception, processing and application (De Jager, 2001: 24) as is illustrated in table 4.1.

Table 4.1 Structure of the Dominance Profile

<i>A. Information received</i>	<i>B. Processing of raw data</i>	<i>C. Information application and implementation</i>
<ul style="list-style-type: none"> •1 Eye - left/right •2 Ear - left/right 	<ul style="list-style-type: none"> •1 Brain hemisphere Left (logical) or Right (gestalt) 	<ul style="list-style-type: none"> •2 Hand – left/right •3 Foot - left/right

The structure of the Dominance Profiles is compatible with the three-step learning process as described in the Information Processing Approach theory discussed in chapter 3. Both the learning process and the Dominance Profile recognise **information input** via the senses, **information processing** in the logic and gestalt brain hemispheres and **information application** through output.

As one of the criteria for scientific validation is the compatibility of new contributions with existing and accepted models, it thus indicates that the Brain Gym model of Dominance Profiles is answering to one criterion for validation as a scientific model.

The Brain Gym Dominance Profile is determined by five paired variables, called variables because it is the differing parts that together constitute the learners preferred way of receiving information, processing information and applying information (De Jager, 2001: 24).

Bearing in mind that the optimal learning state, as indicated in 3.5, is the whole brain state (Jensen, 1994:174; Kruger, 2000:104; Dennison & Dennison, 1985:11), the Dominance Profile is the result of research that has shown that people are born with the potential to utilise the whole brain state, but have a tendency to prefer the use of one side of the brain more than the other side, resulting in a more logical or more gestalt approach (Jensen, 1994: 16; Hannaford, 1997; Neethling, 1997; Fourie, 1998; Dennison & Dennison, 2000:1-3). The difference between these two approaches needs to be described for a solid base to be established prior to the interpretation of the eye, ear, hand and foot dominance.

The Brain Hemispheres

As Broca (Dennison & Dennison, 2000:2) and later Sperry's split-brain research (Bester, 2001:11; Dennison & Dennison, 2000:2) has shown, the brain is composed of two distinct hemispheres - each hemisphere develops and

processes information in a specific manner (Hannaford, 1997:18). The right hemisphere controls the left side of the body and the left hemisphere controls the right side of the body as the nerves cross over from the controlling brain hemisphere (Jensen, 1994:73). When one side of the brain is in control, the other side either co-operates and co-ordinates its movements with the controlling hemisphere, or it may “switch off” and block integration (Dennison & Dennison, 1985:8) and therefore may result in learning difficulties.

The two hemispheres perceive the world from two entirely different perspectives - either as a whole (through the gestalt hemisphere) or one piece at a time (through the analytical hemisphere) (Dennison & Dennison, 1985: 8; Hannaford, 1997:18). The awareness of what one knows depends upon the dominant hemisphere (Dennison & Dennison, 1985:9). Dennison proceeds to state that although neurologically more complicated, the metaphor of the gestalt/receptive view of reality and the expressive/analytical view of reality as two distinct systems can help understand and make changes in function.

Even though the hemispheric differentiation is well known in terms of left-brained and right-brained, in this study the terms logic and gestalt brain will be used as some people are said to be transposed and process their logic on the right and their gestalt functions on the left (Hannaford, 1997:18).

It is estimated that for 80 to 90 percent of the population, whether right or left handed, the managing centre for the coding of analytical, inductive (parts to whole) information for functions such as logic, speech, motor control, visual or auditory construction and fine motor manipulation is in the left hemisphere (Dennison & Dennison, 2000:8). “It is also critical, judgemental and acutely aware of time and survival” (Dennison & Dennison, 1985:9). This is the hemisphere that usually harbours the ability to make distinctions, to learn new skills and to refine experience and expression.

For the same 80 to 90 percent of the population the centres for coding of gestalt

and spatial perceptions are found in the right hemisphere “although the brain’s holographic nature allows for a great deal of variability” (Dennison & Dennison, 2000:8). It is the gestalt hemisphere that usually houses the ability to see the big picture, hear music, make associations, pick up on non-verbal communication and use language to express feelings (Dennison & Dennison, 1985:9; Dennison & Dennison, 2000:8; Hannaford, 1997:20).

Only 80 to 90 percent of the population is accounted for by the functions described above, the other 10 to 20 percent seem to be transposed and process the logic functions on the right and gestalt functions on the left (Hannaford, 1997:18; Dennison & Dennison, 2000:8). For purposes of clarity, the researcher therefore distinguishes the different hemispheres by function, using the terms **logic and gestalt** rather than **left and right**. The following table lists the different characteristics between the logic and gestalt hemispheres as described by Hannaford (1998) and Dennison (2000).

Table 4.2 Logic and gestalt characteristics

Logic

Processes from pieces to whole
 Parts of language
 Syntax, semantics
 Letters, printing, spelling
 Numbers
 Analysis, logic
 Looks for differences
 Controls feelings
 Language oriented
 Planned, structured
 Sequential thinking
 Future oriented
 Time conscious
 Structure oriented

When under stress

Tries harder, lots of effort

Gestalt

Processes from whole to pieces
 Language comprehension
 Image, emotion, meaning
 Rhythm, dialect, application
 Estimation, application
 Intuition, estimation
 Looks for similarities
 Free with feelings
 Prefers drawing, manipulation
 Spontaneous, fluid
 Simultaneous thinking
 Now oriented
 Less time sense
 People oriented

When under stress

Loses the ability to reason well

Without results	Acts without thinking
Without comprehension	Feels overwhelmed
Without joy	Has trouble expressing
Without understanding	Cannot remember details
May appear mechanical, tense, intensive	May appear emotional or spaced-out

The logic hemisphere processes input from pieces to form a whole in a linear manner. This hemisphere deals with the pieces of language (alphabet, words, syntax, spelling) and has been referred to as the language hemisphere (Hannaford, 1997:19). It deals with numbers in a linear manner and prefers step-by-step instructions when learning a new skill. It appreciates symbols and abstract reasoning, is rational, intellectual and objective (Fourie, 1998:19). Dennison (1981:89) also allocates convergent and digital thinking and a tendency to stress and being more introverted to the logic hemisphere. De Jager (2002:28) describes logic brain processing as being perfection driven, neat and organised.

The gestalt hemisphere processes input from the whole to the pieces in a contextual manner to promote comprehension (Hannaford, 1997:21). This hemisphere processes through image, rhythm, movement and emotion. The receptive gestalt brain is responsible for long-term visual memories, orientation in space, tone, body awareness and artistic abilities. "It perceives information passively without judgement or a sense of limitation" (Dennison & Dennison, 1985: 9). Fourie (1998:19) adds the intuitive, non-verbal and subjective aspects of the gestalt hemisphere. This hemisphere has also been referred to as the creative brain because of its spontaneous and curious nature (Hannaford, 1997:21).

Due to the fact that the left brain controls the right side of the body and the right hemisphere the left side (Jensen, 1994:73), all the sensory-motor functions correspond with the opposite brain hemisphere. Thus the left brain controls all sensory-motor functions on the right side of the body and all the sensory functions on the left side of the body are controlled by the right brain.

Hence the right ear for example communicates with the left hemisphere and the left ear with the right hemisphere. “Given the tendency towards hemispheric dominance, it is not surprising that we prefer those sensory-motor functions that are facilitated by our patterns of lateral dominance. Those senses and motor functions where the dominant eye, ear, hand and foot is on the opposite side of the body from the dominant hemisphere, communicate more effectively with the brain even in times of stress” (Hannaford, 1997:21).

Both hemispheres are needed for optimal learning. Even though the logic hemisphere is considered the language brain, the comprehension function of the gestalt brain is needed to benefit from full language function (Hannaford, 1997:23). The same applies to creativity - though the gestalt brain is considered the creative brain, it requires appropriate technique and discipline from the logic brain to be highly creative (Hannaford, 1997:23).

Therefore when learners are fully integrated and functioning from a whole brain perspective, they are able to receive input from both eyes and ears, process input with both hemispheres and respond with both hands and feet (Dennison & Dennison, 2000:5; Hannaford, 1997:25; Hannaford, Dennison, Dennison, Metcalf, McGee & Miekka, 2000:5). Bilateral (left and right) integration and processing is thus the purpose of education programmes optimising potential, coaching and training (Fourie, 1998:9).

But when experiencing stress, a learner reverts to their survival brain (Jensen, 1994:25-26) and to the enrooted and ingrained reactive patterns as discussed in 3.4.1 on the development of the reptilian brain. The Dominance Profile is such a survival pattern and therefore limited (compared to the integrated whole brain state), which results in reliance on the dominant eye, ear, brain hemisphere, hand and foot in order to respond to a situation.

This tendency to respond from the limited survival profile / Dominance Profile, necessitates a description of the differences between the left and right functions

of the eye, ear, hand and foot.

Table 4.3 Differences in vision for gestalt dominant and logic dominant learners

GESTALT EYE sees:

- 1 Reads from right to left
- 2 Doesn't like words and numbers therefore doesn't like reading
- 1 Looks at the whole/ big picture
- 2 Looks for meaning
- 3 Looks creatively at what can be
- 4 Looks at colour and form
- 5 Focuses more easily on distance than nearby on book
- 1 Image, patterns, big picture
- 2 Emotion
- 3 3 dimensional
- 4 Colour
- 5 Future possibilities

LOGIC EYE sees:

- 1 Reads from left to right
- 2 Devours words and numbers, therefore likes reading
- 1 Analyses
- 2 Looks at detail
- 3 Looks for accuracy
- 4 Looks critically at what is
- 5 Looks at line and symmetry
- 6 Focuses more easily on book nearby than at a distance
- 1 Specific
- 2 Linear sequencing
- 3 2 dimensional
- 4 Puts vision in context of the past

Table 4.4 Differences in hearing for gestalt and logic dominant learners

GESTALT EAR listens:

- 1 Creatively
- 2 To intonation
- 3 To HOW things are said
- 4 Emotionally
- 5 Subjectively
- 6 Far and wide, hears everything
- 7 With intuitive empathy
- 8 Generalises information
- 9 To the story
- 10 To understand
- 11 Hears: rhythm
- 12 Perception
- 13 Patterns

LOGIC EAR listens:

- 14 Logically
- 15 Analytically
- 16 To WHAT is said
- 17 Systematically, point by point
- 18 Objectively
- 19 Focused
- 20 To word order and sentence construction
- 21 To information - breaking it down into smaller parts
- 22 To the facts
- 23 To remember
- 24 Lyrics of music / specific notes

Table 4.5 Differences for gestalt and logic access to the dominant hand

GESTALT HAND expresses

- 1 Free movement
- 2 Bold, fluent writing
- 3 A creative writing style
- 4 Figures of speech, emotion and meaning
- 5 Unlined paper
- 6 Drawing and touching
- 7 To supplement language with gestures
- 8 Manual hands-on learning
- 9 Emotionally and physically expressive
- 10 Communicates in metaphors and stories

LOGIC HAND expresses

- 11 Fine motor movements
- 12 Neat and precise writing
- 13 Structured writing style
- 14 Attention to syntax and semantics
- 15 Lined paper
- 16 Writing
- 17 An extensive vocabulary and is well spoken
- 18 Takes notes
- 19 Exact communication
- 20 Careful with details
- 21 Needs to talk to learn

Table 4.6 Differences for gestalt and logic access to the dominant foot

GESTALT FOOT acts:

- 1 Freedom of movement
- 2 Giant leaps
- 3 Variety and change
- 4 Impulsive actions
- 5 Fluidity of movement
- 6 Moves with emotion
- 7 Rhythmic
- 8 spontaneous

LOGIC FOOT acts

- 9 Precise and controlled movement
- 10 Controlled and accurate actions
- 11 Consistency
- 12 Conservative approach
- 13 Technique
- 14 Planned movements
- 15 Step by step

4.10.1.4 Interpretation of the Dominance Profiles

To describe the Dominance Profiles in a logical manner, the learning process or sequence of input, processing and output, will be followed and graphically indicated on the Dominance Profile Diagram.

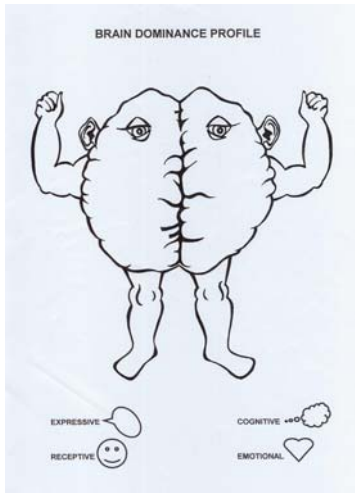


Figure 4.2 Dominance Profile diagram

A. INPUT

Sensory input is received via the eye, ear and to a lesser degree the hand. The efficiency of input depends upon whether or not the dominant eye, ear and hand are on the opposite side of the dominant hemisphere (Hannaford, 1995:180).

Visual input

Visual input is received from the dominant eye representing the dominant eye

field. The view of the eye field is interpreted in the brain where perceptions are formed. According to Hannaford, (1997:23) only 4% of vision is actually received through the eyes, the other 96% is “manufactured in our brains using integrative information from our memories and all our senses”.

The dominant eye determines how visual input is processed depending upon which hemisphere the dominant eye communicates with (Hannaford, 1997:24). Logic eye dominant learners will only process details and disregard the bigger picture and gestalt eye dominant learners will look at the bigger picture and disregard the details. This information translates in the classroom situation as gestalt eye learners preferring graphs, pictures and mind maps and the logic eye dominant learners favouring visuals with words presented in a systematic and linear manner (Dennison & Dennison, 2000: 27; Smith & De Jager, 2001: 20).

Eye dominance is important for reading. In normal eye teaming the dominant eye leads the tracking direction of both eyes (Hannaford, 1997:26). Due to the tracking direction of the left eye (right eye field), the left eye dominant learners may be challenged to read and spell accurately or with ease, as their eyes naturally track from right to left (Smith & De Jager, 2001:20) and so they are inclined to look at the right side of the page first and then track/read towards the left. The right eye dominant learners' eyes naturally track from left to right and thus they are naturally skilled at reading accuracy.

To expand on the implications of left and right eye dominance, it is important to note that nerve ways connect half of the visual field to each hemisphere. Feedback via the corpus callosum from the other hemisphere is necessary for efficient processing of input.

For the 80 to 90 percent of learners who have their logic on the left and gestalt on the right, the logic brain receives input directly from the right eye via the corpus callosum and indirectly from the left eye. For the same learner population, the gestalt brain receives information directly from the left eye and indirectly from

the right eye (Dennison, 1981: 84). The result of this process on reading, writing and spelling is letter and number reversals and therefore inaccurate visual representation, which leads to poor academic achievement.

When the dominant eye (left or right) is on the same side as the dominant hemisphere, “when attempting to learn challenging information, learners may not actually look at the educator. They may even shut their eyes in order to concentrate on verbal information more effectively, especially if their ears are facilitated by their dominance patterns” (Hannaford, 1997:25).

The one eye is not better than the other, it is simply more appropriate for certain functions and as this study focuses on how to enhance learning effectiveness and learner independence, the implications of a left eye dominance is crucial in the later evaluation of Brain Gym effectiveness in promoting whole brain learning.

Auditory input

The ears conduct auditory input to the brain enabling learners to hear and listen to input from the environment (Hannaford, 1997:26) as well as their own thoughts. In the integrated state, sound is received from both ears and interpreted in both brain hemispheres. Auditory input is then integrated with memory and input from all the other senses to provide auditory perception and analysis of the world (Hannaford, 1997:26).

There is a distinctive asymmetry in the nerve networks leading from each ear to the brain hemisphere (Dennison & Dennison, 2000: 28; Hannaford, 1997:27) and due to the asymmetry, the right ear primarily sends input to the left hemisphere while the left ear primarily directs input to the right hemisphere.

Therefore the gestalt ear dominant learners preferentially listen for the overview, metaphor, story, and underlying emotion and the logic ear to exact details in sequence (Dennison & Dennison, 2000:29; Hannaford, 1997:27; Smith & De Jager, 2001:20). The implications in the classroom are that gestalt ear dominant

learners may miss detailed input and often have to ask for information to be repeated. Because they are astute at perceiving emotional undertones, they may process the meaning of the emotional undertones prior to perceiving factual input, which leads to learner behaviour being misunderstood (Smith & De Jager, 2001:20).

B. PROCESSING

During times of stress or new learning, the non-dominant brain hemisphere tends to radically decrease its functioning, leaving the dominant hemisphere to carry its primary function (Hannaford, 1997:22). Thus during times of stress the dominant senses on the opposite side of the dominant hemisphere will be adept at processing and those on the same side as the dominant hemisphere will be limited in function. Dennison (Dennison & Dennison 2000:25) identifies three types of processes as a result of dominance: uniform processing, one-sided processing and mixed processing.

Uniform processing indicates dominance of one side of the brain (either left or right) and the dominant eye, ear and hand on the opposite side (Dennison & Dennison, 2000:25).

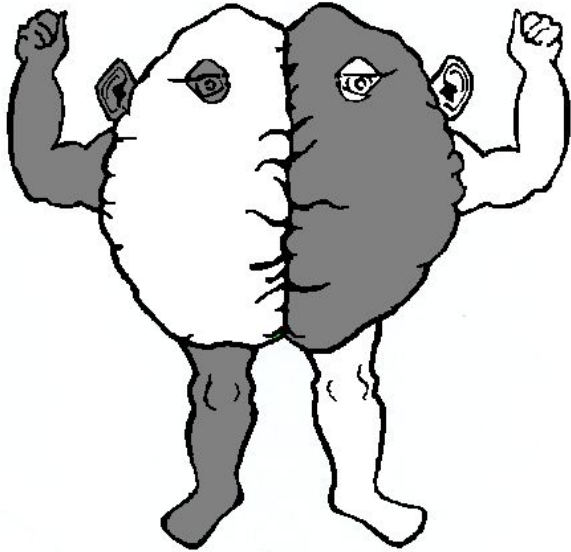


Figure 4.3 Uniform processing

One-sided processing (previously called blocked processing) is defined as dominance of one hemisphere and all sensory channels on the same side as indicated on the diagram below. To access the dominant eye, ear, hand and foot, the dominant hemisphere must often “switch off” the corresponding part of the personality that feels most authentic (Dennison & Dennison, 2000:25).

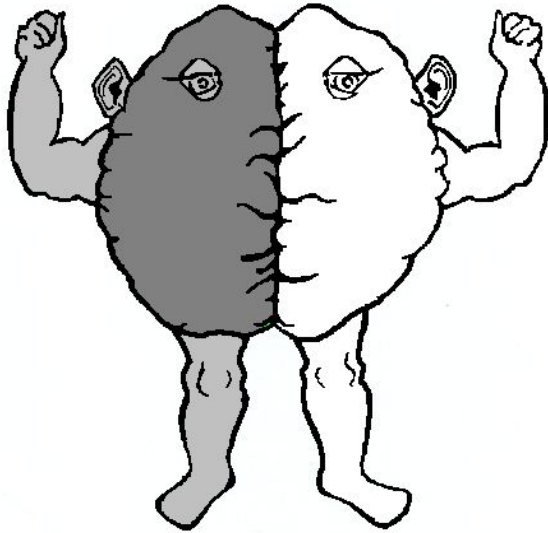


Figure 4.4 One-sided processing

Mixed processing is a term used to describe dominance of one hemisphere (either left or right) with one or two of the dominant functions for vision, audition or fine motor movement on the same side and one or two of the dominant functions on the opposite side (Dennison & Dennison, 2000:25).

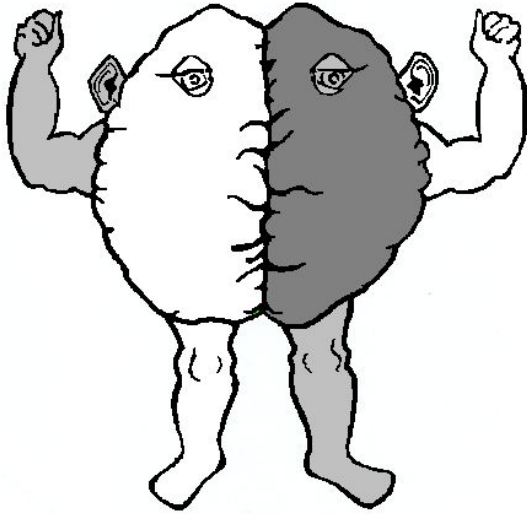


Figure 4.5 Mixed processing

C. OUTPUT

Output is represented by the dominant hand and foot. The hands represents the means of expressing learned knowledge through verbal and written communication as well as in action through fine motor control (De Jager, 2002:30). "PET scans of the brain show that when a person is speaking, there is increased activity in the area of the brain associated with hand movements -

motor and sensory cortex of the neo-cortex” (Hannaford 1997:28), the thumbs are particularly lit up when speaking (Promislow, 1998:131).

Hannaford (1997:29) expands on the link between hand dominance and expression stating that the patterns of dominance for the brain hemisphere and the hands directly influences how learners express themselves. “Most of our communication is with our body and not our words. So if neural communication between brain and hands is compromised, it makes all communication including vocalisation more difficult” (Promislow, 1998: 131).

Learners whose dominant hand is opposite to their dominant brain hemisphere are verbally able, but learners with their dominant hand on the same side as their dominant brain hemisphere are verbally limited when stressed (Hannaford, 1997:29).

The foot reflects the decision-making and stepping into a new situation preference (De Jager, 2002:30; Hannaford, 1997: 31). A learner with a dominant foot opposite the dominant brain hemisphere is movement able (Hannaford, 1997:31). When the dominant foot is on the same side as the dominant brain hemisphere, it means that the learner is movement limited when experiencing stress.

The following diagram of Dominance Profiles shows how the eyes, ears hands and hemispheres work together (Hannaford, 1995:181).

Table 4.7 Dominance Profile interpretation

CROSS LATERAL PROFILES		
DOMINANT SENSE STYLE	DOMINANT HEMISPHERE	PREFERRED LEARNING
Right eye	Left	Visual
Left eye	Right	Visual
Right ear	Left	Auditory
Left ear	Right	Auditory
Right hand	Left	Verbal
Left hand	Right	Kinesthetic

HOMOLATERAL (ONE-SIDED) PROFILES		
DOMINANT SENSE	DOMINANT HEMISPHERE	LEARNING STYLE
Right eye limited	Right	Visually
Left eye limited	Left	Visually
Visually limited learners prefer to learn through their other senses. They may close their eyes or look away to concentrate on information they really want to learn or express.		
Right ear	Right	Auditory limited
Left ear	Left	Auditory limited
Auditory limited learners may tune out when people talk too much, as in lectures.		
Right hand	Right	Communication limited
Communication limited learners see the whole image and may have difficulty breaking it down to the pieces of language to express their understanding.		
Left hand	Left	Kinesthetically

limited

Kinesthetically limited learners may have difficulty manipulating objects in the learning environment to communicate their ideas.

4.10.1.5 Knowledge gap

As one of the criteria for a doctoral study is to make a new contribution to the body of existing knowledge, the researcher makes her contribution on Dominance Profiles by adding the other two dimensions of the brain to the lateral Dominance Profile as originally described by Hannaford & Dennison.

As described earlier in this chapter, the benefit of the Dominance Profiles lies in it being an indication of preferred learning styles when confronted with a new learning situation and most importantly as the substructure and rationale for doing Brain Gym. The gap in the current body of knowledge on the Dominance Profiles lies in the discrepancy between the lateral profile described by the Dominance Profile on the one hand and Dennison's (Dennison & Dennison 1989:1) statement that the human brain is like a **three-dimensional hologram** with parts interrelating as a whole.

Dennison (Dennison & Dennison, 2000:19), Hannaford (1995:112) and Promislow (1998:76) mention the three dimensions of the brain in relation to Brain Gym movements, but not in relation to the Dominance Profiles. According to Dennison (Dennison & Dennison 1989:1) "For purposes of applying Brain Gym movements, the human brain may be understood to comprise of the left and right hemisphere (laterality dimension), the brain stem and frontal lobes (focus dimension) and the limbic system and cerebral cortex (centering dimension)".

