RAISING CHILDREN'S LEARNING AND PERFORMANCE: A STUDY IN A LARGE UK SCHOOL

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PhD

2007

LIVERPOOL JOHN MOORES UNIVERSITY

RAISING CHILDREN'S LEARNING AND PERFORMANCE: A STUDY IN A LARGE UK PRIMARY SCHOOL

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Submitted for the degree

of doctor of philosophy

European Centre

for Corporate Governance

LIVERPOOL JOHN MOORES UNIVERSITY

2007

ABSTRACT

Raising children's learning and performance: a study in a large UK Primary school

Keywords: *children's, learning, development, sound, movement, underlying problems, effectiveness, performance, auditory processing, reflexes, integrated, improvement.*

Raising children's learning and performance and implementing effective strategies to improve standards represent continuous challenges for government policy makers, schools and teachers. Whilst school effectiveness and school improvement policies and strategies have endeavoured to do this through various strategies, the key to sustainable effective improvements in different contexts remains elusive. This study is complementary to school policy studies and provides a different way of raising children's learning and performance. The study also addresses a gap in the literature. The approach adopted was to focus on children through targeting various holistic interventions in the form of sound and movement programmes in order to remediate the underlying causes of under performance by children. The study also adopted a novel approach of combining the two interventions, referred to in this study as an integrated approach.

To date, most studies have focused on external conditions or on the enablers to providing effective learning experiences. In recent years, there have been new and innovative interventions used in private institutions using more holistic ways of improving children's learning and performance. This research builds on this approach and attempts to extend the ideas generated in the private institutions by investigating these approaches in a school context with the hope of furthering the knowledge in this field. In addition, the aim is to propose a holistic model for raising children's learning and performance which capitalises on the work of school effectiveness and school improvement research, to date, in their bid to raise children learning.

To achieve this objective a quasi-experimental, exploratory study which adopted quantitative methods of data collection was used in a school, with four parallel classes

(in total 119 children) aged nine/ten years, using the following standardised tests: Suffolk Group Reading Test, the NFER Non- verbal (NFER Nelson) and TAPS-R (Gardner 1985) Digit Span Test to measure and gain an overall picture of any impact made by the interventions. The experimental study took place over a period of eight months. Two classes completed the individual interventions, whilst one completed both as an integrated approach and one class had no intervention.

Results showed that the movement interventions and the integrated intervention raised overall performance. However, the sound intervention raised only reading performance. The integrated intervention did not show increased results over and above the two individual interventions, leading to the conclusion that it did not generate a significant and marked impact. Based on the empirical findings and on the literature, a model of the Child Centric Learning Effectiveness Cycle (CCLEC) was proposed to help raise children's learning and performance in schools.

DEDICATION

Dedicated to

My husband, Mohamed
Who encouraged and supported me throughout.

My sons
Adel, Bilal and Nadir, for their love and support.

My special friends, especially Joanne.

ACKNOWLEDGEMENTS

The research on which this thesis is based was undertaken at Liverpool John Moores University, European Centre for Corporate Governance under the supervision of Professor Steve Letza and Barbara Walsh. The author is indebted to Professor Letza for his support and supervision, continuing encouragement and valuable suggestions throughout the course of this investigation.

Special thanks are due to all the staff and children at the school in West Yorkshire who made this research possible.

My special thanks and appreciation also go to Elizabeth Moody.

In addition, my special thanks and appreciation are extended to Dr. Riyad Eid, Alan Keoy and Kjeld V. Johansen for their support.

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CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND

The importance of raising child levels of learning and performance and implementing effective strategies to raise standards presents continuous challenges for government policy makers, schools and teachers. Whilst school effectiveness and school improvement policies and strategies have endeavoured to do this through various methods, governments have for some time wrestled with failure to deliver expected outcomes and, when delivered, failure to sustain the results and to transfer them from one context to another. Harris and Chrispeels (2006, p 6) point out that:

> 'The evidence to date is that many of these external interventions though well intentioned have had patchy and variable successes.'

The context of this research lies in an attempt to fill a gap by focusing on children and by targeting various holistic interventions in the form of sound therapy and movement, and studying the resulting impact on learning to investigate the outcomes of combining the two interventions in an integrated form. The aim of a movement programme is to treat the underlying causes of learning and behavioural difficulties, by using activities and movement patterns, to develop neurological organisation; in some cases by integrating reflexes, in others addressing coordination difficulties and in some cases all of these. The sound therapy aims to specifically enhance auditory processing, to affect brain plasticity and to reduce hypersensitivity. Auditory processing problems may affect the processing of information received by the ear although the individual's performance on pure tone hearing tests may be normal. These have emerged in recent years and have been used in private practice clinics. They take into account more holistic ways of improving children's learning and performance.

Some examples of interventions, to date, have included channelling resources into schools, restructuring the curriculum, evolving quality assurance systems, stating standards, assessments, setting targets, leadership initiatives (Sammons et al., 1995), accountability attempts such as Ofsted inspections (Earley, 1996), performance related

pay (Ladd, 1999), networking (Jackson, 2003), benchmarking (Kelly, 2001), additional funding and resources such as reading recovery (Burroughs-Lange, 2006), and teaching assistants (Hancock, 2001). In 2005 a few examples of these schemes included Sure Start aimed at 3 to 4 year olds, Building Schools For The Future, Every Child Matters, Key Stage 3 national strategy, Harnessing Technology, Higher standards, and Better Schools for All - 2005 (DfES, 2005). Yet the results yielded by most were disappointing.

Many different theories have been put