A knowledge gap therefore existed in Hannaford & Dennison's Dominance Profiles as they only described the lateral profile and omitted the other two dimensions of the brain. The researcher & colleague, Dr. Marlize Basson, experimented with three-dimensional profiles, which culminated in 2001 in the researcher describing the Mind Dynamix Profile in her first book *Brain Gym for*

All.

All the information as described in Hannaford and Dennison's Dominance Profiles was still relevant and by adding the centering and focus dimensions, more depth, versatility and diversity of profiles became possible.

This rich diversity in profile combinations may also account for the difference between lateral profiles and temperament as indicated by research done by Bester (2001) on *The potential link between brain dominance and temperament, learning and personality styles: a PPL perspective*.

In the researcher's experience the Mind Dynamix Profiles have proven to be an invaluable tool to explain past behaviour as well as provide a logical rationale for doing Brain Gym movements to "re-invent the past by rewiring the future" (De Jager 2002: 1).

4.10.2 Mind Dynamix Profiles

As indicated in chapter 3, optimal performance and active involvement in the learning process depends on all three layers of MacLean's Triune Brain Theory - the physical / survival brain, the emotional / limbic brain and the mental brain / neo-cortex working in unison. The researcher combined MacLean's three brains and Dennison's three dimensions of the brain and developed the Mind Dynamix Profiles.

Combining the two models, the researcher describes the three brains as three dimensions of the brain: laterality = neo-cortex, centering = limbic system and focus = survival brain to create a model to describe diverse learning styles.

As the Mind Dynamix Profiles are built on generic human development as described by MacLean and genetic dominance as described by Hannaford (1997:47) and Dennison (Dennison & Dennison, 2000:3), it is applicable to all learners irrespective of ethnic grouping, sex, frame of reference, age or language preference.

Table 4.8 Three Dimensional Dominance Profile

<i>A. Information received preferably via either of the senses</i>	<i>B. Information processing of raw data</i>	<i>C. Information application and implementation</i>
<p><i>Test dominant:</i></p> <ul style="list-style-type: none"> •3 Eye •4 Ear 	<p><i>Test 3 dimensional brain dominance:</i></p> <ul style="list-style-type: none"> •4 Left (logical) or Right (global) •5 Top (thinking) or Bottom (feeling) •6 Back (receptive) or Front (expressive) 	<p><i>Test dominant:</i></p> <ul style="list-style-type: none"> •7 Hand •8 Foot

As with MacLean’s model, no dimension of the brain functions independently or in isolation, but for clarity purposes the dimensions are described individually, starting with the focus dimension (survival brain) and progressing through the centering dimension (limbic system) to the laterality dimension (neo-cortex).

4.10.2.1 The focus dimension

The focus dimension reflects the attentional intelligence (Dennison & Dennison, 2000:20) - the ability to cross the participatory midline, which separates the back and front of the body as well as the back brain (occipital lobes) and the front brain (frontal lobes) (Dennison & Dennison, 1989:1). “As human beings we are uniquely evolved to organise ourselves for the accomplishment of a goal, to experience intent and meaning in life and to plan ahead” (Dennison & Dennison, 2000:20).

The brain organises itself around that focus of attention for maximum efficient and directed performance. The frontal lobes house the sense of self as a social being, with a purpose in the world. The focus dimension depends on the relationship of the frontal lobes where the vision of the goal resides unencumbered by emotional restraints and the back brain which holds the most primitive, to freeze, become invisible (Dennison & Dennison, 2000:20), fight or flee (Hannaford, 1995:161).

According to Dennison neural connections must develop linking the back brain with the front brain to determine where an individual is in space, “before we can determine where we ‘end’ and the rest of the world ‘begins’ ” (Promislow: 1998:76). Sometimes sufficient neural connections do not develop due to incomplete developmental reflexes resulting in poor connection between the back and the front brain and resulting in an inability to expression and to participate proactively (Dennison & Dennison, 1989:1).

In terms of the Mind Dynamix Profiles the focus dimension is therefore divided into the receptive back brain and the expressive front brain (De Jager, 2001: 24). As with the laterality dimension where a learner can be more logic or gestalt brain dominant, with the focus dimension a learner can be more back or more front brain dominant.

Table 4.9 The focus dimension is divided into the receptive back brain and the expressive front brain

Front	Back
•1 Expressive	•10 Receptive
•2 Participative	•11 Observant
•3 Processes information interpersonally	•12 Processes information intra-personally
•4 Energetic	•13 Quiet
•5 Driven and	•14 Sometimes withdrawn
•6 Goal oriented	•15 Hypoactive
•7 Hyperactive	•16 Reactive
•8 Pro-active	•17 Sensitive to mood and others
•9 Can be ignorant of others	

Learners who are more back brain dominant are more under focused and often

Learners who are more front brain dominant can be quick off the mark, hyperactive, over focussed and stressed because they try too hard (Dennison & Dennison, 1989:1). They focus more interpersonally and are therefore more extroverted and favour active involvement.

In summary, the focus dimension is about sensing / observing and participating as well as the ability to **comprehend** (Dennison & Dennison, 2000:20) and have insight into choosing when to observe and when to respond appropriately.

4.10.2.2 The centering dimension

The centering dimension is the source of emotional intelligence, the basis of joy, passion, playfulness, memory and associations, societal bonding and the sense of self (Dennison & Dennison, 2000:19). This dimension depends on the relationship between the cerebral cortex and the limbic system. “This relationship juxtaposes the rational and abstract thinking abilities of the cortex - abilities that mediate and control behaviour - with the instinctual, intuitive and sometimes irrational needs of the midbrain” (Dennison & Dennison, 2000:19) or limbic system.

“When we are angry, frightened, grieving, sexually aroused, or protecting our young, we are supported hormonally and chemically to react from our instincts and act before we think unless we are able to access the cerebral cortex for control or containment” (Dennison & Dennison, 2000:19). Ideally a learner should be able to sustain the feeling of tension from unresolved feelings, mediate it with reason and release it appropriately in terms of timing and manner.

In terms of the Mind Dynamix Profiles the centering dimension is divided into the cognitive or “top” brain and the emotional or “bottom” brain (De Jager, 2001: 33). A learner can be more top brain dominant or more bottom brain dominant - more emotional or more rational. This is an important new insight especially when linked with the laterality dimension that implies that a learner can be logical and emotional or gestalt and emotional; logic and cognitive or gestalt and cognitive.

The centering dimension is essential to feel and express emotion (Promislow, 1998: 77), find personal meaning and value in a situation and to be grounded and well organised. In order to enable ideas from the cortex to move into action via the brain stem in the survival brain, they need to move through the emotions, which determine the relevance and importance of the idea and in so doing foster motivation.

In summary, the centering dimension is about feeling and stabilising the feelings with rational thought to enable a learner to be more **organised** (Dennison & Dennison, 2000:19).

4.10.2.3 The laterality dimension

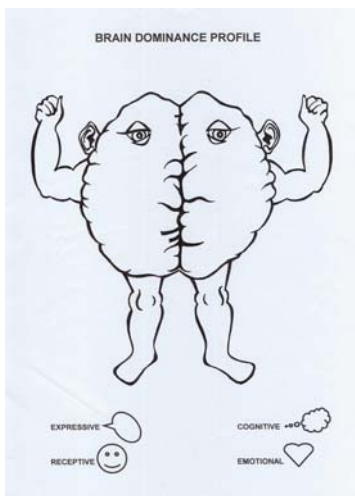
The laterality dimension is the informational intelligence and has as its primary function - left and right brain and body integration (Hannaford, 1995:178; Promislow, 1998:78). The laterality dimension deals with input reception (eyes and ears), input assimilation and processing (logic and gestalt) and output (hands and feet) expression.

Dennison (Dennison & Dennison, 2000:19) also describes laterality as “the manner in which we process the input and output of written and spoken language. Our patterns of thought offer a clear window into the basic constructions on which we build more complex communications with others”. It includes the ability to access rational, linear, language mediated qualities of the logic hemisphere as well as the visual, spatial and intuitive processes of the

gestalt hemisphere.

Laterality is key to labelling things and making distinctions (Promislow,1998:78) as well as to identifying similarities and form associations (De Jager, 2001:32). When the skills of both hemispheres are accessible, a learner can process symbolic, written code with ease - a skill that is fundamental to learning effectiveness (Dennison & Dennison, 1989:1).

In summary the laterality dimension is about thinking, processing and **communicating in symbols** (Dennison & Dennison, 2000:19) with flexibility as pertaining to logical and creativity.



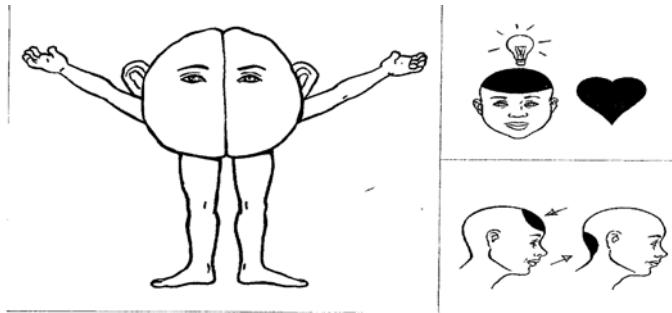


Figure: 4.6 A Mind Dynamix Profile

As described in chapter 3, the behaviour and processing options of the survival brain are more physical, primitive and reflexive in nature and focussed on intrapersonal survival needs. The behaviour and processing options of the limbic system are more emotional and focussed on interpersonal relationships and the behavioural and processing options of the neo-cortex are mediated by rational thought. These rational thoughts can be either based on more gestalt or logical thought processes depending on the dominant brain hemisphere (Hannaford *et al.*, 2000:1-7).

It is clear from the literature study that the human being is born with the potential to be fully integrated and functional. It is also clear that genetic tendencies, environmental factors and natural development through exposure to life and language experiences should culminate in mature, intelligent and independent adults. A learner's ability to have developed all three levels of MacLean's Triune Brain, all the aspects of Hannaford and Dennison's Dominance Profiles and Dennison's three dimensions of the brain **in equal proportions**, would enable them to function from a whole brain perspective.

4.11 WHOLE-BRAIN LEARNING

The whole brain perspective is described by Dennison (Dennison & Dennison, 2000: 19) as a dynamic and continuously changing process of brain organisation that involves three dimensions of the brain instead of the one-sided state suggested by the concept of cerebral dominance. The whole physiology (eyes, ears, hand, brain, etc.) reorganise itself moment-by-moment, to perform tasks that are reinforced through learning experiences over time and ultimately become behaviour patterns. These patterns may be based on genetic tendencies or learned environmental factors, but they most often are patterns of compensation (Dennison & Dennison, 2000:3). Ideally these patterns reflect the integrated whole-brain state, but dominance is a natural and inherited process of preference (Dennison & Dennison, 1989:44).

Intelligence depends on these specialised dominances to consistently access a specific neurological pattern for a given task. “Experiencing dominance (one-sidedness) is a key element of the learning cycle as this process allows us to make distinctions, discern differences and develop specialisation” (Dennison & Dennison, 2000:3), but learners need to return to an integrated whole-brain state as soon as the input has been assimilated to re-establish a state of equilibrium.

When input is received binocularly and binaurally; all three dimensions are available to process input from near (internal input) and far (external input) senses and produce output instantaneously through verbalisation and action, a state of balance and whole-brain integration is experienced. This is the optimal learning (Hannaford *et al.*, 2000:5) and living state. This state is described by Promislow: (1998:17) “as a mind-body moment and is made up of our thoughts, our feelings and our physiology, including our eye movements, breathing patterns, posture and gestures, state of health and physical comfort. A state can change instantaneously as soon as you change any of the variables”.

Jensen in Promislow (1998:17) summarises the whole brain state by asserting, “When your skills, attention, environment and will are all matched up with the task, you are “in the flow”. It is the perfect combination of your personal skill levels increasing at the same time that the challenge of the task seems to increase”. Dennison (Dennison & Dennison 2000:21) resonates with Jensen in saying that when the brain and corresponding movement patterns are organised for optimal performance, learners function at their best.

This whole brain state is also the state referred to in PPL as the state of personal and professional leadership - the ability to be master of ones own thoughts, feelings and behaviour and in so doing foster positive inter and intra personal relationships.

BUT, when one or more of the dimensions are unavailable, stress, tension, confusion, chronic pain or a sense of general discomfort is experienced resulting in less than optimal performance (Dennison & Dennison, 2000:21). This is typically the state currently experienced by many learners in South Africa who are not learning ready and thus fully dependant on educators to ensure their learning effectiveness.

The learners’ optimal state of learning readiness depends on “stimulation of inherent qualities of play and curiosity, as well as a natural desire to act on the world rather than to be acted upon by it. When we teach the passive child - when we act upon him with externally based information - we loose the innate momentum of learning that is his natural inclination. The teacher is then taking the responsibility for learning away from the child, rather than reinforcing the learning that naturally interfaces with every human interaction, and thus returns to the child the initiative to self-teach” (Hannaford *et al.*, 2000:3) and to become independent.

4.12 WHOLE-BRAIN LEARNING AND BRAIN GYM MOVEMENTS

Brain Gym movements help to support the learner's learning style or learning preference and facilitate full integrative processing for optimal learning even when under stress (Dennison & Dennison, 2000:5). The term 'full integrative processing' refers to the whole brain state, and when integrated for whole-brain learning and when learners return to the whole-brain state through stimulation and integration, learners experience dramatic shifts in their learning styles as they are able to approach any new situation and therefore any learning opportunity with both eyes, both ears, both sides of the brain and the whole body in a state of learning readiness (Dennison & Dennison, 2000: 4).

Whole-brain learning as the optimal learning state is therefore within the reach of every learner, but needs to be integrated to be experienced. "The whole-brain experience is elusive and must be experienced to be understood" (Dennison & Dennison, 1985:2). The purpose of Brain Gym is not to understand the brain, but to help people to better understand how to live their lives (Dennison & Dennison, 1985:2).

When they understand their own genetic tendencies through the Mind Dynamix Profiles (Hannaford *et al.*, 2000:5) and they know which Brain Gym movements will switch them on for optimal functioning (Hannaford *et al.*, 2000:7-38), they become truly empowered individuals. Individuals who are capable of establishing inter and intra relationships, manage their own mental and emotional states (Promislow, 1998:17) and take charge of their lives - individuals who are thus destined for academic and other success as well as independence.

Brain Gym movements, as stated earlier, are a series of simple and enjoyable movements to enhance the experience of whole brain learning. "It makes all types of learning easier and especially effective with academic skills" (Dennison & Dennison, 1989:1). There are Brain Gym movements to stimulate the nerve network integration of the lateral dimension (midline movements), to release vitality through integration of the centering dimension (energy movements) and

relax the mind and body through stimulating and integrating the focus dimension (lengthening movements) (Dennison & Dennison, 1989:1).

In the literature study it has been indicated that academic abilities depend on the neurological, chemical and muscular substructures, as developed in sequence through natural developmental stages. When these substructures are well developed and exposure to varied environmental stimuli are coded symbolically through verbal mediation - the learner is the proud owner of a database of experiential knowledge. In the unfortunate event of the developmental stages and the learning process not unfolding as described above and indicated in chapter 3, "Brain Gym activities will help any individual, young or old, to make better use of innate learning potential" (Dennison & Dennison, 1989:i).

These movements of body and energy are appropriate to address the needs of learners in "our modern, highly technological culture" (Dennison & Dennison, 1989:l) - often enabling a learner to make an immediate improvement in behaviour and performance. More often the movements help educators and parents to "guide the learners gradually to long-term benefits. Many use all the movements in the classroom every day; others use only the movements related to reading during the reading hour. No one should ever be required to move in a way, which feels unnatural or uncomfortable. Each learner should work within his or her abilities and be encouraged, yet never forced to do any of the Brain Gym movements" (Dennison & Dennison, 1989:l).

Dennison (Dennison & Dennison, 1989:l) concludes by saying "when learners are introduced to Brain Gym, they seem to love it, request it, teach it to their friends and integrate it into their lives, without any coaching or supervision. The skilled teacher who enjoys movement will inspire that motivation without effort". Once learners have integrated their various dimensions, senses and limbs in an organised manner, Brain Gym movements have served their purpose and integration becomes an automatic choice (Dennison & Dennison, 1989:2).

Some learners use Brain Gym movements' short term to establish a desired behaviour and others continue doing the movements to help reinforce new learning. Many learners seem to return to their favourite Brain Gym movements when stressors or challenges present themselves. Brain Gym movements are a natural, healthful alternative to stress and tension (Dennison & Dennison, 1989:2).

Brain Gym movements were discovered to either stimulate, release or relax learners involved in particular types of learning situations. Specific movements were observed to be more helpful than others for moving through individual learning blocks. A pattern emerged to do specific movements that develop and integrate the three dimensions of **focus** (brain stem / frontal lobes), **centering** (limbic system and neo-cortex) and **laterality** (logic/gestalt) (Dennison & Dennison, 1989:1).

4.12.1 The focus dimension

As described earlier in chapter 4, the focus dimension depends on the relationship between the reflexive back brain and the rational frontal lobes for focussed attention resulting in maximum efficient and directed performance (Dennison & Dennison, 2000:20). When in unfamiliar situations stress may be experienced, which would trigger the survival responses and affect the ability to focus and concentrate, impacting on learners' ability to learn in a whole brain state.

4.12.1.1 Stress and the focus dimension

Stress is a reaction to perceived threat (Hannaford, 1995:160). The survival brain is innately hard-wired for the flight or fight response as protection against harm. The fight or flight stress response prepares for mental and physical protective action by acting and adapting, resolving the threat and restoring balance to the mind, body and emotions.

A brief description of the stress response is appropriate when describing the focus dimension, as “major learning, health and emotional disorders can be off-shoots if stress is not appropriately handled ” (Promislow, 1998:45).

In real danger the survival instincts are invaluable as they heighten sensory awareness, intensify muscular strength, blood flow and oxygen distribution and secrete adrenalin (Hannaford, 1995:161). The survival reflexes triggered by the adrenaline secretion originate in the brain stem and are executed by the sympathetic nervous system to act, adapt and resolve the threat with little activation of the rational neo-cortex (Hannaford, 1995:160). Adrenaline reinforces the body’s primary defences by increasing blood flow to the heart, lungs and muscles, “especially the arms and legs” (Hannaford, 1995:161) away from the digestive system and the brain.

The function of the rational brain is to evaluate the threat, control thoughts and emotions, choose an appropriate response and restore balance to the system. When in survival mode, as Hannaford (1995: 160) indicated, “there is little activation of the rational areas of the brain”.

On a muscular level the tendon guard reflex is triggered which shortens the calf muscles (Hannaford, 1995:163). The function of tendon guard reflex is to protect the tendons and associated muscles from excessive tension by causing the muscles associated with the Achilles tendon (gastrocnemius) to contract while antagonistic muscles (tibialis) relax, moving the body forward (McCrone, 1991:216-217).

When the body moves forward the rest of the body must align to maintain balance. The muscles of the lower back and neck contract decreasing the flow of cerebro spinal fluid around the brain (Hannaford, 1995:163).

Contracted calf muscles and speech impairments seem to be connected as when

“in a perpetual state of stress, the calf muscles naturally tend to shorten and at the same time speech is inhibited. Dennison observed this same correlation of symptoms in his work with children” (Hannaford, 1995:163-164). This situation has grave implications for many learners in South Africa as they live in a constant state of survival due to environmental factors. They do not know or understand the language of instruction, they do not have the sensory stimulation and life experience to provide them with an enriched frame of reference (database) and thus feel threatened by the formal learning environment as experienced in the classroom.

Perpetually responding to a stressful world with survival oriented behaviour impacts on the nervous system because nerve net development and myelination is focussed in the survival centres, nerve net development into the limbic system and neo cortex is limited (Hannaford, 1995:164). Therefore aggression breeds aggression, as behavioural choices are limited. Reactions then come from within the survival brain by fighting, as indicated by school rage and violence or by fleeing as in being passive or absent.

Educators who notice these behaviour can easily deduce that the learners are undisciplined, lazy and unmotivated, hyper active or hypoactive and thus identify and label the learners as suffering from ADD (Attention Deficit Disorder) or ADHD (Attention Deficit Hyperactive Disorder). “When under stress the natural inclination is to move and to look into the distance, rather than to do close work. We tend to hold our breath, which starves the brain of oxygen and less learning can take place. Learning acquired under stress is easily forgotten, as it is not assimilated into the long-term memory of the right brain. When under stress the eyes are tensed creating stress in the eye muscles. If the two eyes do not work together in binocular vision, two images are perceived creating confusing perceptions. This can result in headaches, reduced performance, double vision, fatigue, poor eye-hand coordination and specific barriers to learning in reading, writing, maths and spelling” (Edwards, 2001:12).

What is unknown and unfamiliar can easily be perceived as a threat when in reality it is a learning experience, with the resulting effect of poor attention span and a lack of focus in disruptive learner behaviour. Promislow (1998:47) described this state as “all stressed and nowhere to go”. Physical action dissipates stress hormones and therefore when learners move and behave “inappropriately” they are often behaviourally reflecting their physical, mental and emotional state. Promislow (1998:47) states it clearly in saying what is inbred to brilliantly serve in terms of survival, must be neutralised when response is inappropriate by “improving our coping mechanisms allowing us to move into the future in a balanced state”.

If a learner is able to respond actively to a stressor or stressful situation, neutralise it and restore balance in the body, mind and emotions, there is little long-term ill effect. Thus the ability to learn - receive input, process it and produce optimum output is also restored. “However, we often do not act, because of lack of awareness or coping skills” (Promislow, 1998:45)

Brain Gym lengthening movements help learners to develop and reinforce neural networks, enabling them to make connections between what they already know in the back of their minds and the ability to express and process that information in the front of the brain. The lengthening activities are especially effective when used to release reflexes related to language abilities and behaviour. The lengthening movements relax the muscles and tendons shortened by reflexive reaction in the back brain when in an unfamiliar situation by stimulating the frontal lobes which are involved in comprehension, motor control and rational behaviour necessary for participation in social and classroom behaviour (Dennison & Dennison, 1989:15).

Lengthening activities develop a sense of participative readiness by completing infant reflexes that emphasise one hemisphere response, which is crucial to body differentiation and language development. As indicated in chapter 2, reflexes demand first priority on neural pathways when individuals have not successfully

matured through them (Dennison & Dennison, 1989:16). The reflexes addressed are the labyrinth response (birth to four months) necessary for the development of the inner ear mechanisms and its relationship to gravity and the vestibular system (Dennison & Dennison, 1989:16; Edwards, 2001:16), the tonic neck reflex (birth to three months) critical to the development of sidedness and flexion and erection against gravity (Dennison & Dennison, 1989:16; Edwards, 2001:16) and differentiated movements to distinguish among the muscles, tendons and joints of the body resulting the first gross-motor control and eventually in fine-motor control.

In summary Brain Gym lengthening movements consciously bring neural attention away from the survival response and relax and lengthen the calf muscles (Dennison & Dennison, 1989: 20; Hannaford, 1995:164), neck, shoulder, back and arm muscles for improved focus. There are six lengthening movements:

4.12.1.2 Lengthening activities to restore whole brain learning

These lengthening activities help learners to reinforce those neural pathways that enable them to make connections between what they already know in the back of the brain and the ability to express and process that information in the front of the brain.

Lengthening activities resemble those stretching and limbering exercises done by athletes and dancers in their warm-ups. Although these activities may be used for muscle toning before or after physical exercise, they serve another purpose as well – each re-educates the body to make lasting changes in posture, restoring muscles to their natural length.

Language used to facilitate these movements should describe “reaching, lengthening, expanding”, or “opening”, rather than “stretching” or “trying”, which suggest effort beyond natural capacity. Lengthening activities also help to

develop the sense of participation readiness by releasing or helping to complete infant reflexes that emphasise one-sidedness, crucial to body differentiation and language development. These reflexes continue to demand first priority on neural pathways when individuals have not successfully matured through them.

LENGTHENING ACTIVITIES: THE OWL

The Owl turns his head and eyes at the same time, and has an extremely full range of vision, as he can turn his head 180 degrees. He also has radar-like hearing. The Owl movement addresses these same visual, auditory and head-turning skills. It releases neck and shoulder tension that develops under stress, especially when holding a heavy book or when co-ordinating the eyes for reading or other near-point skills. Further, The Owl releases neck tension caused by sub-vocalisation during reading. It lengthens neck and shoulder muscles, restoring range of motion and circulation of blood to the brain for improved focus, attention and memory skills.

Squeeze one shoulder to release neck muscles, tensed in reaction to listening, speaking or thinking. Move head smoothly across midline, left and then right, keeping chin level. Exhale in each extended head position, left, right and head tilted forward to release back-of-the-neck muscles. Repeat with other shoulder (De Jager, 2001:94; Dennison & Dennison, 1989:17).

This activates the brain for:

- 1 Crosses the “auditory midline” (auditory attention, perception and memory).
- 2 Listening to one’s own voice.
- 3 Short and long-term memory
- 4 Silent speech and thinking ability
- 5 Efficient saccadic eye movement

6 Integration of vision and listening with whole-body movement.

LENGTHENING ACTIVITIES: ARM ACTIVATION

The Arm Activation is an isometric self-help activity, which lengthens the muscles of the upper chest and shoulders. Muscular control for both gross-motor and fine-motor activities originates in this area. If these muscles are shortened from tension, activities related to writing and the control of tools are inhibited.

Hold one arm straight up next to the ear and place the other hand on the elbow. The arms work against one another, in opposite directions, so that the arm, shoulder and back muscles lengthen. Press first one and then the other arm forward, backward, left and right for at least eight seconds each time while exhaling (De Jager, 2001:81; Dennison & Dennison, 1989: 18).

This activates the brain for:

- 1 expressive speech and language ability
- 2 relaxed use of diaphragm and increased respiration
- 3 eye-hand coordination and the manipulation of tools (Dennison & Dennison, 1989: 18).

LENGTHENING ACTIVITIES: FOOTFLEX

The Footflex is a movement re-education process to restore the natural length of the tendons in the feet and lower legs. The tendons shorten to protect the individual from perceived danger, a response caused by a brain reflexes to withdraw or to hold back (the tendon –guard reflex). By keeping the calf tendons in the lengthened position while simultaneously activating the foot, the reflex to hold back is relaxed.

Sit up straight and rest one leg on the other, with the ankle on the knee. Hold the calf muscle between thumbs and fingers. Massage the muscle, moving one hand towards the knee and the other towards the ankle. Alternately flex and point the foot while massaging (De Jager, 2001:89; Dennison & Dennison, 1989: 19).

This activates the brain for:

- 1 back-front integration
- 2 expressive speech and language skills (Dennison & Dennison, 1989: 19).

LENGTHENING ACTIVITIES: THE CALF PUMP

Like The Footflex, The Calf Pump is a movement re-education process to restore the natural length of tendons in the feet and lower legs. At times of perceived danger, these tendons shorten to prepare for the act of running. By pressing down the heel and lengthening the tendon in the calf, one discharge this fear reflex, and the muscles can return to a normal tonus.

Stand up straight with hands against a wall at shoulder height. Stretch one leg to the back and lift the heel. Bend the knee of the front leg. Press firmly against the wall with both hands while pressing the back heel flat against the floor for eight seconds. Lift the back heel and straighten the front knee and breathe in. Breathe out, bending the front knee again and pressing the back heel to the ground. Repeat on the other side (De Jager, 2001:85; Dennison & Dennison, 1989: 20).

This activates the brain for:

- 1 back-brain front-brain integration

- 2 expressive speech and language ability (Dennison & Dennison, 1989: 20).

LENGTHENING ACTIVITIES: GRAVITY GLIDER

The Gravity Glider is a movement re-education activity to restore the integrity of the hamstrings, hips and pelvic area. The movement uses balance and gravity to release tension in the hips and pelvis, allowing the learner to discover comfortable standing and sitting postures. The learner sits comfortably, crossing one foot over the other at the ankles, and reaches forward.

Sit or stand with back bent, ankles crossed and arms relaxed. Inhale slowly, straighten the back and, following both hands with both eyes, lift the arms up in the air. Breathe out slowly and bend forwards again and relax the arms. Repeat several times (De Jager, 2001:90; Dennison & Dennison, 1989: 21).

This activates the brain for:

- 1 a sense of balance and coordination
- 2 a sense of grounding and centering
- 3 increased visual attention (back-front brain integration)
- 4 deeper respiration and increased energy (Dennison & Dennison, 1989: 21).

LENGTHENING ACTIVITIES: THE GROUNDER

The Grounder is a lengthening exercise that relaxes the ileopsoas muscle group. These muscles tighten in response to excessive sitting or to stress in the pelvic area, and have the effect of restricting movement and flexibility. This inhibition at

the hips locks the sacrum, shortens the breath, and interferes with cranial movement. The ileopsoas muscle group is one of the most important in the body. It is the stabilising and grounding muscle group for the body, and its flexibility is essential for balance, whole-body coordination, and body focus. Stand with both feet comfortably apart, one foot pointing forwards and the other to the side. Bend the knee of the foot pointing to the side and move sideways until the knee is in line with the toes. Keep entire body upright throughout. Hold this position for eight seconds and return to the standing position. Do a few movements to both sides, remembering to keep both shoulders in line with the hips (De Jager, 2001: 90; Dennison & Dennison, 1989: 22).

This activates the brain for:

- 1 crossing the participation midline
- 2 centering and grounding
- 3 organisation
- 4 increased respiration
- 5 spatial awareness
- 6 whole-body relaxation
- 7 relaxed vision (Dennison & Dennison, 1989: 22).

4.12.2 The centering dimension

The centering dimension depends upon the relationship between the cerebral cortex and the limbic system (Dennison & Dennison, 2000:19) to connect “our sense of an inner world of dreams, needs and motivation with the outer world of self expression” (Dennison & Dennison, 2000:21). The Brain Gym energy/vitality movements connect the heart and the mind through facilitating flow of electromagnetic energy throughout the body to support the electrical and chemical changes that occur during all mental and physical events (Dennison & Dennison, 1989:23). These movements help to restore equilibrium by connecting all the electro-chemical circuits of the body, which in turn strengthen balance and

the sense of direction to promote feeling centred and in control (De Jager, 2001:65).

Thus the energy movements support the sense of directionality, spatial orientation and organisation. “When we are centred, we have a fixed point in our own brain/body to know where we are in space and where things are. Once we know where we are in space, we can judge our relationship to the world around us” (Promislow, 1998:77).

The human body is one of the most intricate of all electrical systems (Dennison & Dennison, 1989:23). All visual, auditory, kinesthetic, vestibular and proprioceptive input, as described in chapter 2, are changed into electrical impulses and relayed along nerve networks at speeds of up to 400 kilometres per hour (Dennison & Dennison, 1989:23). These impulses and chemical reactions can be hampered and thus create a breakdown in the brain-body connection. “When we are functioning at our best, clear messages feed from all parts of the body to the brain and back again in a loop. Sensory input is processed in an integrated fashion throughout the brain and intentional action is easy. Clear communication on a body level is a precursor to our ability to have clarity of thought and expression in our intellectual life” (Promislow, 1998:16).

The Brain Gym energy movements validate important inner sense input about inner body relationships that usually develop during an infant’s first year. When visual, auditory and kinesthetic skills are built on a proprioceptive foundation, “a match is easily made between what has been experienced (frame of reference) and what has been perceived. Without this congruency conflict among the sensory channels make learning difficult” (Dennison & Dennison, 1989:23).

Sunbeck (1991:12) stated that the learning process is about all the senses working together to provide the brain with best possible sensory input available, enabling the brain to verify new input against memories and emotional responses providing additional insight. Sensory input preferences are reflected by eye

movements based on the work of Wilder Penfield who mapped the correlation of eye movements to brain function (De Jager, 2002:43; Hannaford, 1995:74) and gave rise to the saying “the eyes are to the brain what the mouse is to the computer” (De Jager, 2002:42).

Penfield performed open brain surgery using only local anaesthesia on a fully awake patient in the 1930's and discovered the different functional areas of the brain (Hannaford, 1995:74). Richard Bandler & John Grinder applied the work of Penfield to the field of Neuro Linguistic Programming resulting in the ability to observe sensory preferences by noticing eye movements (De Jager, 2002:43). “Core competencies are wired and supported by circuitry developed through repetition. By applying this knowledge the eyes would turn more easily and readily in a direction they often utilise to access a sensory modality” (De Jager, 2002:43).

The eyes turn upward to access the visual centres; turn horizontally towards the ears to access auditory centres and downwards to access kinesthesia and the emotional centres of the brain (De Jager, 2002:43).



Figure 4.7 Eye accessing cues

4.12.2.1 Eye accessing cues and energy movements

The implications of the eye movements on learning are that one can ascertain whether a learner is able to access all the sensory circuitry supporting the learning process by doing a simple sensory modality preference test (De Jager, 2002:41-43). The test is performed by turning a page landscape and drawing a big free-flowing eight lying horizontally on its side.

An interesting observation is that many of the learners with reading, spelling and writing difficulties produce an eight indicating poor visual circuitry. By doing the Brain Gym energy movements, the different sensory circuitries are integrated with the left and right brain hemispheres to promote quality input and improve perception and cognition. The Brain Gym energy movements “balances the visual, auditory and kinesthetic modalities and promote flexibility in your use of preferred sensory modalities. You are thus able to alternate more freely between the eyes, ears and emotions for receiving information” (De Jager, 2002:72).

Brain Gym energy movements activate the neo-cortex “thus refocusing electrical energy back to the reasoning centres. This stimulates parasympathetic function and decreases the release of adrenalin” (Dennison & Dennison, 1989:23). The nine energy movements increase the electrical threshold across the cell membrane, to release any blockages and ensure that thoughts, emotions and actions are co-ordinated.

4.12.2.2 Energy activities to restore whole brain learning

The Brain Gym energy exercises help to re-establish neural connections between the body and brain, thus facilitating the flow of electromagnetic energy throughout the body. These activities support electrical and chemical changes that occur during all mental and physical events. Left-to-right/right-to-left, head-to-foot/foot-to-head, and back-to-front/front-to-back circuitries establish and support our sense of directionality, of sidedness, of centeredness, and of focus, as well as our awareness of where we are in space and in relation to objects in our environment.

The energy exercises validate important tactile and kinesthetic information about inner-body relationships that are usually developmentally established during the infant's first year. When visual skills are built on this proprioceptive foundation, a match is easily made between what is seen and what is experienced. Without this congruency, conflict amongst the sensory channels makes learning difficult.

The human body is one of the most complex of all electrical systems. All visual, auditory, or kinesthetic input, in fact, all sensory information, is changed into electrical signals and relayed to the brain along nerve fibres. The brain then sends out electrical signals along other nerve fibres to tell the visual, auditory, and muscular systems how to respond. These currents travel at a speed of up to 400 km per hour – faster than the fastest electric train in use!

ENERGY EXERCISES: WATER

Water is an excellent conductor of electrical energy. Two-thirds of the human body (about 75%) is made up of water. All of the electrical and chemical actions of the brain and central nervous system are dependant on the conductivity of electrical currents between the brain and the sensory organs, facilitated by water. Like rain falling on the ground, the body when provided in frequent small amounts best absorbs water.

The brain consists of about 90% water – thus when one drinks too little water, a high concentration of waste products builds up in the bloodstream and the blood carries less oxygen and nutrients to the cells. The result is weaker cells, which are more susceptible to disease, and make the learning process, in particular more difficult.

Water aids the solution of minerals in the body, forming electrolytes that charge the cells positively inside and negatively outside. These positive and negative

cell charges form the basis of the body's energy. The brain is the dynamo that generates the electricity or body energy and spreads it throughout the body with the help of the nervous system. To maintain electrical balance in the brain, learners need balanced cell charges and sufficient water (De Jager, 2001:40; Dennison & Dennison, 1989: 24).

Drinking water activates the brain for:

- 1 efficient electrical and chemical action between the brain and the nervous system
- 2 efficient storage and retrieval of information (Dennison & Dennison, 1989: 24).

ENERGY EXERCISES: BRAIN BUTTONS

Brain Buttons (soft tissue under the clavicle to the left and right of the sternum) are massaged deeply with one hand while holding the navel with the other hand (Dennison & Dennison, 1989: 25).

Place one hand on the navel (this stimulates balance) and, using the thumb and index finger of the other hand; stimulate the two hollows just under the collarbone, on either side of the breastbone (De Jager, 2001:84; Dennison & Dennison, 1989: 25).

This activates the brain for:

- 1 sending messages from the right brain hemisphere to the left side of the body and vice versa
- 2 receiving increased oxygen
- 3 stimulation of the carotid artery for increased blood supply to the brain
- 4 an increased flow of electromagnetic energy (Dennison & Dennison, 1989: 25).

ENERGY EXERCISES: EARTH BUTTONS

Earth Buttons bring the attention to the central point of reference (front lateral midline of the body), necessary for making decisions regarding the positions of objects in space. When a person can organise his visual field in terms of his own body, his eyes, hands, and whole body become better co-ordinated (Dennison & Dennison, 1989: 26).

Place one hand on the navel and place the other hand on the chin. Looking down, move eyes slowly from left to right a few times. Experiencing this connection between the body's upper and lower halves allows a person to co-ordinate them for increased stability (De Jager, 2001: 87; Dennison & Dennison, 1989: 26).

This activates the brain for:

- 1 the ability to work in the midfield
- 2 centering
- 3 grounding (looking down to perform near-visual skills (Dennison & Dennison, 1989: 26).

ENERGY EXERCISES: BALANCE BUTTONS

Balance Buttons provide a quick balance for all three dimensions: left/right, top/bottom, and back/front. Restoring balance to the occiput and the inner-ear area helps to normalise the whole body (Dennison & Dennison, 1989: 27).

Place one hand on the navel and the other on the soft hollow where the skull and the neck meet just behind the ear. Keeping the head upright, move eyes horizontally from left to right while softly stimulating the hollow. Change hands

and stimulate the Balance Buttons on the other side as well (De Jager, 2001: 82; Dennison & Dennison, 1989: 27).

This activates the brain for:

- 1 alertness and focus
- 2 decision-making, concentrating, and associative thinking
- 3 changing visual focus from point to point
- 4 increased proprioception for balance and equilibrium
- 5 relaxed jaw and cranial movement (Dennison & Dennison, 1989: 27).

ENERGY EXERCISES: SPACE BUTTONS

Space Buttons provide increased nourishment to the brain through the blood and cerebrospinal fluid (Dennison & Dennison, 1989: 28).

Place one hand on the coccyx (this stimulates the flow of cerebrospinal fluid) and the other between upper lip and nose. Look upwards and move eyes from left to right a few times (De Jager, 2001:95; Dennison & Dennison, 1989: 28).

This activates the brain for:

- 1 ability to work in the midfield
- 2 centering and grounding
- 3 relaxation of the central nervous system
- 4 depth perception and visual contexts
- 5 steadier eye contact
- 6 near-to-far vision (Dennison, 1989: 28).

ENERGY EXERCISES: THE ENERGY YAWN

The Energy Yawn is a natural respiratory reflex that increases circulation to the brain and stimulates the whole body. Yawning while holding tense points on the jaw helps balance the cranial bones and relaxes tension in the head and jaw (Dennison & Dennison, 1989: 29).

Pretend to yawn, close the eyes tightly and massage the jawbone, using circular movements around the upper and lower molars. While massaging, give a deep, relaxed yawn (De Jager, 2001:89; Dennison & Dennison, 1989: 29).

This activates the brain for:

- 1 increased sensory perception and motor function of eyes and muscles for vocalisation and mastication
- 2 increased oxidation for efficient, relaxed functioning
- 3 improved visual attention and perception
- 4 relaxed movement of facial muscles
- 5 enhanced verbal and expressive communication
- 6 increased discrimination of relevant from distracting information

(Dennison & Dennison, 1989: 29).

ENERGY EXERCISES: THE THINKING CAP

The Thinking Cap helps the learner focus attention on his hearing. It also relaxes tension in the cranial bones (Dennison & Dennison, 1989: 30).

Sit or stand up straight and hold ears between thumbs and index fingers. Massage the entire ear firmly a few times, from top to bottom. The ears could become red and warm as a result of the increased blood flow and neural stimulation (De Jager, 2001:96; Dennison & Dennison, 1989: 30).

This activates the brain for:

- 1 crossing the auditory midline (including auditory recognition, attention, discrimination,
- 2 perception, memory)
- 3 listening to one's own speaking voice
- 4 short-term working memory
- 5 silent speech and thinking skills
- 6 increased mental and physical fitness
- 7 hearing with both ears together
- 8 switched-on reticular formation (screens out distracting sounds from relevant sounds) (Dennison & Dennison, 1989: 30).

ENERGY EXERCISES: HOOK-UPS

Hook-Ups connect the electrical circuit in the body, containing and thus focussing both attention and disorganised energy. The mind and body relax as energy circulates through areas blocked by tension. The figure eight pattern of the arms and legs follows the energy flow lines of the body. The touching of the fingertips balances and connects the two brain hemispheres (Dennison & Dennison, 1989: 31).

Sit or lie comfortably with ankles crossed. Stretch arms out, the backs of the hands together and thumbs facing downwards. Turn the hands so that the palms are together and interlace the fingers. Bend the hands down and inwards towards the chest. Relax shoulders and place the tongue against the highest part of the palate. Breathe slowly and deeply. After several breaths, uncross the hands and ankles, rest the fingertips against one another and take a last deep breath (De Jager, 2001:91; Dennison & Dennison, 1989: 31).

This activates the brain for:

- 1 emotional centering
- 2 grounding
- 3 increased attention (stimulates reticular formation)
- 4 cranial movement (Dennison & Dennison, 1989: 31) .

ENERGY EXERCISES: POSITIVE POINTS

Positive Points help to remember what one would like to remember (Dennison & Dennison, 1989: 32).

The Positive Points are halfway between the eyebrows and hairline, directly in line with the midpoint of the eyes when looking forward. Stimulate these points with both hands or, with the thumb and index finger of one hand (De Jager, 2001:94; Dennison & Dennison, 1989: 32).

This activates the brain for:

- 1 accessing the frontal lobes to balance stress around specific memories, situations,
- 2 people, places and skills
- 3 relaxing the reflex to act without thinking when stressed (Dennison & Dennison, 1989: 32).

“When the centering dimension is balanced with the focus and laterality dimensions, we feel more present in the moment, alive with our feelings, grounded in a sense of self and organised for effective action” (Dennison & Dennison, 2000:19), while sensitive and aware of the environment and the individual’s place in it. It therefore provides learners with the ability to develop their emotions through stimulation of the limbic system resulting in improved memory, motivation and learner behaviour.

4.12.3 The laterality dimension

Laterality is the ability to coordinate the left side of the brain and body with the right side and is fundamental to reading, writing and communicative abilities (Promislow, 1998:78).

The laterality dimension is also fundamental to name and label experiences and objects to create a sense of permanence. “With the laterality dimension one can ask and answer the question: ‘What is it?’ We can master rational cause and effect consequences. We have communication across the midfield and can move and think at the same time. Flowing freely through the corpus callosum, sensory input is shared appropriately by the two hemisphere” (Promislow, 1998:78).

For centralised focal tasks such as reading, writing or spelling that involve eye-hand coordination across the visual kinesthetic midline, one eye must point, one ear must attend to language and one hand must move the pen from left to right across the midline. This may be a compensatory pattern of dominance or a pattern of integration, depending on whether the non-dominant eye, ear, hemisphere, hand and foot are inhibited or are cooperating by achieving such equally important tasks as “blending, supporting, comprehending or synthesising” (Dennison & Dennison, 2000:19). Optimal performance presupposes both eyes, ears, hemispheres, hands and feet are contributing to the balanced effect producing effective output in the midfield.

“The midfield (first defined by Dennison) is the area where left and right visual fields overlap, requiring the paired eyes and all their reciprocal muscles to work so well as a team that the two eyes work as one” (Dennison & Dennison, 1989:3). The midfield, which is the domain of the laterality dimension, does not only refer to the visual modality, but also to the auditory and kinesthetic modalities.

4.12.3.1 Laterality - the visual midfield

The visual cortex receives input from two eyes “each one with a slightly different view of the world” (Promislow, 1998:118), either as a whole (through the gestalt hemisphere) or one piece at a time (through the analytical hemisphere) (Dennison & Dennison, 1993: 2). It processes the input by building a composite picture by comparing and integrating input from each eye. It transposes visual input as it is projected upside down on the back of the retina (Dennison & Dennison, 1993:38; Hannaford, 1997:24; Promislow, 1998:118). The visual images must constantly be re-imprinted on the rods (light detectors) and cones (colour detectors) or go “blind” to the image (Promislow, 1998:118). For learning to occur, the eyes need to move to stimulate the visual apparatus.

The eyes are designed to move and accommodate light to provide sufficient visual input. “The eyes must actively be moving for learning to occur. The vestibular system controls ocular-motor movement through the vestibular ocular track. If the vestibular system is under processing, eye muscle movement may be deficient resulting in: poor eye tracking ability, convergence, near to far accommodation, difficulties in visual-spatial processing (up/down, left/right), focussing and deficits in eye teaming skills” (Edwards, 2001:34).

Edwards (2001:34) elaborates by stating that stress affects the eyes by becoming more peripheral and far-sighted to detect danger. When the eyes are then forced into near-focus such as reading and writing, further stress and strain is generated, resulting in tiredness, eyestrain and or headaches. The more the eyes are exercised, the more automatic the eye movements become for processing familiar input and the more free the visual centres will be to stop and focus on details, new input and learning.

4.12.3.2 Laterality - the auditory midfield

Promislow (1998:122) describes the auditory midfield neatly by saying, to truly

understand and comprehend what was heard, the auditory input must be perceived in the context in which it was heard. To accomplish full understanding, both ears and both hemispheres must be involved in the process and overlap in the midline. When input is flowing through the corpus callosum “auditory information is shared and assimilated from both sides of the brain: We can understand and interpret the content, in the emotional context of how it was said” (Promislow, 1998:123).

The ability to focus and concentrate on an auditory level depends on the ability to filter out extraneous sounds and to pay attention to what is relevant (Edwards, 2001:37). When feeling unsafe, the ears listen to all sounds to warn of approaching danger - focus and concentration become difficult and optimal learning does not occur. According to Dennison (Dennison & Dennison 1989:17) hearing and memory are associated with the proprioceptors in the shoulder and neck muscles, which respond to sound by repositioning themselves. When stressed, the neck tension tends to shut down the listening reflex resulting in speech, language, comprehension, memory and thinking difficulties. Auditory ability is then reduced to either the logic or the gestalt ear resulting in the inhibition of listening and comprehending on the auditory midline.

4.12.3.3 Midline movements to restore whole brain learning

Midline movements focus on the skills necessary for easy two-sided (left-right) movement across the midline of the body. The vertical midline of the body is the necessary reference for all such bilateral skills. The midline is the area where the left and right visual fields overlap, requiring the paired eyes and all of their reciprocating muscles to work so well as a team that the two eyes function as one. Development of bilateral movement skills for crawling and walking is essential to the child’s growing sense of autonomy. It is also a prerequisite for whole-body coordination and ease of learning in the near-visual area. The midline movements help to integrate the binocular vision, binaural hearing, and the left and right sides of the brain and body.

THE MIDLINE MOVEMENTS: CROSS CRAWL

Cross Crawl is a contra-lateral exercise, similar to walking in place. Because Cross Crawl accesses both brain hemispheres simultaneously, this is an ideal warm-up for all skills, which require crossing the body's lateral midline (Dennison & Dennison, 1989: 4).

Sit or stand up straight. Touch the right knee with the left elbow, then the left knee with the right elbow. Continue to cross the body midline slowly (De Jager, 2001: 86; Dennison & Dennison, 1989: 4).

This activates the brain for:

- 1 crossing the visual/auditory/kinesthetic/tactile midline
- 2 left-to-right eye movements
- 3 improved binocular (both eyes together) vision (Dennison & Dennison, 1989: 4).

THE MIDLINE MOVEMENTS: LAZY 8's

Lazy 8 enables the reader to cross the visual midline without interruption, thus activating both right and left eyes and integrating the right and left visual fields. The 8 is drawn on its side and includes a definite midpoint and separate left and right areas, joined by a continuous line (Dennison & Dennison, 1989: 5).

Stand up straight and hold thumb out in front, at eye level. Look at thumb as it moves in a large circle around the left eye and then around the right eye. Repeat a few times, with both hands (De Jager, 2001:92; Dennison & Dennison, 1989: 5).

This activates the brain for:

- 1 crossing the visual midline for increased hemispheric integration
- 2 enhanced binocular and peripheral vision
- 3 improved eye-muscle coordination (especially tracking) (Dennison & Dennison, 1989: 5).

THE MIDLINE MOVEMENTS: DOUBLE DOODLE

The Double Doodle is a bilateral drawing activity, which is done in the midline to establish direction and orientation in space relative to the body. The Double Doodle is best experienced with the large muscles of the arms and shoulders (Dennison & Dennison, 1989: 6).

Keeping the head still, focus on both hands simultaneously “drawing” large circles that are mirror images of each other. When the hands work easily together, but in opposite directions, make large, free form, symmetrical doodle patterns (De Jager, 2001:86; Dennison & Dennison, 1989: 6).

This activates the brain for:

- 1 hand-eye coordination in different visual fields
- 2 improved peripheral vision
- 3 body awareness, coordination, and specialisation of hands and eyes
- 4 improved sports abilities and movement skills (Dennison & Dennison, 1989: 6).

THE MIDLINE MOVEMENTS: ALPHABET 8's

Alphabet 8's integrate the movements involved in the formation of letters, enabling the writer to cross the visual midline without confusion. Each letter is clearly superimposed on either one side or the other. A down stroke either ends the letter or begins another letter. For most learners, when the printing of the lower-case letters improve, handwriting becomes easier (Dennison & Dennison, 1989: 7).

Do a few Lazy 8's – first with one hand and then with the other. Start in the centre of the Lazy 8 and form the letters of the alphabet over one another on the curves of the circles. Make a Lazy 8 between each completed letter to improve fluency in writing and relaxation (De Jager, 2001:80; Dennison & Dennison, 1989: 7).

This activates the brain for:

- 1 crossing the kinesthetic midline for bi-hemispheric writing in the
midfield
- 2 visual integration
- 3 increased peripheral awareness
- 4 eye-hand coordination
- 5 symbol recognition and discrimination (Dennison & Dennison, 1989: 7).

THE MIDLINE MOVEMENTS: THE ELEPHANT

The Elephant activates the inner ear for improved balance and equilibrium and also integrates the brain for listening with both ears. It releases tight neck muscles, which often tense in reaction to sound or to excessive lip movement during silent reading. In The Elephant, the torso, head, pointing arm and hand function as a single unit. This unit moves around a distant, imaginary Lazy 8, eyes focussing beyond one hand. The whole body moves without any separate arm movements (Dennison & Dennison, 1989: 8).

Sit or stand up straight, with one arm stretched out and pressed to the ear, eyes focussing on the tips of the fingers and beyond. As for Lazy 8, moving from midline, make a large circular movement to left and right, always moving upwards at the centre, where the two circles touch. Change arms and repeat the movement (De Jager, 2001:88; Dennison & Dennison, 1989: 8).

This activates the brain for:

- 1 crossing the auditory midline (including skills of attention, recognition,
- 2 perception, discrimination and memory)
- 3 listening to one's own speaking voice
- 4 short and long-term memory
- 5 silent speech and thinking ability
- 6 integrating vision, listening, and whole-body movement
- 7 depth perception and eye-teaming ability (Dennison & Dennison, 1989: 8).

THE MIDLINE MOVEMENTS: NECK ROLLS

Neck Rolls relax the neck and release tensions resulting from an inability to cross the visual midline or to work in the midline. When done before reading and writing, they encourage binocular vision and binaural hearing. Roll the head in the forward position only. Complete rotations to the back are not recommended (Dennison & Dennison, 1989: 9-10).

Sit or stand upright. Imagine that the head is a heavy metal ball and the neck a strong piece of string. Move the head slowly in a rolling movement to the left shoulder and then to the right shoulder. Lengthen the neck muscles as much as possible and remember to breathe deeply (De Jager, 2001:93; Dennison & Dennison, 1989: 9-10).

This activates the brain for:

- 1 binocular vision and the ability to read and write in the midfield
- 2 centering
- 3 grounding
- 4 relaxation of the central nervous system (Dennison & Dennison, 1989: 9-10).

THE MIDLINE MOVEMENTS: THE ROCKER

The Rocker releases the low back and sacrum by massaging the hamstring and gluteus muscle groups, stimulating nerves in the hips dulled by excessive sitting. When the sacrum is freed to move, the brain, at the other end of the central nervous system, is activated as well. Circulation of cerebrospinal fluid within the spinal column is then stimulated, and the body works more efficiently (Dennison & Dennison, 1989: 11).

Lie flat on the back on a thick mat or bed and pull the knees up to the chest, as far as possible. Keeping the knees up and the shoulders flat on the bed or mat, swing the hips from one side to the other (De Jager, 2001:95; Dennison & Dennison, 1989: 11).

This activates the brain for:

- 1 centering and the ability to work in the midfield
- 2 study skills
- 3 left-to-right visual skills
- 4 skills of attention and comprehension (Dennison & Dennison, 1989: 11).

THE MIDLINE MOVEMENTS: BELLY BREATHING

Belly Breathing reminds one to breathe instead of holding breath during focussed mental activity or physical exertion. When one breathes correctly, there is abundant oxygen for higher brain functions (Dennison & Dennison, 1989: 12).

Place hands on stomach. Think of the stomach as a balloon that inflates when breathing in and deflate when breathing out (De Jager, 2001:89; Dennison & Dennison, 1989: 12).

This activates the brain for:

- 1 the ability to cross the midline
- 2 centering and grounding
- 3 relaxation of central nervous system and cranial rhythms (Dennison & Dennison, 1989: 12).

THE MIDLINE MOVEMENTS: CROSS CRAWL SIT-UPS

Cross Crawl Sit-Ups strengthen the abdominal muscles, relax the lower back, and activate the integration of the left and right brain hemispheres. They develop coordination of the core, postural muscles and a sense of organisation around the body's midline (Dennison & Dennison, 1989: 13).

Do the exercise while positioned on back. The knees and head up and the hands clasped behind the head for support. Touch the one elbow to the opposite knee, then alternate movement as though riding a bicycle, neck staying relaxed and breathing rhythmically. Imaging an X connecting hips and shoulders, increasing awareness of the abdominal muscles (Dennison & Dennison, 1989: 13).

This activates the brain for:

- 1 left-right integration
- 2 centering and grounding
- 3 awareness of core, postural muscles (Dennison & Dennison, 1989: 13).

THE MIDLINE MOVEMENTS: THE ENERGIZER

The Energiser lets one experience breath as the source of strength (Dennison & Dennison, 1989: 14).

Sit comfortably on a chair, head bent and back hunched, and place the hands (fingertips facing) on the table. Breathe in deeply and slowly; raise the head and eyes, straightening the back. Breathe out slowly as the head lowers. Relax. Repeat several times (De Jager, 2001:88; Dennison & Dennison, 1989: 14).

This activates the brain for:

- 1 the ability to cross the midline
- 2 a relaxed central nervous system (Dennison & Dennison, 1989: 14).

THE MIDLINE MOVEMENTS: THINK OF AN X

Thinking of an X is a brain organisation pattern for crossing the lateral midline (Dennison & Dennison, 1989: 15). Ideally, through completion in infancy of a series of one-sided and cross-lateral developmental steps, the left hemisphere moves the right side of the body and the right hemisphere moves the left. The whole brain learns through movement to work co-operatively, making both sides available for both receptive and expressive processes.

The X is also a reminder of the Lazy 8, activating left and right brain hemispheres for both body movement and relaxation, and activating both eyes for binocular vision (Dennison & Dennison, 1989: 15).

Learners may remind themselves to respond to situations in the optimal, whole-brained way by “thinking of an X”.

This activates the brain for:

- 1 binocular vision
- 2 binaural hearing
- 3 whole-body coordination
- 4 centralised vision (Dennison & Dennison, 1989: 15).

This concludes the description of the 26 Brain Gym Movements in the three categories: **focus** (lengthening movements), **centering** (energy exercises) and **laterality** (midline movements). These three categories of movements stimulate the three step learning process as described in chapter 3 as the - INPUT STEP (the near and far senses), THE PROCESSING STEP (the three dimensions of the brain) and the OUTPUT STEP (hands and feet).

In the words of Hannaford (1998:18) “The more connections, the faster the processing between both hemispheres and the more intelligently we are able to function”. As the researcher has indicated in her contribution to the existing body of knowledge, the brain is three-dimensional and thus need not only integrate the left and right sides of the brain but also the back and front as well as the top and bottom parts of the brain. In applying the previous words of Hannaford (1998:18), “The more connections between the whole brain and all the senses (sensory input) and limbs (motor output), the faster the processing and the more intelligently we are able to perform”.

4.13 FINDINGS AND CONCLUSIONS

In chapter 4 Brain Gym was described as a learning readiness programme that physiologically prepares learners of all ages to practice and master the skills required for the mechanics of learning (Edu-K Foundation, 2002:3).

The scientific framework established in chapter 3 indicated that learning is founded on neurological development through repeated sensory motor movement activities. Evaluating Brain Gym against this framework and Brain Gym's compatibility with the Information Processing Approach to learning theory, it seems that Brain Gym can make a contribution to promote whole brain learning and in so doing improve academic performance and learner independence. Notwithstanding the value of Brain Gym as described in chapter 4 by Dennison, Brain Gym instructors and available literature on Brain Gym, the absence of scientific validation and explanation for the movements and the absence of detailed scientific research studies necessitates subjecting Brain Gym to scientific evaluation in chapter 5. This evaluation will be conducted within a South African context by designing and implementing an empirical research intervention.

CHAPTER 5

RESEARCH DESIGN

5.1 BACKGROUND

The previous chapters contain the theory supporting this research study and serve as background to the subsequent chapters. According to Gallahue and Ozmun (1998: 78) the functions of theory are to integrate existing facts and organise them in such a way as to give them new meaning. Facts alone are important, but on their own they do not constitute science, for science depends on the advancement of theory.

In the previous chapters the theory indicated the importance of affective, cognitive and physical development to enhance learning based on MacLean's Triune Brain Theory. This approach was also in accordance with a statement by Elmer Green, stating, "every change in the physiological state is accompanied by an appropriate change in the mental and emotional state – conscious or unconscious" (Pert, 1997:138).

Claims by Dennison and other Brain Gym practitioners indicated that Brain Gym is a technique that can enhance physical, emotional and mental states resulting in whole brain and person development. Without testing these claims, the researcher could not hope for a higher level of understanding and awareness in the chosen field of interest neither could she avail Brain Gym to educators and learners as a technique to enhance the learning process. These claims are to be scrutinised in this chapter through a scientific research design.

According to Mouton (1996: 108), "the rationale for a research design is to plan and structure a research project in such a way that the eventual validity of the

research findings is maximised through either minimising or, where possible, eliminating potential error” The intent of this chapter is to present a research strategy and design. This is grounded in a theoretical framework to evaluate the role Brain Gym plays as a part of the process of whole brain and whole child development resulting in learner independence and learning effectiveness.

As a research strategy was what directed the study and determined the methods to be used, both an empirical and non-empirical research strategy was followed, exploring the unity between doing educational research and the value such research could add to enhance educational practices in a practical and empowering manner.

According to Johnson (2002:13) the research process involves five steps: “First, ask a question, identify a problem or define an area of exploration”; secondly, decide what data should be collected as well as method of data collection; thirdly, collect and analyse data; the fourth step describe how findings can be applied to improve the quality of classroom practice and lastly share the findings and plan of action with others. Steps 1 - 2 will be described in chapter 5, the third step will be covered in chapter 6 and chapter 7 will serve to complete this research study by addressing steps 4 and 5.

Due to the fact that Brain Gym is relatively unknown and often viewed as unscientific, the nature of this study required a multi-layered approach to address the research problem in a scientific and ethical manner. Such an approach would incorporate concept analysis through a descriptive and analytical literature study as addressed in the previous chapters, followed by programme development and qualitative as well as quantitative research in the subsequent chapters.

5.2 THE RESEARCH QUESTION

The primary research question for this study is: Can Brain Gym promote whole

brain learning and in so doing contribute to learner success and independence in South African schools?

The sub-questions supporting the primary research problem are:

- 7 What is the current situation in South African schools in terms of academic achievement?
- 8 What are the most prevalent learning difficulties and factors contributing to these learning difficulties?
- 9 What is learning?
- 10 What is Brain Gym?
- 11 What is a Dominance Profile?
- 12 Can Dominance Profiles and Brain Gym potentially be mental and emotional self-management tools for educators and learners to overcome learning difficulties?

The descriptive and analytical literature study has addressed the first sub-questions. Claims by Dennison and Brain Gym practitioners were that Brain Gym is able to address the primary research question as well as the remaining sub-question. The claims made about Brain Gym effectiveness needed to be clarified to address the research question. This clarification process was conducted through an empirical pre-test post-test control group design, following the criteria for scientific research to evaluate if a Brain Gym intervention can address the research question.

5.3 CONCEPTUALISATION

The purpose of conceptualisation is to clarify and analyse the key concepts of the study (Mouton, 1996: 108). The key concepts relevant to the research design of this study were listed in the claims made about Brain Gym effectiveness in promoting whole brain learning, learner independence and academic achievement. If these claims were valid, it would follow that implementing Brain

Gym in the classroom would improve left and right brain integration, crossing the visual, auditory and kinesthetic midlines, eye-muscle coordination, reading comprehension, spelling, eye-hand coordination, mathematical computation, focus and concentration, social behaviour and self concept. The list of claims was too extensive for the scope of this study and was narrowed down, according to the following criteria: 1) the concepts had to be easily and accurately evaluated in groups pre and post a Brain Gym intervention and 2) results must be noticeable within a six-week time frame.

For the purpose of this study only the following concepts were evaluated:

- logic and gestalt brain integration
- crossing of the visual midline
- eye-hand coordination
- self image
- mathematical computation
- concentration.

These key concepts were selected because they met the above criteria and were indicators of the learning difficulties discussed in chapter 2, which were language and literacy difficulties, maths difficulties as well as difficulties in concentration and motivation. A brief discussion on the rationale for this selection will follow.

5.3.1 Logic and gestalt brain integration

Evaluating learners' logic and gestalt brain integration was relevant because this process forms the basis of thinking which is crucial to the ability to learn. "Cogito, ergo sum" (Gaarder, 1995: 198) refers to "I think and therefore I am".

The need for logic brain integration is due to language being part of the left-brain and as indicated in chapter 3, language ability – the ability to name, is crucial to

thought, reasoning and cognition and therefore crucial to learning. It is also one of the fundamental skills needed for mathematical computation. Right brain integration is necessary due to the emotive components in the gestalt brain, which impact on memory, motivation and comprehension.

The value of logic and gestalt brain integration lies in learners' ability to focus and learn the learning content in context (gestalt brain), remember the facts (logic brain) while simultaneously applying their knowledge to their lives and in so doing note the relevance of learning (whole brain). As indicated in chapter 3, relevance in turn is essential to motivation.

5.3.2 Crossing of the visual midline

Crossing of the visual midline is essential to literacy and producing written output. Confusion when crossing the visual midline results in an inability in near focus skills, resulting in an aversion to read and write.

Due to the fact that the majority of South African learners were raised in an oral tradition, their auditory circuitry is more developed than their visual circuitry as can be observed through analyses of their eye movements. Furthermore their visual circuitry is also more developed to scan the horizon and therefore their far focus skills are more acute than their near focal vision. Under developed near focal vision would thus impact on learners' ability to progress academically. According to Rossouw (2001:1) stimulating the visual skills and specifically the near focal visual skills, will impact on reading and understanding symbols (symbolic receptive language development), writing (symbolic expressive language) and finally creating in language (writing poetry/ public speaking) affecting the overall level of literacy, hence crossing the visual midline was selected as one of the key concepts in this study.

5.3.3 Eye-hand coordination

Hannaford (1995: 26) illustrates the physiological grounding and importance of

eye-hand coordination by stating: “Our knowledge expands as we overlay our understanding of a three dimensional world with learned techniques that allows us to represent perspective. In this the hand guides the eye through eye-hand coordination as we draw what we see, referring to our acquired reality instead of to our hand”.

Eye-hand coordination is an application of the ability to cross the visual midline. It is a near focus skill, which when stimulated forms a sensory-motor loop. Eye-hand coordination completes the sensory-motor loop that forms part of the reptilian brain and which is essential to producing verbal and written output as discussed in chapter 3. Thus it is clear that selecting to evaluate if the Brain Gym intervention can impact on hand-eye coordination, was relevant to this research.

5.3.4 Self concept

The researcher selected self-concept because of it being a determining factor in learning success. Self-concept is the image a learner has in relation to himself, others and the world. As indicated in chapter 3, emotional development is a part of limbic system development and the limbic system impacts on memory, intra and interpersonal relationships as well as motivation. Hansen and Maynard elaborate on this when stating in Raath and Jacobs (1993: 3) that they “have come to the conclusion that a positive correlation exists between healthy, enhancing concepts of the self and academic success. On the other hand, a negative self-concept and under-achievement show a high positive correlation.” Therefore the selection of self-concept is relevant to this study because, “increased learner self-confidence follows along with intrinsic motivation for future learning” (Jensen, 1994: 32).

5.3.5 Mathematical computation

As was observed from the discussions in 5.3.1, 5.3.2 and 5.3.3 mathematical computation or reasoning is a product of integrating the logic and gestalt brains,

crossing the visual midline and hand-eye coordination. It is a neo-cortical skill based on the above-mentioned skills. The combination of **sensory-motor patterns** (logic/gestalt, visual skills, hand-eye coordination) and **emotions** (self image) provide the essential criteria on which rational decision-making/thought is based (Damasio, 1994:199). According to Ruch (1984: 24) thought is what separates the human species from others species. It is the ability to think, to solve problems and be creative that are the basis of mathematical computation and an indicator of potential learning effectiveness and independence.

Observing learners' mathematical computation pre and post the Brain Gym intervention, would enable the researcher to evaluate the claims about Brain Gym being effective in enhancing mathematical computation.

5.3.6 Concentration

Claims made about Brain Gym includes that: "these movements are easy and enjoyable and bring about rapid and often dramatic improvements in concentration, memory, reading, writing, organising, listening, physical coordination and more, because Brain Gym develops the brain's neural pathways the way nature does: through movement" (Edu-K Foundation, 2001: www.braingym.org/faq.html).

In chapter 2 the educators indicated that one of the gravest challenges they are presented with are learner's inability to focus and concentrate. Given the claims about Brain Gym effectiveness, it became logical to evaluate learners' levels of concentration after exposure to a Brain Gym intervention.

5.3.7 Summary of conceptualisation

From the above it is clear that should this research indicate improved logic and gestalt brain integration, crossing the visual midline, eye-hand coordination, self image, mathematical computation and concentration, it would naturally follow that

learners with language and literacy difficulties, maths difficulties as well as difficulties in concentration and motivation, would be given tools to master the skills necessary to achieve learning effectiveness and become independent learners.

5.4 OPERATIONALISATION

During the operationalisation phase of the research design the relevance of the research problem to the real world of things and events (Mouton, 1996:66) was to be indicated. This was done through programme development, identifying the target population, selecting the measuring instruments, planning the Brain Gym intervention and the data collection with the purpose of evaluating the effect of the Brain Gym intervention in the real world of events and things.

5.4.1 Programme development

A programme had to be developed by the researcher to evaluate the effectiveness of a Brain Gym intervention in the classroom, called: **Brain Gym in the Classroom** (Addendum 1). This programme was developed for the purposes of this study. The following 10 steps in the educational design process were followed (Anon, <http://www.ag.ndsu.nokad.edu/orientation/Education/education.htm>. 2005:1-5) to develop **Brain Gym in the Classroom**:

- STEP 1 Defining the target audience – the staff of the school selected for this research study is the target audience.

- STEP 2 Rationale for programme selection for this audience – interview with management team indicated a grave need for a programme to address barriers to learning in the classroom. As Brain Gym claims indicated that it can address barriers to learning, it follows that developing a Brain Gym programme for the classroom would address the educators' need for tools and the researchers' need to evaluate such tools.

- STEP 3 Identify what the audience should learn from this programme – the educators needed to learn that learners and learning styles differ

and as a result of these difference that not all learners benefit equally from educators' teaching style. Understanding diversity is not enough, the educators also needed tools to stimulate the learners' receptive ability to be able to learn simultaneously irrespective of learning style preferences.

- STEP 4 Characteristics of target audience – the target audience needed an 'injection' of insight and understanding as a pre-course questionnaire indicated high levels of demotivation, anxiety, depression and helplessness due to challenges facing them teaching in a disadvantaged social milieu where barriers to learning are numerous and parental involvement are low. The educators indicated that their workload is massive and can not be burdened with working harder, they wanted to work smarter and thus needed simple tools to get results.
- STEP 5 Organise and sequence content – the content was determined after an interview with the management team and on completion of questionnaires to minimise information overload and maximise skills gain.
- STEP 6 Selection of teaching tools – teaching tools were limited to handouts, a flipchart and an overhead projector. The greatest teaching tool was the educators' own bodies experiencing the effect of doing the movements to reduce barriers to learning.
- STEP 7 Estimate budget – the researcher sponsored the total cost.
- STEP 8 Marketing plan – the researcher researched the market needs through interviews and questionnaires and then did a presentation to the management team and parent body to motivate approval for the programme.

- STEP 9 Creating an effective learning environment – with the support of the principal and with available resources a relaxed learning environment was created by rearranging the seating in the staffroom, replacing light bulbs, opening windows and welcoming staff with refreshments.
- STEP 10 Assessing the learning outcomes – The educators were all to evaluate their own energy levels and emotional state on a scale of 1-10 (1 low energy and negative - 10 energised and positive) pre and post the workshop. As only the grade one educators were involved in this research study, the outcome of this workshop will be described in the research study. The outcome for the rest of the staff was determined three months after completion of workshop through a discussion between the researcher and the management team followed by interviews with management team, educators and learners by a TV production team for viewing on SABC 2 in 2004.

The content of this one-day programme for educators included:

- 1 What is Brain Gym?
- 2 How does Brain Gym benefit the educator?
- 3 How does Brain Gym benefit the learners?
- 4 Brain Gym premises
- 5 Brain Gym model of the brain
 - Principles of learning
 - Dominance Profiles
 - The preferred sense for learning test
 - Stress and Dominance Profiles
- 6 The 26 Brain Gym movements

The purpose of this programme was to equip educators with the necessary skills and understanding of why to consistently and how to accurately implement Brain

Gym in the classroom on a daily basis for a period of six weeks.

Once the educators were trained, they were handed a record sheet (Addendum 2) to plot the Brain Gym movements on a daily basis. The record sheet served as a control measure to ensure the participation and effective roll out of the intervention as well as to minimise the burden on the educators to implement the Brain Gym intervention.

Once the educators had undergone the experience-based training in **Brain Gym in the Classroom**, they understood why they needed to do Brain Gym, how they needed to do the Brain Gym movements correctly and the potential results if they were implemented on a daily basis. This knowledge served to motivate the educators to commit to implementing the programme for a six-week period. Their buy-in, commitment and motivation were crucial to this study to determine if the proposed Brain Gym intervention succeeded in addressing the aforementioned key concepts crucial to whole brain learning. If the programme produced results in a noticeable manner, it could be concluded that the selected claims about Brain Gym successes were substantiated.

The scientific evaluation of these claims is to be addressed in this chapter according to the methodological criteria for the selection of valid measuring instruments

(Mouton, 1996: 110):

- 1 The selected target population must be exhaustive.
- 2 The measuring instruments must be unambiguous and mutually exclusive.

5.4.2 Target population

According to Dennison & Dennison (1989:i) when measuring Brain Gym effectiveness in promoting whole brain learning, the target population can be all learners - irrespective of age, gender or ethnic group. Due to the scope of such a

study and considering the resources available, the target population needed to be narrowed down to a sample that was as representative as possible of the target population (Mouton, 1996: 110).

The sampling frame is the operational definition of the population that provides a basis for sampling (Mouton, 1996: 135). Taking the scope and practical requirements of the research into consideration, the sampling frame for this study were three groups of grade one learners attending Ennerdale Primary School. Grade one learners from Ennerdale Primary School were selected as the target population for this study based on three reasons:

- 1) The rationale for selecting grade one learners was that they were at the beginning of their school career and if they were to benefit from the **Brain Gym in the Classroom** programme, it would follow that they would approach academic learning in a positive and motivated manner, which could impact on the entire school career.
- 2) The groups were comparable in terms of size – two groups of 37 and one group of 36 learners.
- 3) The school is situated in a diverse socio-economic environment with learners attending grade one from affluent as well as disadvantaged homes and whose home languages and ages differ. This diversity afforded the researcher an ideal opportunity to address the research question as the school can be viewed as representative of the grade one learner populations in South Africa.
- 4) The third reason for selecting Ennerdale Primary School was due to the support of the principal, Mr. Desmond Campbell. The support of the principal is crucial in research of this nature to maintain the integrity of the research and motivate and monitor the educators involved in this study.

According to Huysamen (1994:42) “when pre-existing, heterogeneous groups, called clusters, are drawn randomly all the members of the selected clusters are the eventual sample”. Of the three grade one groups, two groups were randomly

selected as the intervention group and the remaining group served as the control group.

The ethical implications for the target population were discussed and permission was granted to state the name of the school, principal and educators in this study. They viewed the publication of the names as a marketing opportunity for the school.

Due to the low level of parental involvement at the school, the parent body of the target population granted permission for this research study to take place at Ennerdale Primary on behalf of the parents and they did not deem it necessary for learners to sign assent.

5.4.3 Measuring instruments

“Operationalisation consists of the construction of a set of operations or measures that link the research problem to the world” (Mouton, 1996:66), and therefore a measuring instrument or measuring instruments needed to be identified to evaluate the validity of the claims about Brain Gym. When considering measuring instruments the question of measurement validity arose (Mouton, 1996:127).

5.4.3.1 Validity, reliability and ethics

Addressing the question of validity, reliability and ethics necessitates a brief discussion on the nature of social science research to create a context for the measurement instrument selection of this study. Due to the practical, action-oriented goal for research in the social sciences, a researcher needs to present insights and conclusions that are based on scientific principles but that also “rings true to readers, educators and other researchers” (Merriam, 1998:199). Cronbach (1975: 126) elaborated on this stating that researchers can assess local events accurately, to improve short-run control or they can develop explanatory concepts, concepts that will help people to use their heads and both

these approaches would address the question of validity, reliability and ethics.

The statement by Cronbach (1975: 126) indicates researchers would either select a controlled assessment approach (quantative) or an explanatory approach (qualitative). According to Firestone (1987: 19) “the quantitative study must convince the reader that procedures have been followed faithfully because very little concrete description of what anyone does is provided. The qualitative study provides the reader with a description in enough detail to show that the researcher’s conclusion makes sense”.

Due to the researcher’s wholistic and inclusive approach to the research question, both qualitative and quantitative measuring instruments were implemented in this study. Implementing both qualitative and quantitative measuring instruments ensured that the research problem was approached and analysed inductively by the researcher (qualitative research) and deductively by statistical methods (quantitative research) (Merriam, 1998:9).

In an attempt to address the research question both measuring instruments were used to measure the grade one learners attending Ennerdale Primary’s abilities pre and post the 6 week Brain Gym intervention regarding:

- left and right brain integration
- crossing of the visual midline
- eye-hand coordination
- mathematical computation
- self image
- concentration.

The rationale for the selection of each of these two distinctive measuring instruments will be discussed in more depth in 5.4.3.2 and 5.4.3.3.

5.4.3.2 Measuring instruments - quantitative

“Quantitative methods are used when the data have been collected in or are soon converted into numbers for analysis” (Blaikie, 2003: 47). According to Merriam (1998:9) quantitative research “takes a phenomenon apart to examine component parts, which becomes the variables of the study”.

The rationale for the selection of quantitative research was that the design characteristics were structured and predetermined with the purpose of providing the researcher with data that was precise and numerical, which enabled the researcher to validate or falsify claims/hypotheses objectively (Merriam, 1998:9). To further ensure valid findings, a standardised measuring was utilised for this study.

Huysamen (1994: 124) defines a standardised test as “a collection of tasks of which i) the content, ii) the administration and iii) the scoring of the obtained responses are the same irrespective of who is administering it, on whom it is administered and by whom it is scored”. A standardised test thus promotes the degree of certainty with which statements can be made about the existence of a causal relationship between variables (Heppner *et al.*, 1998:58), which are the learners’ test scores in the key concepts pre and post the Brain Gym intervention.

Incorporating a standardised test thus addressed the need for internal validity in this study.

The measuring instrument selected for this study was the Aptitude Test for School Beginners (ASB). ASB is a HSRC test and was standardised in 1973 (Olivier & Swart, 1995:44). “The Aptitude Tests for School Beginners (ASB) have been compiled in order to fulfil a long felt need to find a measuring instrument for the evaluation of certain aptitudes which are important in elementary education.” (Olivier & Swart, 1995:1).

This test was selected because The ASB is a test with sub tests to evaluate

learners' perception, spatial awareness, reasoning, numerical skills, gestalt, coordination, memory and verbal comprehension.

Perception

This test is used to establish the aptitude a learner has for visual perception, which is the capacity to make contact with the outside world through the eyes and accurately interpret the stimuli. The focus is on visual analysis, which is the ability to differentiate between similarities and differences, in this case of the picture presented. This skill is necessary for adept reading, writing and spelling (Olivier & Swart, 1995:3).

Spatial

The purpose of this test is to assess a learner's ability to cognitively turn around a specific image, in a predetermined way. This gives an indication of the learner's spatial orientation, a skill that builds the bridge to abstract reasoning and is essential for accuracy in writing, spelling, reading and especially mathematics (Olivier & Swart, 1995:3).

Reasoning

The intention of this test is to measure the learner's concept formation, abstract reasoning, logical thinking and the ability to classify his environment. These thinking skills are vital in terms of the learning process and give an indication of future academic success (Olivier & Swart, 1995:3).

Numerical

This test offers insight into the learner's numerical aptitudes and incorporates counting, number recognition as well as deciphering quantities and proportions. Logical thinking, verbal comprehension and concentration are also tested and together with the numerical skills, these abilities establish proficiency in learning mathematics and ongoing academic progress (Olivier & Swart, 1995:4).

Gestalt

The term gestalt could be categorised by physical components, physiological and psychological functions or representative elements.

All visual perception skills are utilised and the simple images are examined in order for the learner to accurately replicate them. In order to achieve this, the learner's acuity of "Gestalt" is essential.

To establish aptitude for future reading and writing skills, the learner has to correctly determine the location of the horizontal, vertical, oblique and curved lines and then duplicate them.

Further skills, which are necessary for accomplishment in this test, are attentiveness, concentration and lack of foreground / background confusion (Olivier & Swart, 1995:4).

Co-ordination

In this test, the learner's use of a pencil and paper are observed, establishing his maturity and fine motor control. This skill is vital for writing and an inability to execute these skills well in this test could indicate future problems in these areas (Olivier & Swart, 1995:5).

Memory

Visual memory is the ability to remember what the eye has seen. The learner will be required to use this ability through much of his initial stages at school, which is why the non-intentional visual memory is examined during this test (Olivier & Swart, 1995:5).

Verbal comprehension

It has been established by Lenneberg (1970) that verbal comprehension is more crucial to language development than merely mastering the art of speech, putting sounds together to form words in order to express thoughts. Thurstone and Thurstone (1963) found that verbal comprehension is an indicator of a learner's aptitude for academic skills. This test determines the learner's verbal

comprehension abilities and therefore also his academic potential in its entirety (Olivier & Swart, 1995:5).

The rationale for selecting the ASB is the relevance of these sub-tests for this research study to assess if a Brain Gym intervention can improve learners' ability to integrate the logic and gestalt brains, cross the visual midline, eye-hand coordination and mathematical computations. The relevance of these sub tests to measure these key concepts will be indicated on table 5.2.

The ideal time to implement the ASB is within the sixth to eighth week of grade one as the norms have been established for this period. The tests may also be applied at another stage "however, in such cases the norms should be interpreted very carefully" (Olivier & Swart, 1995:2). For the purposes of this study this instrument was not applied to test learning aptitude, but to measure improvement in the identified key concepts. Because a period of six weeks is relatively short to notice improvement on a skills level, an instrument was needed that could measure subtle improvements. The ASB was relevant because scoring the ASB the learners' raw score in each test were converted into a standard score as indicated on table 5.1. The standard scores are then plotted on the test profile in terms of the ASB rating scale consisting of a collection of items each of which involved a continuum of between one and five rank-ordered points, where one is poor and five is good. The ASB was therefore a suitable instrument due to the fact that it indicates raw scores (subtle improvements), which can then be converted into standard scores (general improvements), in the event that no improvement is noted in the standard scores, raw scores would be available for statistical analysis to note more subtle improvements.

Table 5.1 Aptitude for school beginners test scores

APTITUDE FOR SCHOOL BEGINNERS							
TEST SCORES							
TEST	RAW SCORE	STANDARD SCORE	TEST PROFILE				
			1	2	3	4	5
Perception		

Spatial orientation		
Reasoning		
Numerical		
Gestalt		
Coordination		
Memory		
Verbal comprehension		

For the purposes of this study only the sub-tests measuring perception, spatial awareness, reasoning, numerical skills and gestalt were utilised to evaluate changes in pre and post test scores. The rationale for selecting only these sub-scores was the relevance that these sub-tests have for this research study to assess if a Brain Gym intervention can improve learners' ability to integrate the logic and gestalt brains, cross the visual midline, eye-hand coordination and mathematical computations.

The relevance of these subtests to assess the key concepts is indicated on table 5.2.

Table 5.2 The relevance of the ASB in terms of the participants' ability to integrate the key concepts

	KEY CONCEPTS			
ASB	Logic/gestalt integration	Cross the visual midline	Eye-hand coordination	Mathematical computations
Perception	X	X	X	
Spatial	X	X	X	
Reasoning	X	X	X	
Numerical	X	X	X	X
Gestalt	X	X	X	X

Comparing the participants' pre and post intervention ASB tests scores provided

the researcher with precise and numerical data, which could be generalised to evaluate the effect of Brain Gym on the key concepts within a six-week period. According to Heppner, Kivlighan and Wampold (1998:58), the degree to which the causal relationship can be generalised across persons, settings and times reflects the external validity of a study.

Due to the fact that the ASB is a standardised test and its findings have been proven to be valid and reliable in measuring change, it follows that the quantitative data gained from the ASB would validate or falsify the claims made about Brain Gym enabling the researcher to address the research question.

5.4.3.3 Measuring instruments - qualitative

The qualitative data is substantiated by a more subjective but no more unscientific approach, because not all scientific observations can be converted into numbers and therefore qualitative measures are also incorporated in this study. Qualitative methods are used when data are in words and remain in words throughout the analysis (Blaikie, 2003: 47).

In contrast to quantitative research, qualitative research “ can reveal how all the parts work together to form a whole. It is assumed that meaning is embedded in people’s experiences and that this meaning is mediated through the investigator’s own perceptions” (Merriam, 1998:6).

The rationale for the selection of qualitative research was that the design characteristics were flexible, evolving and emergent with the purpose of providing the researcher with data that was holistic and richly descriptive, which enabled the researcher to reach a more comprehensive understanding of the phenomena (Merriam, 1998:9). In comparison to the objective and inanimate use of questionnaires used in quantitative research, an interactive qualitative approach was utilised to limit the distance between the researcher and the involved parties.

The researcher

In a qualitative study, the researcher is the primary instrument for gathering and analysing data and as such can respond to the situation by maximising opportunities for collecting and producing meaningful data. Like rating scales are assessed in other forms of research, in this study the researcher (and to what extent she has certain personality characteristics for this type of research) needs to be assessed (Merriam, 1998:20).

The researcher must have a tolerance for ambiguity because there are no set procedures to follow step by step and needs to be sensitive/intuitive to the context and all the variables within it (Merriam, 1998:21). Due to several personality assessments done by the researcher, indicating that she possesses high levels of sensitivity, creativity and tolerance for ambiguity as well as 20 years experience as a therapist, the researcher seemed to qualify to embark on qualitative research and to conduct focus group interviews.

Even though the researcher was qualified to embark on qualitative research, she was limited by being human because mistakes could be made, opportunities could be missed and personal biases may have interfered (Merriam, 1998:21). The aforementioned limitations and resulting questions regarding the validity, reliability and ethics of the qualitative data and the researcher were addressed in this study through triangulation.

Triangulation

Triangulation is the process of “pooling judgement” to establish validity (Foreman: 1948:413) using several sources of data such as interviews, observations and materials (Heppner *et al.*, 1998: 250). To this end the researcher contracted in three facilitators to participate in this research project. Each facilitator was selected due to extensive previous training in noticing skills and who had above average levels of objectivity and logic.

Noticing skills refer to the ability to observe posture and behaviour as indicators of physical, emotional and mental state changes. The facilitators were to write

down their observations during the pre and post testing phases of the research for the purpose of gathering qualitative data.

Each facilitator was randomly allocated to a specific group and facilitated the qualitative and quantitative pre and post testing with their respective groups. This ensured a certain level of distance between the researcher and the other parties to promote objectivity and reduced the risk of the researcher's bias affecting the results.

Focus group interviews

The qualitative research was also supported by interviews with the educators of the target population as well as the principal. The interviews were structured as informal discussions to determine the principal and educators' experience regarding the learning receptiveness of the grade one learners and the educators' emotional and mental states.

Artefacts

Artefacts are any form of documentation produced during the research without the use of words. Artefacts constituted the use of video recordings documenting the movements and reactions of the learners while doing the exercises as well as three other activities performed by the learners: drawing an infinity sign, completing a pattern around the edge of an A4 page and drawing a person.

Drawing an infinity sign was used as a measure of the learners' level of visual stimulation and integration. As indicated in chapter 4, the eye movement patterns as indicated on the infinity sign are based on the work of Penfield who performed open brain surgery using only local anaesthesia on a fully awake patient in the 1930's and discovered the different functional areas of the brain (Hannaford, 1995:74). Richard Bandler and John Grinder applied the work of Penfield in the field of Neuro Linguistic Programming resulting in the ability to observe sensory

preferences by noticing eye movements (De Jager, 2002:43). “Core competencies are wired and supported by circuitry developed through repetition. By applying this knowledge the eyes would turn more easily and readily in a direction they often utilise to access a sensory modality” (De Jager, 2002:43).

The procedure to draw an infinity sign was first demonstrated by the facilitator on the blackboard. Then each learner received a blank A4 page and placed it in a landscape position in front of them. They wrote their name on the page then placed their pencil tips in the centre of the page. Once it has been established that they have placed their pencils correctly, they proceeded to draw one infinity sign on the page.

The activity of **completing a pattern** around the edge of an A4 page was selected as a well-known activity used in the reception phase to determine concentration, resilience and task completion. This activity also indicated any challenges regarding crossing the visual midline.

The procedure to complete a pattern was commenced by handing out A4 pages – one to each learner. The page was placed in an upright position. The facilitator discussed the shapes to be drawn (circle, triangle, square). She then demonstrated the sequence of the pattern on the board. The learners were required to maintain the pattern around the edge of the paper starting from left to right, then proceeding down the right margin. When they got to the bottom of the page on the right hand side, they had to proceed from the right margin to the left margin and all the way up the left margin, while maintaining the pattern. This activity had to be completed within five minutes.

The last measuring instrument utilised in this research was the **draw-a-person activity**. According to Newmark (1996:165) “even ancient societies consistently recognised that artists project themselves into their

artistic productions”. Hammer (1958:6) elaborated on the importance of drawings stating that drawings are a reflection of the artist’s inner world and his ability to “handle his psychodynamic conflicts, both interpersonal and intra-psychic”. Drawing a person is thus generally viewed as a reflection of a learner’s self-concept and as such a relevant qualitative measuring instrument for this study.

The learners were required to turn the **repeat a pattern** page over. They were to place the page in an upright position in front of them and draw a picture of a person with a pencil. This activity had to be completed within five minutes.

Summary of qualitative and quantitative measuring instruments

Implementing both qualitative and quantitative measuring instruments ensured that the research problem was approached and analysed inductively by the researcher (qualitative research) and deductively by statistical methods (quantitative research) (Merriam, 1998:9).

5.4.4 Data collection

Due to humans’ awareness when participating in research and their tendency to react to it, called reactivity (Mouton, 1996:141), a measure of control needed to be exerted. In an attempt at controlling the level of reactivity and the effect of error, a greater degree of structure was required.

Randomisation is a form of control that involves the assignment of research subjects to experimental and control groups on a random basis to control the possible effect of individual differences (Mouton, 1996: 143). As Krathwohl (1993:450) aptly points out, “random assignments makes group comparable in all of the variables we think might present problems and also in all other things we had not expected”.

Such measures can be perceived as intrusive and therefore the greater the

number of controls the researcher builds into the research situation, the more likely the participants are to be reactive (Mouton, 1996: 143). The advantages and disadvantages are evaluated to increase the validity of the most findings by the fact that reactivity and control are positively correlated, necessitating a form of compromise.

5.4.4.1 Sampling

To adequately make comparisons across groups necessitated that the groups did not differ in important ways before the experiment and therefore the researcher needed to investigate the composition of the groups to ensure comparability in number, gender, language and ability. To further optimise the collection of data the three groups of grade one learners were randomly divided into one control group and two intervention groups assigned to randomly selected facilitators. Two experimental groups were selected to control the variability of the influence of the educators' attitude and discipline in implementing the six-week Brain Gym intervention and the possible impact on the findings.

5.4.4.2 Pre and post tests

The research design selected for this study was a pre-test post-test control group design comparing the variables across two or more groups under controlled experimental conditions. Due to the multi-layer approach of this study quantitative and qualitative measuring instruments (pre-tests) were utilised with the intervention and control groups prior to the Brain Gym intervention and this is indicated on the following tables..

Table 5.3 Overview of quantitative research process

COLLECTING DATA: QUANTITATIVE	RESPONSIBLE PERSON	MEASURING INSTRUMENT	RECORDING METHOD
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Aptitude Test for School Beginners (ASB)	Facilitators	Questionnaires	Test profile
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From the above table it is clear that the ASB was the only quantitative measuring instrument to be utilised in this study to gather data prior to the Brain Gym intervention (quantitative pre-test).

The following table reflects the variety of measuring instruments and persons involved in gathering qualitative data prior to the Brain Gym intervention (qualitative pre-test).

Table 5.4 Overview of qualitative research process

COLLECTING DATA:	RESPONSIBLE PERSON	MEASURING INSTRUMENT	RECORDING METHOD
Primary source	Researcher	Noticing skills	Note taking
Triangulation	Facilitators	Noticing groups	Note pad
Focus group interviews	Researcher	Interviews	Video recording
Artefacts	Educators	Brain Gym activities	Record sheet
	Facilitators	Draw infinity sign	A4 paper
	Facilitators	Complete a pattern	A4 paper
	Facilitators	Draw a person	A4 paper
	Leader per group	Record Brain Gym Stimulation	Star chart
	Researcher	Movements in action	Video recording

The pre-testing was followed by the intervention group being subjected to a six-week Brain Gym Programme. After completion of the Brain Gym programme all three groups were re-evaluated (post-test) using the aforementioned measuring instruments to record changes.

5.4.5 Monitoring

The validity of the research finding was based on the correct and consistent implementation of the Brain Gym Programme. To ensure cooperation four measures were incorporated:

- 1) The educators were given a record sheet to tick what Brain Gym they did on which day.
- 2) The educators were offered a performance related reward for consistently implementing and maintaining the programme.
- 3) To monitor the frequency of implementation, a leader per group was selected and given a calendar and stars. Every time they did the Brain Gym, the leader would stick a star on the calendar.

5.5 DATA CAPTURING AND EDITING

Permission obtained, methods and techniques of data capturing, periods during which the research was executed, the events that could have had an influence on the data collected and the controls used to ensure that the process of data collection yielded reliable results will be discussed.

5.5.1 Permission

Permission was obtained from the necessary authorities to conduct this research at the premises of Ennerdale Primary School.

5.5.2 Methods and techniques of data capturing

The quantitative data was captured and interpreted after the conclusion of the post tests. Once the ASB tests were scored, the participant's raw scores were converted into a standard score and plotted on the test profile. The data obtained was divided into two basic groups, namely the control group and the intervention group.

The different variables that existed within each of these groups was coded and prepared for statistical analysis as follows: Language (1:English; 2:Afrikaans; 3:Other); Age and Gender (1:Male; 2:Female). The raw and standard scores (obtained from the ASB) were then entered for the following five variables: Perception, Spatial, Reasoning, Numerical and Gestalt and handed to Statcon for analysis and interpretation.

The qualitative data was analysed and interpreted during the different phases of the research. This process commenced once the researcher and facilitators had made notes during the pre-tests on any observations they made and perceptions

formed. This feedback was given to the researcher in written form. From this feedback the researcher identified categories to support the qualitative data.

The artefacts produced by the learners in the form of Lazy 8's, completing a pattern and drawings were filed with the ASB tests for comparison with the artefacts produced by the learners as part of the post-tests. Further artefacts in the form of video recordings were also collected and interpreted in terms of the identified categories. The researcher recorded her observations in note form.

The quantitative and qualitative data collected was prepared along the principles for scientific research and documentation for presentation in chapter 6.

5.5.3 Research period

Due to the claims that Brain Gym can enhance learning within six weeks, the research period was seven weeks:

- one day to present the **Brain Gym in the Classroom** workshop
- one day to brief the facilitators
- one day to conduct the testing prior to the intervention (pre-tests)
- one week for the intervention
- one day after the conclusion of the intervention to conduct the post-testing
- one day to conduct the focus group interviews and debriefing.

The period during which the research was executed was from September to December 2003. The research was done in four phases; phase 1 was to train the educators in the Brain Gym programme - **Brain Gym in the Classroom**. Pre intervention data collection included pre-testing and interviews, which concluded phase 2. Phase 3 dealt with programme implementation and monitoring and phase 4 concluded the study with post-intervention data collection including post-testing and interviews.

5.5.4 Data contamination

The events that could possibly have had an influence on this research study are the correctness and frequency of programme implementation, attitude of teachers and facilitators and uncontrollable variables. These concepts will briefly be discussed as well as the control measures taken to minimise their impact.

If the movements were not done correctly, it could reduce the impact of the Brain Gym movements and influence the results of the experiment. To ensure the movements were done correctly, the researcher would make frequent unscheduled visits to the classes to observe the programme implementation. When the movements were done incorrectly, they would be corrected immediately through explanation and demonstration.

Not only the correctness of the movements, but the frequency of doing the Brain Gym movements was crucial for a valid and reliable evaluation of Brain Gym as the whole brain state is claimed to be established through frequently and repeatedly doing Brain Gym movements. Control measures to ensure the frequency of programme implementation was attempted in requiring the educators to record the movements on the chart and the group leaders to allocate stars per session. Notwithstanding these control mechanisms, the margin for error still persisted.

The attitude of educators and facilitators (who conducted the pre and post-tests) could have had an influence on the data. As indicated in chapter 3 the limbic system or feeling part of the brain determines amongst other feelings, action and motivation. What the educators or facilitators were feeling could thus have had an impact on how they were thinking and what they were doing, which may have influenced the learners and their performance. For this reason a second intervention group was selected in an attempt to control the number of uncontrollable variables to ensure a milieu where Brain Gym can be evaluated scientifically.

Any unforeseen situation may have cropped up and this is called an uncontrollable variable. One of the possible uncontrollable variables in this study is the 'halo effect'. This positive effect is the result of focussed attention and not due to the intended intervention. For ethical reasons and to address the possibility of the 'halo effect' contaminating the data, the control group received focused attention (in the form of a song, rhyme or short story) during the exact same time the intervention group were doing Brain Gym.

Focussed attention during this time would minimise the effect of such attention on the intervention group and thus maximise the opportunity to evaluate the effect of the Brain Gym intervention without contamination through the halo effect.

5.6 DATA ANALYSIS

Data analysis "means to break something down into its component parts so that it can be understood (Johnson, 2002:71). In research data is analysed and organised into categories for others to understand the reality the researcher are attempting to represent. The elements related to data analysis for this study were a) accuracy and credibility, b) validity and reliability and c) inductive and deductive analysis.

The **accuracy and credibility** of the data is of critical importance to enable the researcher to make effective choices and changes. To this end all observations were recorded carefully and precisely by the researcher, the educators and the facilitator and cross-correlated. The steps used in collecting the data have been described in chapter 5 to enable another researcher to duplicate the steps as a requirement for credibility of scientific research.

Selecting measuring instruments ensures the **validity and reliability** of the data,

which measures what it claims it does, as according to Johnson (2002:72). “validity is the degree to which a thing measures what it reports to measure” The measuring instruments used in this study were selected due to its capacity to measure what it is suppose to measure. The variety of measuring instruments (qualitative and quantitative) were selected to notice similar patterns using two or more forms of data (triangulation), which provides greater depth and dimension and thereby enhancing accuracy and credibility (Johnson, 2002:73).

Both **inductive and deductive data analysis** methods were selected for this study - inductive analysis to create order in the qualitative data by organising what has been observed into themes or emerging patterns and deductive analysis to present the quantitative data. Both approaches were utilised to enhance the integrity of the research findings to evaluate the claims about Brain Gym effectiveness. The method of analysing the data will be discussed in the next chapter.

5.7 SUMMARY OF CHAPTER 5

In this chapter the focus has been on a description of the research design and the implementation thereof to examine the causality of Brain Gym on academic achievement and learner independence.

CHAPTER 6

RESEARCH FINDINGS

6.1 BACKGROUND

In chapter 5 the focus was on a description of the research design and the implementation thereof to examine the causality of Brain Gym on learning effectiveness and learner independence by stimulating whole brain functioning.

This chapter has as its focus 1) the implementation of the Brain Gym intervention and 2) a description of the results and methods utilised to obtain these results.

This chapter thus serves as the author's attempt to examine causality by systematically altering a set of variables and examining the resultant changes in or consequences for another set of variables.

6.2 IMPLEMENTATION

Causality will be examined in this chapter by discussing the implementation of a six week Brain Gym intervention and measuring the results to evaluate the claims about Brain Gym and its effect on academic achievement and learner independence.

This evaluation will specifically be done in terms of left and right brain integration, crossing the visual midline, eye-hand coordination, self-concept, mathematical computation and concentration.

6.2.1 Permission

Permission for this research was obtained from the necessary authorities to conduct this research at the premises of Ennerdale Primary School. The SMD granted the staff one days leave for staff development during term time. The parents volunteered to supervise the learners during the training.

6.2.2 Research period

After the initial interview with the principal and management team was concluded, the necessary permission was obtained and the research design and programme development was completed, the intervention_research period was from September 2003 to November 2003 and conducted in four phases:

Phase one commenced on 15 September 2003 and all the educators at Ennerdale Primary School were invited to attend the one-day **Brain Gym in the Classroom** workshop (Addendum 1) on the same date. The entire staff attended the workshop even though only the grade one educators participated in this research study.

Phase two was implemented on 1 October 2003 when the researcher and three facilitators did the interviews and pre-intervention testing. The facilitators were briefed just prior to the implementation and were handed their ASB tests, A4 paper, pencils and sharpeners. The researcher introduced the facilitators to the educators and the group and then left the facilitators to continue.

The researcher interviewed the educators and had a briefing session on the implementation of the Brain Gym intervention while the facilitators did the pre-tests. The educators were handed their score charts and thanked for their participation. The educators indicated which learners were reliable leaders to take responsibility for managing the star charts and the researcher handed the stars and charts to these leaders – one chart per group.

Phase 3 - programme implementation was initiated on 2 October for a period of six weeks. The educators undertook to do Brain Gym every day for six weeks before the school day commenced and again after each break. To minimise the impact on the school day, each session was to only last three to five minutes.

One of these sessions was videotaped to serve as an artefact. The movements they chose to achieve the outcome for that specific lesson were ticked off on a chart (Addendum 2) for recording and monitoring purposes.

During phase 3 the researcher and principal independently made unscheduled visits to ascertain whether the programme was being implemented according to the briefing. During these occasions the researcher also rewarded the learners proportional to the number of stars on their charts.

The researcher also had discussions with the staff on each of these visits to address any challenges and motivate them to continue diligently. During one of these visits the researcher was informed that one of the educators from one of the intervention group would be on study leave for two weeks. The educator arranged with her colleague to continue the Brain Gym movements by joining both groups early in the morning and after break. It was arranged that the relief teacher would assist the remaining educator to implement the movements.

The programme was concluded on 13 November 2003.

Phase 4 commenced on 14 November 2003, during which time the three facilitators did the post-intervention testing. Phase 4 was concluded on 17 November 2003 when the researcher video taped the interviews with the educators and principal and had the debriefing session with the facilitators.

6.3 DATA COLLECTION

The facilitators collected the qualitative and quantitative pre and post-tests and handed them to the researcher on the same day they were conducted, tied in bundles. All data compiled by the researcher were labelled and filed for interpretation.

According to Heppner, *et al.* (1999:41) once the data has been collected, sense must be made of it with the express purpose of testing the research question. Because the research design incorporated both quantitative and qualitative approaches, the analysis of the results will reflect the results of both approaches - first in terms of the quantitative research and secondly in terms of the qualitative research.

6.4 QUANTATIVE RESEARCH RESULTS

The analysis of the quantitative results (data that can be counted) is presented in terms of descriptive statistic as well as inferential statistics.

6.4.1 Descriptive statistics

According to Huysamen (1980:9) descriptive statistics are a summary of a vast amount of information with the purpose of reducing and simplifying the information to enable the researcher to draw conclusions. For the purposes of this study two kinds of descriptive statistics were available: 1) statistics in terms of the experiential and control groups and 2) statistics to describe the tests.

6.4.1.1 Descriptive statistics - groups

To minimise the threat to validity, the research sample was randomly divided into one control group and two intervention group.

Table 6.1 A summary of the research sample in terms of the intervention and control groups

GROUP	TEACHER	FREQUENCY	% OF SAMPLE	CUMULATIVE %
Intervention Group	Mrs. Graham	24	29.6	
Intervention Group	Mrs. Beukes	27	33.3	Experiential group 62.9%
Control group	Mrs. Holloein	30	37.1	Control group 37.1%
	TOTAL	81	100%	100%

From table 6.1 it is clear that 81 grade one pupils participated in this research project of which 62.9% were representative of the experiential group and 37.1% of the control group. Two experiential groups were selected as a control measure in the event that one of the experiential groups could not complete the experiment so that the research could still be concluded.

In chapter 5 it has been indicated that two groups of 37 learners and one group of 36 learners would participate in this experiment totalling a 110 learners. Due to the high percentage of absenteeism the number of learners who participated pre and post the intervention were reduced to 81 learners.

To optimise the possibility of comparative data, the control and intervention group were further evaluated in terms of gender, age and home language.

In terms of gender, the distribution of boys and girls in the control and intervention group were recorded and analysed to determine any imbalance in the distribution that could impact on the validity of the results.

Table 6.2 A summary of the research sample in terms of the distribution of boys and girls in the groups.

GROUP	GENDER		
	BOYS	GIRLS	TOTAL
Intervention group	23	28	51
Control group	14	16	30
TOTAL	37	44	81

Table 6.2 indicates that 37 of the participants were boys and 44 of the participants were girls. These statistics indicate that class composition regarding gender was equally distributed between the classes, which indicates a comparative distribution.

The second variable that was identified that may have influenced the validity of the results was the age of the participants.

Table 6.3 The distribution of age amongst the control and intervention groups

GROUP	6 years old	7 years old	8+ years old	TOTAL
Intervention group	1	42	8	51
Control group	1	12	17	30
TOTAL	2	54	25	81

Table 6.3 indicates that the distribution of six year-old participants was evenly

distributed between the classes. The same table indicates that there were substantially more seven year-old participants in the intervention group compared to the number of seven year-old participants in the control group.

The table also indicates that the control group had substantially more participants in the eight+ year old group compared to the intervention group. These statistics indicate that class compositions regarding age were not equally distributed between the classes, which does not indicate a comparative distribution. These discrepancies in age distribution are significant and may have had an impact on the findings and will be analysed in depth with regards to the inferential statistics.

The last variable that formed part of the descriptive statistics reflects the distribution of mother tongue or home language speakers amongst the control and the intervention group.

Table 6.4 The distribution of mother tongue/home language speakers amongst the control and intervention groups

GROUP	ENGLISH	AFRIKAANS	OTHER	TOTAL
Intervention group	5	15	31	51
Control group	3	4	23	30
TOTAL	8	19	54	81

Table 6.4 indicates an uneven distribution of Afrikaans speaking participants between the control and intervention group. This discrepancy was not significant in terms of this study as the medium of instruction in this school is English, any language (irrespective if such a language is Afrikaans or other) would impact on the participants' ability. Afrikaans and other languages needed to be grouped together to ensure a responsible interpretation of these descriptive statistics. When grouped together the statistics indicated that class composition regarding

home language was equally distributed between the classes, which indicated a comparative distribution.

In terms of the descriptive analysis of the available data it is clear that a comparative distribution exists between the control and intervention group in terms of gender and home language. An uneven distribution exists between the control and intervention group in terms of age.

6.4.1.2 Descriptive statistics – tests

To minimise the threat to the validity and maximise the reliability of the results of this research study, the HSRC's Aptitude Test for School Beginners was implemented as a pre-test.

The reliability of a test refers to the consistency with which a test measures and is expressed as a coefficient, which can assume any value between 0 and 1. The higher the reliability of a test, the smaller the difference between the researcher's scores in repeated applications of the test and the more useful such test results will be.

The reliability coefficients of the various sub-tests are indicated in table 6.5 as well as a summary of the sub-tests, number of test items, and standard error of measurement. The standard error of measurement of a test is based on its reliability and indicates the fluctuation in test scores, which can be attributed to chance factors. The higher the reliability of a test, the smaller the standard error of measurement will be. The standard errors of measurement are indicated in terms of raw scores and standard scores.

Table 6.5 Descriptive statistics of the ASB regarding the reliability and standard error of measurement (N=1815)

APTITUDE TEST FOR SCHOOL BEGINNERS HSRC				
NAME OF TEST	NUMBER OF TEST ITEMS	RELIABILITY Kuder- Richardson 20	RAW SCORE Standard error of measurement	STANDARD SCORE Standard error of measurement
Perception	10	0.77	0.83	0.48
Spatial	10	0.82	1.17	0.43
Reasoning	10	0.81	1.08	0.44
Numerical	10	0.74	1.14	0.51
Gestalt	11	0.91*	6.53	0.30

- Calculated according to Ferguson's adaptation of the Kuder-Richardson formula 20.

Table 6.5 indicates that the reliability coefficients of the sub-tests are generally satisfactory.

In summary the descriptive statistics regarding group distribution and tests indicate that all but the distribution of age, is scientifically sound and presents a comparative basis to analyse the test results in terms of inferential statistics.

6.4.2 Inferential statistics

Inferential statistics reflect the inferences that can be made regarding the norms, correlations and other parameters of populations on grounds of corresponding statistics calculated for specific samples (Huysamen, 1980: 12).

The sample selected for this study has been described in 6.2.1. As the sample selection represents a population of grade one learners that come from diverse socio-economic milieus and are varied in age, gender and home language, this sample can be viewed as representative of the majority of grade one learners in South Africa.

The test selected for this study has been described in 6.2.2 and due to the indications that the reliability coefficients of the sub-tests are generally satisfactory; the inferential statistics provided the researcher with valid and reliable quantitative results to evaluate the research question whether Brain Gym can improve academic performance and learner independence.

To evaluate if the implementation of a Brain Gym stimulation programme had any effect after a short-term period (six weeks), the ASB test results of the experiential group who had the benefit of such a stimulation programme were compared to the ASB test results of the control group, who did not have the benefit of such a stimulation programme.

For each test variable in the ASB (Aptitude test for School beginners), a standardised score was reached from the raw scores. The standardised scores were used for the data analysis. Firstly an analysis was undertaken to see if there was a difference between the pre-scores and the post-scores of the control group and the intervention group. The goal was to have a difference in the intervention group scores but not the control group. The reason being if there was a difference in the control group scores the changes in the results were not due to the intervention and must be attributed to other factors.

Two types of tests were performed: a parametric test and non-parametric test. A parametric test is used if a normal distribution of scores exists. Non-parametric tests are used if the scores are not normally distributed. A test for normality is undertaken in which case, if $p < 0.05$ the scores are not normal.

Tests performed were: Parametric test (t-test or paired sample t-test) and non-parametric test. Results for the t-test were unnecessary, as the scores did not follow a normal distribution. It was therefore necessary to look at the results of the non-parametric tests (Mann-Whitney or Wilcoxon).

The non-parametric test used is called the Wilcoxon Signed Ranks test, because it is a non-parametric test and deals with ranks and not mean scores to obtain data in a normal form. The Wilcoxon Signed Ranks Test was performed for both the control group and the intervention group to discover if there was a difference between the pre and post test results.

$$H_0: \text{Mean}_{\text{Pretest}} = \text{Mean}_{\text{Posttest}}$$

$$H_A: \text{Mean}_{\text{Pretest}} \neq \text{Mean}_{\text{Posttest}}$$

The Wilcoxon Signed Ranks test provides evidence of significant differences between the groups or not. The goal is $p < 0.05$ for the intervention group so that H_0 can be rejected and $p > 0.05$ for the control group to retain H_0 . These results indicated that the control group stayed the same during the intervention and there was no significant difference between the pre and post-test results and the intervention group showed significant changes from the pre test to the post-test. This in turn indicated that the intervention had been successful.

If $p < 0.05$ for both the control and intervention group it means that the groups both improved over the duration of the intervention. Then the Mann-Whitney Test is used to compare the pre and post ranks of the control group against the intervention group to determine where the significant differences lie between the two groups.

P value is the significance value (sig. value). If p value is smaller than 0.05 the null hypothesis is rejected.

6.4.2.1 Control group – Wilcoxon Signed Ranks Test

In the control group there was a difference in the pre and post-test ranks in the case of spatial, reasoning, numerical, gestalt. No difference was found in perception.

Table 6.6 Wilcoxon Signed Ranks Test: Test Statistics

	Z	Asymp. Sig. (2-tailed)
Post-Perception – Pre-Perception	-1.165 ^a	.244
Post-Spatial – Pre-Spatial	-2.627 ^a	.009
Post-Reasoning – Pre-Reasoning	-3.213 ^a	.001
Post-Numerical – Pre-Numerical	-3.139 ^a	.002
Post-Gestalt – Pre-Gestalt	-2.138 ^a	.033

a. Based on negative ranks

Table 6.6 indicates there is a significant difference between pre and post test as $p < 0.05$. Therefore H_0 could be rejected. This meant that with 95% confidence the pre and post groups differed significantly. In the control group a difference between the pre and post-test results existed. This can be confirmed by the mean value when observing the descriptive statistics.

Table 6.7 Paired Sample Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Pair 6 Pre-Perception	4.23	30	1.073	.196
Post-Perception	4.40	30	.855	.156
Pair 7 Pre-Spatial	2.87	30	.730	.133
Post-Spatial	3.37	30	1.129	.206
Pair 8 Pre-Reasoning	3.48	30	1.306	.238
Post-Reasoning	4.27	30	1.258	.230
Pair 9 Pre-Numerical	2.77	30	.774	.141
Post-Numerical	3.40	30	.855	.156
Pair 10 Pre-Gestalt	3.57	30	.898	.164
Post-Gestalt	3.83	30	.834	.152

Regarding Perception there was no significant difference ($p = .244$), but regarding Spatial, Reasoning, Numerical and Gestalt the post mean scores were higher indicating that the control group improved significantly in these variables (with 95% confidence).

6.4.2.2 Intervention group – Wilcoxon Signed Ranks test

In the intervention group there was a difference in the pre and post-test ranks in the case of Perception, Spatial, Numerical and Gestalt. No difference was found in Reasoning.

Table 6.8 Wilcoxon Signed Ranks Test: Test Statistics

	Z	Asymp. Sig. (2-tailed)
Post-Perception – Pre-Perception	-2.032 ^a	.042
Post-Spatial – Pre-Spatial	-3.465 ^a	.001
Post-Reasoning – Pre-Reasoning	-1.876 ^a	.061
Post-Numerical – Pre-Numerical	-2.396 ^a	.017
Post-Gestalt – Pre-Gestalt	-3.652 ^a	.000

b. Based on negative ranks

Evaluating the differences necessitated observing the mean scores to note what the difference was: namely to what extent the scores improved or deteriorated.

Table 6.9 Paired Sample Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Pair 6 Pre-Perception	4.10	51	.985	.138
Post-Perception	4.37	51	.958	.134
Pair 7 Pre-Spatial	3.04	51	.824	.115
Post-Spatial	3.55	51	.945	.132
Pair 8 Pre-Reasoning	3.51	51	1.223	.171
Post-Reasoning	3.90	51	1.253	.175
Pair 9 Pre-Numerical	2.45	51	.832	.117
Post-Numerical	2.76	51	.839	.117
Pair 10 Pre-Gestalt	2.90	51	1.005	.141
Post-Gestalt	3.31	51	1.104	.155

Reasoning did improve but not significantly ($p = .061$). In each case of Perception, Spatial, Numerical and Gestalt the post mean scores were higher indicating that the intervention group improved significantly in these variables (with 95% confidence).

6.4.2.3 Mann-Whitney test

The Mann-Whitney test was conducted due to the fact that changes were recorded in both the control group and the intervention group. Comparisons

different scores of each subtest. The rationale was to note if the control and intervention groups differed on the pre tests and/ or the post-tests. This provided evidence of relevant significant changes in the intervention group.

The first step was to evaluate the pre scores to determine if the control and intervention groups differed. The goal was that no significant difference existed between the pre-test of the different variables for the control and intervention group. This proved that the sample group chosen was homogenous.

$$H_0 : \text{Pretest}_{\text{control}} = \text{Pretest}_{\text{intervention}}$$

$$H_A : \text{Pretest}_{\text{control}} \neq \text{Pretest}_{\text{intervention}}$$

Differences were found to exist between the control group and intervention group in the pre test with respect to the Gestalt variable ($p = .006$). Therefore the null hypothesis could be rejected, meaning the control and intervention groups were significantly different in the pre-test therefore no valid conclusions could be made as to significant differences in the post tests for Gestalt.

The next step was to observe the differences in the post-tests. In the post-test ranks for Perception, Spatial and Reasoning there were no significant difference between the control and intervention groups ($p > 0.05$). In the case of Numerical, a significant difference existed ($p = .000$). With 95% confidence this could be attributed to the intervention.

Table 6.10 Group Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Post-Perception	Control	4.40	30	.855	.156
	Intervention	4.37	51	.958	.134
Post-Spatial	Control	2.87	30	1.129	.206
	Intervention	3.37	51	.945	.132
Post-Reasoning	Control	4.27	30	1.258	.230
	Intervention	3.90	51	1.253	.175

Post-Numerical	Control	3.40	30	.855	.158
	Intervention	2.76	51	.839	.117
Post-Gestalt	Control	3.89	30	.834	.152
	Intervention	3.31	51	1.104	.155

In the case of the Numerical mean score, the control group had a higher post value than the intervention group (see above table). This indicated that the control group improved more than the intervention group in Numerical.

As a result of the significant difference in the pre-test scores in the Gestalt variable ($p = .006$), it was necessary to find out what the difference in Gestalt could be attributed to. In this case the difference scores between the control and intervention groups were analysed. Since the difference scores were not normally distributed, the non-parametric Mann-Whitney test was used.

Table 6.11 Mann-Whitney Test: Test Statistics

	Difference Perception	Difference Spatial	Difference Reasoning	Difference Numerical	Difference Gestalt
Mann-Whitney U	704.000	750.500	672.500	642.000	666.000
Wilcoxon W	1169.000	1215.500	1998.500	1968.000	1131.000
Z	-.638	-.150	-.927	-1.282	-1.080
Asymp. Sig.(2-tailed)	.523	.881	.354	.200	.280

In no single case was $p < 0.05$ (see above table).

$$H_0 : \text{diff}_{\text{control}} = \text{diff}_{\text{intervention}}$$

$$H_A : \text{diff}_{\text{control}} \neq \text{diff}_{\text{intervention}}$$

In both the control and intervention groups' $p > 0.05$, therefore H_0 could not be rejected. This meant that there were no significant differences between the two groups in terms of Reasoning, Spatial, Perception, Numerical and Gestalt.

The post-test indicated that there were differences but that they could be influenced by the fact that the pre test showed significant differences between the control and intervention groups. Analysis of the data proved that there was no significant difference between the control group and the intervention group. There was not enough evidence to assert that the control group and intervention group were the same or significantly different.

In summary, the p values for Spatial, Reasoning, Perception, Numerical and Gestalt indicated that there were no significant differences in the difference ranks as can be observed in table 6.11.

6.4.2.4 Chi-Square test

Utilising the difference ranks, groups were formed using the Chi-Square Test to measure whether the scores improved, deteriorated or stayed the same in the control and intervention groups respectively. The goal was that they were the

no progress was made in the relevant areas tested.

Using the Pearsons Chi-Square Test the significance values for the cross-tabulations of the different variables were as follows: Perception $p = .384$; Spatial $p = .887$; Reasoning $p = .021$; Numerical $p = .455$; Gestalt $p = .356$.

Therefore the H_0 could not be rejected for all variables other than Reasoning. This meant that in the case of Reasoning there was a significant difference between the control group and the intervention group.

Table 6.12 Cross tabulations

	Group		Deteriorate	Same	Improvement	Total
Perception	Control	Count	5	17	8	30
		% within group	15.7%	56.7%	26.7%	100.0%
		% of Total	6.2%	21.0%	9.9%	37.0%
	Intervention	Count	10	21	20	51
		% within group	19.6%	41.2%	39.2%	100.0%
		% of Total	12.3%	25.9%	24.7%	63.0%
	Group		Deteriorate	Same	Improvement	Total
Spatial	Control	Count	4	12	14	30
		% within group	13.3%	40.0%	46.7%	100.0%
		% of Total	4.9%	14.8%	17.3%	37.0%
	Intervention	Count	5	21	25	51
		% within group	9.8%	41.2%	49.0%	100.0%
		% of Total	6.2%	25.9%	30.9%	63.0%
	Group		Deteriorate	Same	Improvement	Total
Reasoning	Control	Count	2	13	15	30
		% within group	6.7%	43.3%	50.0%	100.0%
		% of Total	2.5%	16.0%	18.5%	37.0%
	Intervention	Count	15	11	25	51
		% within group	29.4%	21.6%	49.0%	100.0%
		% of Total	18.5%	13.6%	30.9%	63.0%
	Group		Deteriorate	Same	Improvement	Total
Numeracy	Control	Count	2	13	15	30
		% within group	6.7%	43.3%	50.0%	100.0%
		% of Total	2.5%	16.0%	18.5%	37.0%
	Intervention	Count	8	22	21	51
		% within group	15.7%	43.1%	41.2%	100.0%

		% of Total	9.9%	27.2%	25.9%	63.0%
	Group		Deteriorate	Same	Improvement	Total
Gestalt	Control	Count	2	19	9	30
		% within group	6.7%	63.3%	30.0%	100.0%
		% of Total	2.5%	23.5%	11.1%	37.0%
	Intervention	Count	4	24	23	51
		% within group	7.8%	47.1%	45.1%	100.0%
		% of Total	4.9%	29.6%	28.4%	63.0%

In the cross-tabulations in the above table it is evident which of the percentage of subjects deteriorated, stayed the same or improved in the control and intervention groups respectively. It was important to compare the percentages (in the above table) rather than the numbers, as there were more subjects in the intervention group than the control group.

In terms of Perception, Spatial, Numerical and Gestalt there were no significant differences between the groups ($p > .05$). In terms of Reasoning $p < .05$ therefore H_0 was rejected. This meant that there was a significant difference separating the control group from the intervention group in Reasoning.

In the case of Reasoning, improvement in both the control and intervention groups was more or less the same. The significant difference was that a higher percentage of subjects in the intervention group were more likely to deteriorate in Reasoning than in the control group.

6.4.2.5 Differences in the tests

The Wilcoxon Test was undertaken for the control and intervention groups separately to see if differences existed between pre and post-tests, the learners from both groups improved. Next step was to determine who improved the most. The Mann-Whitney test was done to compare the control group vs. the intervention group to determine which group improved the most. This was undertaken with the pre and post-tests separately. A significant difference was found in pre-test for Gestalt, which resulted in the dismissal of the post-test results for Gestalt.

The Mann-Whitney was performed again on difference scores to ascertain whether a significant difference existed in the difference scores. The control group was compared to the intervention and no significant differences were

found.

Data was then categorised with the Chi-Square Test into three groups, namely: improved, stayed the same or deteriorated. The only significant difference found was in Reasoning, where the control group deteriorated less than the intervention group, but both the intervention and control groups improved by 49%. There were five p-values for Wilcoxon, five p-values for the first Mann-Whitney, five p-values for second Mann-Whitney, five p-values for Improved, five p-values for Same and five p-values for Deteriorated - a total of 30 p-values or hypotheses to report on.

Differences could only be explained in the control and intervention groups where control = intervention and where pre = post. According to gender there was no significant difference. According to language groups there was no significant difference. According to age there was a significant difference ($p = .000$).

A larger percentage of participants in the intervention group were found to be younger than those in the control group. The Mann-Whitney test was then undertaken to ascertain whether age had an impact on the scores. No significant differences were found between the groups when age was used as the grouping variable ($p > .05$). This indicated that results were comparable even though there was a significant difference in age between the control and intervention group.

6.4.2.6 Summarising the quantitative research results

The quantitative results yielded no significant results, which indicate that the six week Brain Gym intervention for the grade one learners in Ennerdale Primary School did not have a measurable effect on their ASB test scores. These results do not reflect conclusively that the results were due to the Brain Gym claims being invalid or due to a flawed research design, but that various uncontrolled variables could have impacted on the results or that the intervention period was insufficient.

Uncontrolled variables that could have had a compounding effect on the results

were poor training and briefing sessions, an insufficient research period, a poor command of English, the lack of language comprehension and resulting misinterpretation of standardised instructions.

In addition to this, despite the stringent control measures, the movements may not have always been executed correctly and frequently enough, pencils were used during pre-tests and pens during the post-tests, the learners' displayed lack of sensory-motor integration, the attitude of the educators and / or facilitators, the level of emotional stability in all the key players, the intervention group educator's two week study leave and the possibility of the learners sharing the techniques with their friends in the control group. These uncontrolled variables will be discussed in more depth in chapter 7.

One of these uncontrolled variables needs brief discussion to contextualise the quantitative results meaningfully. The variable in question is *the learners' lack of sensory-motor integration*. According to MacLean's Triune Brain Theory discussed in chapter 3, cognitive development, is the result of physical and emotional maturity. It follows that without sufficient physical and emotional maturity, cognitive development would be hampered.

Considering the fact that all the ASB subtests evaluate cognitive development, it stands to reason that physical (sensory-motor) and emotional development would need to take place prior to achieving noticeable improvements on a mental level as on the ASB test scores.

A further investigation into this and the other uncontrolled variables is thus necessary to evaluate the claims about Brain Gym effectiveness.

6.5 QUALITATIVE RESEARCH RESULTS

According to Merriam (1998:6) qualitative research can reveal how all the parts

work together to form a whole, because it is assumed that meaning is embedded in people's experiences and that this meaning is mediated through perceptions. The most basic form of presenting qualitative data is through a descriptive narrative conveying the meaning the researcher has derived from studying the phenomenon (Merriam, 1998:179).

6.5.1 Descriptive narrative

The qualitative research included focus group interviews, three activities (draw an infinity sign, complete a pattern, draw a person) and noticing group performance and interaction during the pre and post-tests as well as the learners' participation during unscheduled visits. The descriptive data will be presented under headings called: interviews, artefacts and general perceptions.

6.5.1.1 Interviews

Interviews were conducted with the educators, principal and facilitators pre and post the intervention. The feedback from the educators will be presented separately from the feedback received from the facilitators during the debriefing session.

INTERVIEWS WITH EDUCATORS

The following account thereof has been captured verbatim prior to the intervention. The interviews contain spelling and grammatical errors due to the fact that neither the educators nor the principal were English mother tongue speakers.

Due to ethical considerations, the feedback is presented anonymously to protect the confidentiality of their responses.

RESEARCHER: How do you currently feel about teaching?

RESPONDENT: *I've lost my passion for teaching. Most of the time I am negative and forever under pressure. I am frustrated with the conflicting policies of the GDE and only in control sometimes and it takes a lot of effort. I feel I am "uitgelewer" in teaching because there is no alternative for corporal punishment and the learners know they can't fail anymore therefore they do not learn.*

Although I feel demotivated, I believe I can still make a positive contribution towards education.

RESPONDENT: *Most of the time I am feeling frustrated and depressed. Its very seldom that I feel motivated. If you are teaching grade one's you should be motivated because you are actually laying the foundation of that individual. Laying a sound foundation for future development is of utmost importance in the grade one's. Feeling depressed and frustrated was not the case earlier on because communication was good between teacher and the learner, which is not the case at present.*

RESPONDENT: *I would like to see a difference for the future of the learners that started grade one in my class. Even if it is the slightest positive idea that I have planted that will make them special individuals.*

RESPONDENT: *It wasn't always enjoyable but now because of sharing I intend to consider what has been said and done. I want best results. I always feel frustrated because things don't go as planned where I find myself at work. But the fact or joy that when the learner enters the class, the educational knowledge is not build up yet But at the end of each term you see results. It makes you feel good. It is like dreaming about a house. Unless you lay the foundation and start building, it brings you nowhere .When the learner leaves the grades, you know that it is you who moulded that masterpiece. I don't care what happens after grade one. The foundation is laid and is from that learner will proceed and be*

successful.

Summary of interviews pre-intervention with educators:

The interviews conducted prior to the intervention indicated a general feeling of de-motivation and frustration. The respondents were open in their feedback and some indicated concerns regarding discipline and conditions at work. There was a marked difference in the perceptions of the educators, where some were clearly more negative and focussed on the past, while others were more positive and future oriented.

The interviews conducted post intervention yielded the following responses:

RESEARCHER: Have you notice any differences since you've started doing Brain Gym?

RESPONDENT: *Yes sure, more creative thinking and the maths have improved and even the reading. I'm not talking about the children who are good readers, I am talking about those that had difficulties.*

RESEARCHER: Really?

RESPONDENT: *Really.*

RESEARCHER How do you mean?

RESPONDENT: *They recognise words more and even the good readers are reading more fluent. And especially the handwriting, it is amazing to see how the*

handwriting also has improved.

RESEARCHER: Since you've done Brain Gym are there any changes/ Have you noticed anything different in the children and if there is, in what way?

RESPONDENT: *No, there definitely is a change that I have noticed. Especially with reading I've noticed a change, their reading have improved a lot, I think it has something to do with the eye thing they did. Handwriting also has improved.*

RESEARCHER: In what way?

RESPONDENT: *You know the little ones can't really write straight, but what I have noticed is we work on paper with no lines and we draw lines for them, but it takes a lot of time. I asked them work self without lines by keeping a line with their eyes, and what I have noticed is that they really kept the line with their eyes that is the stronger ones. The weaker ones also did it but they didn't keep it quite as well as the stronger ones. That was the first thing I have noticed the thing with the eye. So that is how there was a remarkable difference with the handwriting. And with concentration it is better, I saw when Cross Crawling I have asked them to stand on all four legs and concentrate to lift two and put it down and then lift the other two and then you can see how they are thinking. I have asked them to practice more at home and that is why they have come on so much. Oh I don't know just, there just was a noticeable improvement. I have always said if only the year could have been three months longer then it would fit them well those extra months, but they picked up the last term and can work on their own.*

RESEARCHER: That is important because one of the things we were testing was if they could work independently without additional support, acknowledgement and approval.

RESPONDENT: *Yes, definitely. Like one Tracy Lee who I remember did not have a lot of confidence I always had to stand with her and help especially with maths.*

She was weak and especially maths and reading, but I was surprised I could not believe it when she could do the minus sums all on her own and plus. And then we come to reading. The reading improved not a lot, but it wasn't so weak anymore. And then I think of a case Thato who had very little confidence, he stand out in my mind. When I came back he has asked for a reading book to read and this is really true I am not exaggerating that's was amazing, that confidence and then his reading too improved.

RESEARCHER: Me X, does you think the exercises brought about the change or do you think it just happened because time passed that he improved?

RESPONDENT: *No, I believe I mean I think it really made a difference. Look if it helped me now in the exams I think it the results would have been more clear if it was over a longer period because it was only five weeks or so, but definitely definitely I would say there was an improvement.*

RESEARCHER: Anything else or any other example you can think of?

RESPONDENT: *Jerome, yes his work has improved and his handwriting has come a long way.*

RESEARCHER: Nothing else?

RESPONDENT: *Silence*

RESEARCHER: Was it practical for you to do the exercises? Was it a lot of effort, please answer honestly. Did you need equipment and did it impact a lot on your day as you did it in the beginning of the day.

RESPONDENT: *Yes, we did it in the beginning of the day. No it didn't bother me*

because I made a point of doing it first thing in the morning and the children enjoyed it a lot. We often talked about the progress we saw. Especially because that part has been neglected I can say these last couple of years and we realised that it is crucial for the child to have that part as well because it does something for them. And we have also decided we are not going to work without the Brain Gym. We are also not going to lend our books out otherwise it may get lost.

RESEARCHER: Yes it is your property. A comment to summarise?

RESPONDENT: *Silence*

RESEARCHER: What about discipline? Did it disrupt your discipline?

RESPONDENT: *No, in the beginning because it was something new and as Me X said we seldom do physical education like in the past, there was more of an enthusiasm and so because children like moving and so on, but there was no problem.*

RESEARCHER: Thank you very much. I have great appreciation for your work especially because you were overburdened as it is. I appreciate it.

RESPONDENT: *We have also enjoyed it, we enjoyed it a lot.*

RESEARCHER: It is wonderful how you have also benefited from it.

RESPONDENT: *Yes, the ear rub and the calf stretches. REALLY!*

RESEARCHER: Do you think it helped?

RESPONDENT: *No, I do not think I have imagined it. Definitely, definitely.*

RESEARCHER: I would like to thank you (the principal) that we could run the programme here in the way they have implemented the programme. Thank you very much for that. Have you noticed any changes or have you hear any comments from them.

RESPONDENT: *Yes, definitely and we would like to thank you for coming out and for your programme. There definitely is an improvement especially with the grade ones. They have given me the assurance that they do these 26 exercises every day and that there is an improvement.*

RESEARCHER: **Were they specific Mr X, specific in what areas did they improve?**

RESPONDENT: *The reading, and definitely the maths.*

RESEARCHER: **Okay.**

RESPONDENT: *The children are excited to do these exercises and I have tried to do them at home as well.*

RESEARCHER: **You have!**

RESPONDENT: *They work.*

RESEARCHER: **For what?**

RESPONDENT: *Yes to improve concentration and to put on my thinking cap.*

RESEARCHER: **Mr X anything you would like to add?**

RESPONDENT: *I can see progress in literacy and numeracy is what I have been told. In the beginning there were problems, but now they can now count they don't need to count their toes anymore. I need to add something, our numbers are dropping considerably and we need to improve our learner enrolment and we would like to ask if you can give us a part of the tape to use as part of our marketing strategy especially at the crèches next year. At the moment we are loosing 160 grade seven learners and we only have 40 new grade ones, which means three teachers will be without jobs.*

RESEARCHER: Yes we can do it.

RESPONDENT: *Thank you very much.*

RESEARCHER: Any comments from the rest of the staff as they have also been trained in Brain Gym even though they were not part of the experiment.

RESPONDENT: *Actually we have been asked to focus on reading and as from next year on a Tuesday the last period they will help the children with this Brain Gym programme.*

RESEARCHER: And for yourself sir, have you noticed any changes?

RESPONDENT: *Just before you came in I drank about a litre of water and then I feel wide-awake.*

RESEARCHER: Thank you very much for the opportunity. May you have a blessed Christmas and only the best in the New Year.

RESPONDENT: *Thank you.*

Summary of interviews post-intervention with educators

The interviews conducted post-intervention indicated a general feeling of optimism and excitement. The feedback also indicated that the educators felt more empowered to facilitate results both in the learners and in themselves and described a variety of noticeable improvements.

Improvements were noted in reading ability (recognising more words, reading fluency and requests for reading material), numeracy (don't need to count on toes, work independently), handwriting (writing in a straight line), concentration, task completion, enthusiasm, 'helping themselves' and confidence to complete tasks on their own.

Improvements were not only noted in learners but the educators had noticed changes in themselves as well (concentration, thinking and feeling awake).

The educators also commented on a need for a longer period to improve results, no problems with discipline or movements disrupting the day and the importance of movement.

INTERVIEWS WITH FACILITATORS

The facilitators formed impressions of the groups during the periods when administering the pre-test and post-test. The facilitators were not given any criteria for observation and their impressions were shared during the de-briefing session. Mailing their written notes to the researcher followed the debriefing session. The following feedback has been transcribed verbatim. This section will be concluded with an interpretation of their impressions.

RESEARCHER: Thank you ladies for your time and effort. Please take turns in sharing your impressions.

FACILITATOR: *My observations in re-testing the little angels at Ennerdale were:*

1. *They seemed more confident overall, there weren't as many children that asked for acknowledgement that they had answered correctly.*
2. *There was a great improvement in how the children wrote their names.*
3. *There wasn't as much copying from others because they felt they knew the answers themselves.*
4. *On thinking about it, there were fewer disruptive children in the class.*
5. *When communicating with the children, many more of them were able to understand what I was saying and respond accordingly.*

FACILITATOR: *Yesterday the kids were quite disruptive for a number of*

reasons: Their teacher was away I did not feel as well organised as I was last time - this always influences kids. I should have had a better understanding of what you had done between my visits and known the exercises that you taught them. We started on a bad footing because I did not know my starting point. Last time you did not come into the classroom. This time each time you came in there was confusion as to who was in control and they became more disruptive (no offence- merely an observation). This was for two reasons- I broke the flow of where I was, their focus was diverted. I was extremely stressed myself- and the kids probably felt it and I think I may have over reacted in some circumstances. Although the kids were generally very talkative, there was a general class organisation that was not there previously. They sat in their desks for longer periods of time, with much less jumping up and down, and walking around. They were more tolerant of waiting for their turn to have errors corrected and the number of errors to be changes was much, much less. Their period of concentration was much better. They were better able to keep together as a group when completing tasks. Those that worked faster were more prepared to wait for the slower ones with more tolerance. There was a greater need for individuals to show their worth to me, and so they were more obliging. There was a general enthusiasm and desire to work that really surprised me. I really don't think that this was fuelled by the sweet bribe because the sweets did not work as a discipline tool. The value of them was not high enough for many of the kids. The biggest change was with Nicole (Nico). From sitting in the front totally disorientated last time she sat at the back and completed tasks on her own. She also came and greeted me and made much more eye contact. Her results would be great to compare. I was impressed by her level of independence that had been achieved. The other kid who really impressed me was that boy in round one (Don't know his name but he wrote it in blocks and not on the lines on the front page. I previously wrote a comment about total inability to complete tasks) This time he seemed to cope much better. Previously I was convinced that he had no command of English at all- yesterday he gave opinions, stole sweets and challenged me on my requests. Quite a turn around. In your observations compare the way in which they wrote their names. I got the feeling that their letter

formation had improved Their ability to sense time and time structure was better. They were aware that it was break and when it started and ended. Last time they worked into break and were not aware of it. There was a general maturity that was not there previously. All the kids seemed to be able to Cross Crawl and do all of the exercises. You will need to compare your observations of this from when you did exercises with them last time.

FACILITATOR: *What a job!*

Factors I feel compounded the results:

- 1 Language factor – inability to understand instructions of facilitator due to second language.*
- 2 Unstable home environments – emotional factors influencing results as can be seen in one or two drawings. Improvement in certain facets and deteriorate in others within the same exercise.*
- 3 Added attention induces improvement versus intervention results.*
- 4 Pre-tests were done in pencil and the post-tests in pens.*
- 5 Instructions were not standardised between facilitators.*
- 6 Difficulty of learners understanding the language.*
- 7 Time constraints impacted on completion of tasks.*

General comments:

- 1 More at ease during post-test – know what is expected of them.*
- 2 As a facilitator more at ease post-test due to familiarity with task.*
- 3 Sharpening pencils during pre-tests was very distracting.*
- 4 Student more cooperative the second time with respect to following instructions.*

Summary of interviews and feedback from facilitators.

It was the first experience any of the facilitators had had of a grade one class in a previously disadvantaged community. They were unanimous in their agreement that it is close to an impossible task to teach such a diverse group of children

who do not share a decent command of the language of instruction, which is English. They all commented that despite the situation, some children still seemed to learn and be on the same standard as children from more advantaged communities. They “took their hats off” to these educators.

There was a marked difference in the written feedback from the various facilitators. Therefore the researcher separated the feedback from the intervention group facilitators and the control group facilitator, because she only documented comments that were confirmed more than once.

The two facilitators who were randomly allocated to the intervention groups both commented independently on a noticeable improvement in behaviour, participation, confidence and learners’ ability to write their own names. They got the impression that they had an improved sense of their own worth (which was generally also noticeable in their drawings). These two facilitators also mentioned that the learners seemed to be more independent, completed their tasks on their own and copied less from each other.

The one facilitator mentioned that she was not in a positive frame of mind when she started out with the post-tests and hence some of the feedback seems to contradict itself. The feedback recorded in the previous paragraph doesn’t reflect the comments that were only mentioned once but not elaborated on, it only reflects the comments that were elaborated on and indicated more thought.

The facilitator from the control group commented on learners’ inability to comprehend instructions, emotional factors influencing their performance and that she and the learners were more at ease during the post-tests. During the post-testing she also noted that the learners were also more co-operative in following the instructions. In general she noted that the learners found it hard to complete the tasks within the allotted timeframes.

6.5.1.2 Artefacts

The artefacts collected for this study include a video recording as well as three paper activities and will be discussed briefly.

VIDEO RECORDING

The researcher, who noted the following changes, compared to the first day the learners did Brain Gym evaluated the video recording made during one of the unscheduled visits. The changes noted were described as follow:

- 1 The learners were keen to do the exercises and excited to show what they knew. They showed obvious pleasure in doing the movements and approached them with confidence.
- 2 In one of the intervention groups, the educator exerted a lot of control on the learners resulting in a lack of spontaneity to such an extent that she instructed the learners when to breath.
- 2 She also misinterpreted some of the exercises resulting in the cross lateral crawl being done crawling on all fours, which was impractical in the confined space available.
- 3 The other intervention group educator had a more caring attitude and showed enjoyment doing the movements with the learners and in her support of the learners who were battling.
- 4 Eye exercises were difficult initially, resulting in lots of eye rubbing, which did not occur as often on the video. The eyes were generally also able to follow the thumbs more easily without any need to turn the head to be able to follow the thumb, which indicated an increase in near focal visual integration skills.
- 5 When doing the cross lateral crawl the first day, the majority of the learners did a homolateral crawl, indicating low levels of left and right integration across the midline. On the video just a few of the learners needed support to cross their midlines, indicating a definite increase in brain patterning.
- 6 Even after extensive explanations and demonstrations, a noticeable percentage of the learners hesitated before they could start the movements and required encouragement and even physical support to be able to execute some of the movements. After the six

week period there was a greater level of flow and fluency in the movements, indicating heightened levels of coordination.

- 7 Quite a few learners appeared to be clumsy the first time, but were more co-ordinated and controlled in their movement during the video recording. Their sense of balance also seemed to have improved, which would ultimately result in an improvement in spatial relationships and handwriting.
- 8 When doing the Thinking Caps (an ear exercise rubbing the Pinna or outer ear) the learners initially experienced difficulty in following the shape of their ears. When observing the Thinking Caps on the video, the learners' hands moved with certainty around the parameter of ear after the intervention period.
- 9 There was little space available in the classes, but it did not hinder the groups in doing the movements. Not one of the educators considered doing the movements outside the classroom on the lawn.
- 10 The discipline in the intervention groups was not disrupted substantially. When the learners got up to move, there was a fair amount of talking and noise, but in general they seemed to respond better to instructions.

No recording was made of the control group, due to battery failure, but the following was documented:

- 11 The control group continued their daily tasks and enjoyed the songs and rhymes. No short stories were told.
- 12 The control group teacher had a calming and confident manner, which echoed in the behaviour of her learners.

THREE PAPER ACTIVITIES

The three paper activities performed were draw-a-person, drawing a Lazy 8 and completing a pattern around the edge of an A4 page. These activities were completed with pencil during the pre-tests and in pen during the post-tests. The choice of instrument was changed due to the amount of time spent in sharpening pencils during the pre-tests.

Draw-a-person

Each learner's post intervention drawings were compared to the pre intervention drawings and general changes were noted. A substantial number of learners in the intervention group drew more detail or added a line to indicate a level of groundedness. Quite a few of the drawings were bigger and clearer with fewer extended arms, indicating a decline in the learners' sense of helplessness.

A few of the drawings in both groups deteriorated, but showed noticeable signs of anger and aggression (sharp nails, prominent mouths, bulging eyes and hard lines) or signs of depression (small faint drawings in the top corner).

Drawing a Lazy 8

The eights drawn by the intervention group were more balanced in shape and coordinated in movement. Quite a large percentage of the learners' eights were bigger at the top indicating that their eyes were more comfortable moving into a visual position. The penmanship also seemed more controlled - an observation that was confirmed by the intervention group facilitators. In comparison, the Lazy 8's completed by the control group stayed more or less the same.

Completing a pattern

This activity showed by far the most noticeable changes. In general the control group's work was well done and stayed well done. The intervention group did well during the pre-tests in maintaining the pattern, but the majority of the learners did not complete the pattern around the edge – they either made the

shapes bigger to fill the space or simply abandoned the task when the time was up.

During the post-test more often than not their shapes stayed the same size, their shapes were better defined and the majority of learners completed the task within the allotted timeframe. This activity indicated an improvement in concentration, near focal skills and penmanship and to a lesser degree the ability to cross the visual midline.

6.5.1.3 Categorised general perceptions

The feedback from the principal, educators, facilitators and observations made by the researcher (based on the video recording and paper exercises) indicated a large variety of improvements in the intervention group.

The researcher chose to move beyond the basic description and constructed categories to capture some recurring patterns in the data as indicated in the following tables. The data was combined to note improvements, the meaning the researcher attached to these improvements and the emerging categories.

The categories were constructed in terms of the key concepts as discussed in chapter 5 to enable the researcher to evaluate the claims about the effectiveness of Brain Gym in the classroom and in so doing address the research question.

Table 6.13 Summary of qualitative data and category formation – principal

INSTRUMENT	IMPROVEMENTS NOTED	CATEGORY
Principal	<ul style="list-style-type: none"> •1 General improvement - Positive impact of intervention •2 Literacy - reading skills, which also implies visual skills •3 Numeracy - maths ability, moving from concrete to abstract reasoning •4 Self improvement – empowerment and self management 	Self concept Independence Visual skills LandR brain integration Crossing visual midline LandR brain integration Mathematical computation Independence Self concept Independence Concentration

Table 6.13 indicates that according to the principal, improvements have been noted in all key concepts.

Table 6.14 Summary of qualitative data and category formation – educators

INSTRUMENT	IMPROVEMENTS NOTED	CATEGORY
Educators	<ul style="list-style-type: none"> •1 Handwriting – indicates an improvement in eye-hand coordination and near focal skills •2 Maths – reasoning ability and left and right brain integration 	Eye-hand coordination Visual skills LandR brain integration Mathematical computation

visits, evaluating the video as well as the three paper activities, improvements have been noted in all key concepts.

In summary the feedback from the principal, educators, facilitators and the researcher indicated a noticeable improvement in: reading ability (recognising more words, reading fluency and requests for reading material), numeracy (don't need to count on toes, work independently), handwriting (writing in a straight line), concentration, task completion, enthusiasm, 'helping themselves' and confidence to complete tasks on their own. The educators have also noted improvement in their own functioning affecting their concentration, thinking and their ability to feel more awake.

6.6 SUMMARY OF CHAPTER 6

Chapter 6 served to describe the implementation of the Brain Gym intervention at Ennerdale Primary School with three groups of grade one learners. It also described the process of collecting and analysing the qualitative as well as quantitative data for interpretation in chapter 7.

CHAPTER 7

SUMMARY OF FINDINGS, LIMITATIONS AND RECOMMENDATIONS

7.1 BACKGROUND

This chapter will ascertain whether the research question has been addressed. In an attempt to meet this objective, the essence of the research will be summarised as well as the subsequent findings and conclusions thereof.

The limitations and shortfalls of the study will also be discussed prior to making recommendations for future research.

7.2 SUMMARY OF FINDINGS RELATED TO RESEARCH QUESTION

The primary research question is: Can Brain Gym promote whole brain learning and in so doing contribute to learner effectiveness and independence in South African schools?

The sub-questions supporting the primary research problem is:

- 13 What is the current situation in South African schools in terms of academic achievement?
- 14 What are the most prevalent learning difficulties and factors contributing to these learning difficulties?
- 15 What is learning?
- 16 What is Brain Gym?
- 17 What is a Dominance Profile?
- 18 Can Dominance Profiles and Brain Gym potentially be mental and

emotional self-management tools for educators and learners to overcome learning difficulties?

According to (Heppner *et al.*, 1999:525) findings related to research questions and sub questions should be organised so that the results of specific statistical and other tests can be tied to the research questions. To be able to discuss the findings, the meaning and the implications thereof in the light of the purpose for which the research was undertaken, it necessitates a brief summary of this study.

The need for techniques to enhance learning effectiveness in schools and the claims by Dennison and Brain Gym practitioners stating that Brain Gym can address an extensive range of learning difficulties within a period of six weeks motivated the researcher to embark on this study to evaluate the merit of these claims. Attempting to evaluate these claims within a South African context necessitated a closer look at the current reality in South African schools.

To address the sub-question “What is the current situation in South African schools in terms of academic achievement”, feedback from a sample of educators indicating the range of challenges they need to contend with on a daily basis as well as the opinion of the public (as expressed in the press) have been described in chapter 2.

To address the sub-question “What are the most prevalent learning difficulties and factors contributing to these learning difficulties”, feedback on the current reality was categorised to identify the most prevalent learning difficulties, which were identified as language and literacy difficulties, maths difficulties as well as difficulties in concentration and motivation.

To evaluate the claims about the effect of Brain Gym on learning difficulties and address the sub-question “What is learning and how does it take place”, the concept **learning** needed to be clarified. Chapter 3 served to clarify the concept as well as to investigate the possibility of enhancing the ability to learn. The literature study indicated that all learners have the potential to learn by accessing

the optimal learning state called the **whole brain state**. This background served as a framework to evaluate Brain Gym on a theoretical basis.

To address the sub-questions “What is Brain Gym” and “What is a Dominance Profile?” and thus scrutinise the scientific foundation of Brain Gym, a literature study was attempted in chapter 4. This was accomplished by defining Brain Gym as a technique that enhances the whole brain state while addressing learning difficulties through removing physical barriers to learning.

The urgent need for techniques to effectively address the prevalent learning difficulties in South Africa necessitated a further evaluation of the claims stating that Brain Gym is such a technique, in the form of empirical research. If these claims were substantiated, it would follow that Brain Gym is a technique that can easily and cost effectively be introduced into schools to empower educators and learners in order for them to master the process of learning.

To address the sub-question “Can Dominance Profiles and Brain Gym potentially be mental and emotional self-management tools for educators and learners to overcome learning difficulties”, a Brain Gym intervention was designed and implemented. In chapter 5 the research design for the scientific evaluation of Brain Gym was described, while chapter 6 served to describe the implementation of the Brain Gym intervention and the results and methods utilised to obtain these findings.

This chapter thus serves to present a summary of the findings and to address the sub-question “What are the results achieved by doing Brain Gym in the classroom”. The findings are the results of both qualitative and quantitative measuring instruments so that the research question is approached and analysed inductively by the researcher (qualitative research) and deductively by statistical methods (quantitative research).

7.2.1 Summary of the quantitative research findings

A summary of the quantitative research findings will be presented in terms of the results of the descriptive statistic and the results of the inferential statistics.

7.2.1.1 Summary of the descriptive statistics results

The research sample was randomly divided into one control group and two intervention groups. To optimise the possibility of comparative data, the control and intervention groups were further evaluated in terms of gender, age and home language.

Differences in the results of scientific research can only be explained in the control and intervention groups where control = intervention and where pre = post. According to gender and language groups no significant difference was indicated. According to age there was a significant difference ($p = .000$). The Mann-Whitney test was then undertaken to ascertain whether age had an impact on the scores. No significant difference was found between the groups when age was used as the grouping variable ($p > .05$).

The above indicates that results were comparable even though there was a significant difference in age between the control and intervention groups.

7.2.1.2 Summary of the inferential results

Analysis was done to evaluate if there was a difference between the pre-scores and the post-scores of the control group and the intervention group. In the control group there was a difference in the pre and post-test ranks in the case of Spatial, Reasoning, Numerical, and Gestalt. No difference was found in Perception. This meant that with 95% confidence the pre and post groups differed significantly.

In both the intervention and control groups a difference was noted in the pre and post-test ranks in Perception, Spatial, Numerical and Gestalt. No difference was

found in Reasoning. Reasoning did improve but not significantly ($p = .061$). In Perception, Spatial, Numerical and Gestalt the post mean scores were higher for the intervention group indicating that this group improved significantly in these variables (with 95% confidence).

The Mann-Whitney test was conducted due to the fact that changes were recorded in both the control group and the intervention group. Differences were found to exist between the control group and intervention group in the pre test with respect to the Gestalt variable ($p = .006$). Therefore the null hypothesis was rejected, because the control and intervention groups were significantly different in the pre-test and therefore no valid conclusions could be made as to significant differences in the post tests for Gestalt.

The differences in the post-tests were analysed and in the post-test ranks for Perception, Spatial and Reasoning there were no significant differences between the control and intervention groups ($p > 0.05$). In the case of Numerical, a significant difference existed ($p = .000$).

In the case of the Numerical mean score, the control group had a higher post value than the intervention group, indicating that the control group improved more than the intervention group in Numerical, but due to the $p > 0.05$ in both the control and intervention group the H_0 could not be rejected, meaning that there were no significant differences between the two groups in terms of Reasoning, Spatial, Perception, Numerical and Gestalt.

It could thus be concluded that the quantitative results yielded no significant results, which indicated that the six-week Brain Gym intervention for the grade one learners in Ennerdale Primary School did not have a measurable effect on the ASB test scores.

7.2.2 Summary of the qualitative research findings

The qualitative research revealed how all the parts worked together to form a whole, based on the pooling of judgement of the principal, educators, facilitators and researcher to establish validity using several sources of data such as interviews, observations and materials.

The feedback from the principal educators, facilitators and the researcher independently indicated a noticeable improvement in all key concepts, being:

- Left and right brain integration
- Crossing of the visual midline
- Eye-hand coordination
- Mathematical computation
- Self image
- Concentration.

7.3 CONCLUSIONS

The findings of the quantitative data indicated that the six-week Brain Gym intervention did not bring about measurable improvement in the key concepts as measured by the selected ASB subtests.

The findings of the qualitative data supported the claims made by Dennison and Brain Gym practitioners by indicating improvements in all the key concepts.

The discrepancy between the quantitative and qualitative findings can be understood within the context of the Triune Brain Theory, where the quantitative data reflected improvement on an academic level and the qualitative data reflected improvement on a physical and emotional level. According to MacLean's Triune Brain Theory physical and emotional development is a prerequisite for development on an academic level. It would thus follow that emotional and physical development would be more noticeable within a short

time span like a research period of six weeks and would thus account for the discrepancy in quantitative and qualitative findings.

The research period of six weeks were chosen because claims were made that academic skills can be improved within a period of six weeks. This same time frame was reflected in the international studies on Brain Gym as referred to in chapter 4.

From the findings it can be concluded that the Brain Gym programme did promote an improvement on a physical and emotional level within six weeks, but did not promote measurable improvement on an academic level as indicated by the ASB within the same research period.

Even though the claims made about improving academic skills in a short period were falsified within this specific population, it can be concluded that the researcher's contribution to the body of knowledge in describing 1) the effect of physical dominance (as indicated by the Mind Dynamix Profiles) and 2) knowledge that a disruption in the flow of information (between input, processing and output) can hamper development, enables educators to change their attitude and approach barriers to learning in a new way.

It can further be concluded that a change in attitude is not enough to address these developmental deficits or promote whole brain learning. Educators also need simple cost effective tools, with which to bring about change in the classroom. These tools can be repeated physical movements to stimulate both eyes, ears, hands, legs and different parts of the brain to create a common denominator in all learners – the ability to learn from a whole brain perspective.

The value of this study is that targeted physical movements pose a practical and cost effective solution to address barriers to learning. This is done by promoting whole brain integration to produce the optimal learning state – whole brain learning. The ability to stimulate whole brain learning transcends barriers to

learning like learning styles, frames of reference, language barriers and levels of sensory integration and offers a solution to learners within the diversity of South African schools. Because whole brain learning enables learners and educators to manage their own mental and emotional states, this study showed that targeted movements increase the chances of achieving academic success.

7.4 LIMITATIONS OF STUDY

The events that could possibly have had an influence on this research study and contaminated the data are called uncontrolled variables. In this study some of the uncontrolled variables may have been the duration of the intervention, language of learning, correctness and frequency of programme implementation, attitude and competence of educators and facilitators and the 'halo effect.

These variables and the measures to limit their impact have been discussed in chapter 5, but to enable the researcher to address the research question and make further recommendations, it necessitates a brief discussion.

7.4.1 Language of learning

The mother tongue of most of the learners and the educators that participated in this research study was not English. The language of learning in this school is English and therefore the language of evaluation during this intervention was English. Many of the educators and learners were not fluent in English and hence their vocabulary and level of concept forming was limited. Their limited knowledge of English could have impacted on the results, as their means of verbal and written communication was limited.

7.4.2 The duration of the intervention

The intervention period may have been too short to notice significant changes.

Even though claims indicated that Brain Gym could improve a variety of skills within a six-week period, this period may have been too short and could account for the lack of positive qualitative results in this study.

7.4.3 Correctness and frequency of programme implementation

Despite the control measures discussed in chapter 5 and even though the record sheet

indicated that the intervention programme was implemented on a daily basis, it could have reduced the possibility of inaccurate and infrequent intervention implementation if the researcher implemented the programme herself.

7.4.4 The attitude and competence of educators

The groups were randomly allocated to intervention and control groups. Of the three educators, the control group teacher had a more positive and proactive approach to teaching and was the head of department. Both her attitude and level of competence thus could have had an impact on the research results.

The more competent educator of the two intervention groups went on study leave mid the intervention. The other educator undertook to do the movements with both groups during that period. She was an intermediate phase educator and was still finding her feet in the reception phase and thus her attitude and time availability could have impacted on the results.

7.4.5 The attitude and competence of the facilitators

As can be noted from the facilitator's feedback, the facilitator of one of the intervention groups was not in a positive frame of mind during the post-tests and this could have impacted on the research results.

7.4.6 The "halo effect"

Due to the educator of the control group's level of competence, her attitude as well as paying the learners extra attention in the form of rhymes or stories during the intervention time in the other groups, could have had a positive impact resulting in a "halo effect".

7.5 RECOMMENDATIONS

In the light of the value of movement to stimulate whole brain learning, it is recommended that a movement programme is developed and made available to educators to promote whole brain learning in the classrooms. In implementing such a programme more learners would be able to benefit from learning and positively address some of the prevalent learning difficulties. Removing barriers would ultimately result in a confident, competent and agile workforce. Such a workforce would be able to move out of a survival state characterised by poverty, violence, unemployment and AIDS and into a state of self-management, internal locus of control and personal leadership

It is also recommended that the findings of this study are communicated through print media and workshops to educators in South Africa to involve a more extensive target population to embark on a further study. A further study is recommended to evaluate the effect of the above mentioned movement programme on academic achievement by addressing the various uncontrolled variables identified in this study.

**At first people refuse to believe that a strange new thing can be done,
then they begin to hope that it can't be done.
They hope it can't be done because it means seeing the garden in a whole new way.
Then they see it can be done.
Then it is done and all the world wonders why it was not done centuries before.**

Frances Hodgson Burnett

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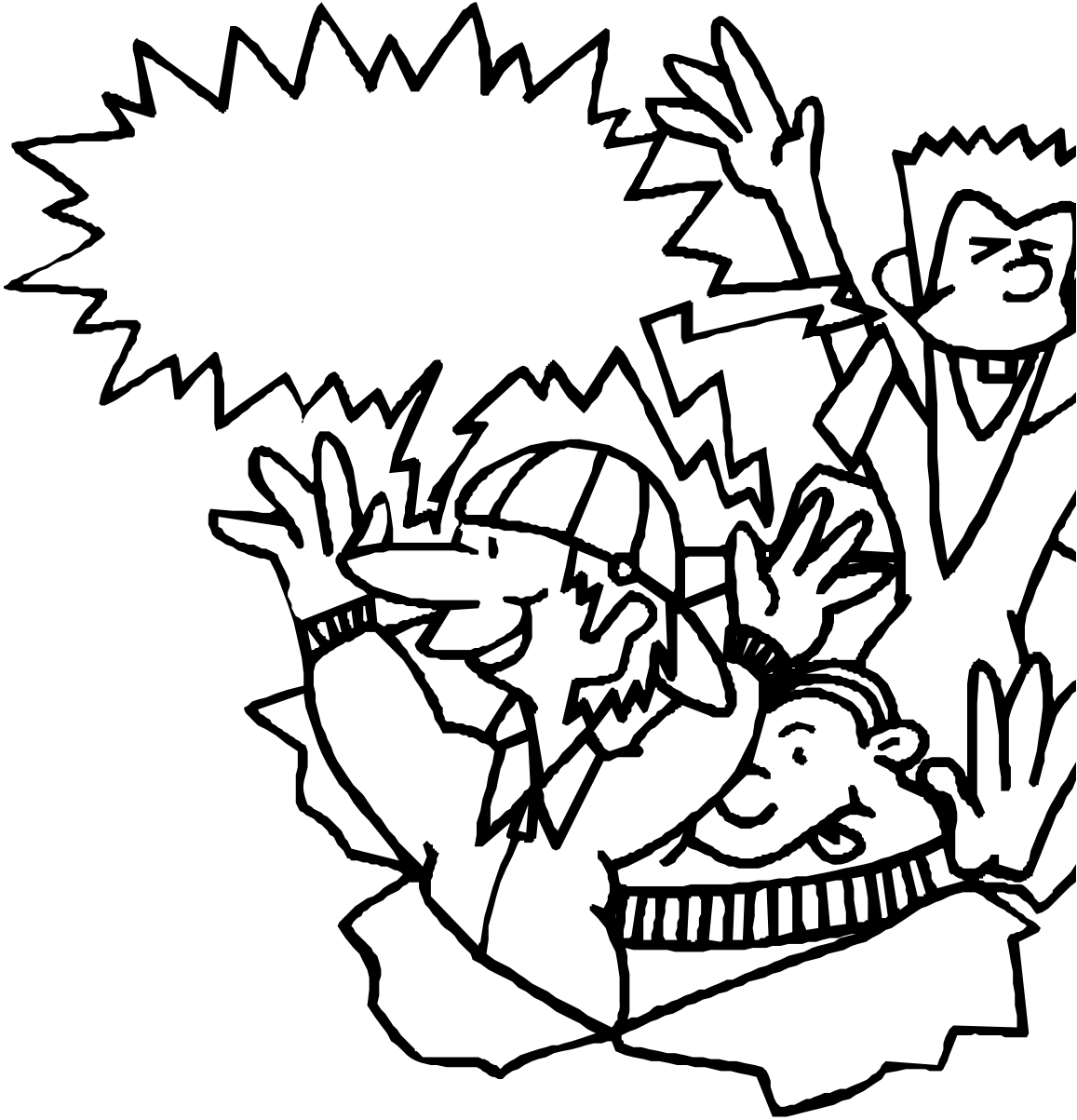
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ADDENDUM 1



Brain Gym® in the Classroom

1) What is Brain Gym®?	3
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1) What is Brain Gym®?

Traditionally, educators have addressed failure by devising programmes to better motivate, entice, reinforce, drill and “stamp in” learning. These programmes succeed only to a degree, often because learners try too hard and in so doing, switch off the brain integration mechanisms necessary for complete learning. The back brain receives the new learning content as an “impress”, but it is not available to the front brain as an express to answer questions, participate and write tests. This inability to express what is learned locks the student into a failure syndrome while impacting on their self-image, confidence, behaviour and motivation.

The solution is whole-brain learning, Brain Gym® is a Whole Brain learning technique that enables learners to access those parts of the brain previously inaccessible to them. The changes in learning and behaviour are often immediate, as they learn how to **receive** learning content, **internalise** it and **express/apply** it simultaneously.

Brain Gym® is a series of 26 quick, simple, task-specific movements of the body. These movements/exercises:

- 1) Stimulate whole brain learning
- 2) Release mental and emotional blocks
- 3) Relax and focus learners.

Movement is the door to learning.

Brain Gym® movements are a simple and effective solution to learning difficulties and are appropriate to address the special needs of learners learning in a modern, highly technological culture. They are a natural and healthful alternative to tension and stress whenever new learning and challenges present themselves.

2) How does Brain Gym® benefit the teacher?

The teacher becomes an expert at identifying behaviours indicating that a learner is having difficulty processing learning content. Brain Gym® enables the teacher to recognise and address learning blocks in a supportive manner in the classroom. It is a helpful technique for teachers to draw out the full potential of their learners in a positive and effective way. Each teacher will have new information and strategies to explain, refine and vary activities for a particular individual, situation or need. Brain Gym® brings fun back to the classroom.

3) How does Brain Gym® benefit the learners?

It helps all learners (young and old) to utilise their innate learning potential in a fun and stimulating way. Brain Gym® movements stimulate new neurological pathways and in so doing address their past failure syndrome experiences and create the possibility of a successful learning future. When given the opportunity to move, learners are capable of completing the learning cycle. With teacher support and the permission to move in the classroom in a positive and constructive manner, learners will unfold their unique intelligence in a way that is natural and easy. They will not be learning blocked; they will be free to learn.

4) **Basic principles of learning**

INFORMATION IN

The first step refers to the ability to observe through the senses by:

- 1 Smelling and tasting
- 2 Seeing
- 2 Listening
- 3 Feeling (through the skin)

PROCESSING INFORMATION

The second step refers to the ability to process what has been seen, heard, smelled, tasted or felt by:

- Critical analysis or interpreting of the whole
- Thinking over what has happened or acknowledging the feelings you have about it.
- Talking about it or just quietly pondering over it

INFORMATION OUT

The third step refers to the ability to respond by:

- 1 Taking action
- 2 Applying the knowledge
- 3 Just knowing about it and contemplating possible actions



Logic Brain Hemisphere
Brain Hemisphere

Gestalt



Processes from pieces to whole Processes from whole to pieces
Language driven
driven
Parts of language
comprehension
Numbers
numbers
Perfectionist
artistic
Analysis, logic
feeling
Verbal and eloquent
drawing, manipulation
Planned, structured
Spontaneous, fluid
Sequential thinking
Simultaneous thinking

Feelings
Language
Application of
Creative and
Intuition, gut
Prefers

Time conscious
 sense
 Structure / task oriented
 oriented
 Reliable and predictable
 Unpredictable
 Neatness / order
 Filing system
 Technique (sports, music, art)
 movement
 Learns best by listening and talking

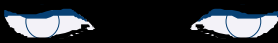

by experience and

Less time
 People
 Atmosphere
 Piling system
 Flowing
 Learns best
 movement

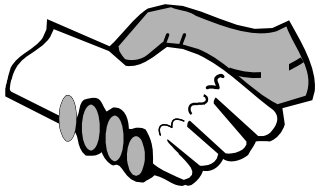
Logic Brain Hemisphere
Brain Hemisphere
Under pressure
pressure

Tries harder, lots of effort
 to reason well
 Without results
 thinking
 Without comprehension
 overwhelmed
 Without joy
 expressing
 Without understanding
 remember details
 May appear mechanical, tense, insensitive
 emotional or


Gestalt
Under
 Loses ability
 Acts without
 Feels
 Has trouble
 Can not
 May appear
 spaced out.

 LOGIC EYE GESTALT EYE	
	

GESTALT EAR	LOGIC EAR



GESTALT HAND	LOGIC HAND

GESTALT FOOT	LOGIC FOOT
	



EYE MOVEMENTS AND

Visual

Auditory

Kinesthetic

5) Stress and Dominance Profiles

When **relaxed**, there is a continuous flow of vitality and information through the body and one can live up to maximum potential. Endorphins are secreted that provide a feeling of well-being and stimulate the immune system. But when experiencing stress, the brain starts to divide its focus and this focus is redeployed away from the thinking part of the brain.

When **stressed**, the survival brain is activated to address the threat by either fighting, fleeing or freezing. The survival brain and the intense experience of anxiety, worrying, fear and depression send high priority messages to the body to be ready for the fight, flight or to freeze up:

- The muscles shorten to strengthen the body,
- The eyes and ears try to observe a full 360 degrees to establish from which direction the “attack” will be,
- The skin goes pale because blood rich in oxygen flows to the muscles - away from the thinking centres of the brain,
- The breathing is shallower,
- And adrenaline starts pumping.

It is very difficult for anyone to learn and work in a consistent atmosphere of tension and stress, because we may not be concentrating and thinking logically and rationally, our memory switches off in order to try and concentrate on the present situation, original and creative ideas are generally inhibited and we function from our basic dominance profile.

6) The 26 Brain Gym® Movements

Traditionally, problems with learning, life and behaviour are addressed by remedial efforts and therapy. **Brain Gym®** differs from this approach by focusing more on the **physical** aspects of learning and behaviour, rather than on the **cognitive (mental)** aspects. Behaviour and abilities are, to a large extent, determined by the physical functioning of the brain and nervous system. If one can revitalise the physical functioning of the brain and nervous system by neurological stimulation, one can change behaviour and abilities with the added bonus of a changed self-esteem.

- **Lengthening activities – releasing learning blocks**
Addressing the survival reflexes
Integrating the receiving back brain and the expressing front brain
- **Energy exercises – relaxing mental and emotional stressors**
Addressing overly mental and emotional functioning
Integrating the emotional brain with the thinking brain
- **Midline movements – stimulating whole brain learning potential**
Preparing the left and right brain for learning
Stimulating eyes, ears and whole body movement to cross the midline with ease

7) Classroom Application

Maths: Thinking Caps, The Elephant, The Owl, Cross Crawl
Spelling: Lazy 8's, Brain Buttons, Balance Buttons, Space Buttons, Earth Buttons, Alphabet 8's
Reading: Lazy 8's, Brain Buttons, Balance Buttons, Space Buttons, Earth Buttons,
Comprehension: Double Doodles, The Grounder, Calf Pump
Communication: Arm Activation, Cross Crawl, Energy Yawn, Calf Pump



A

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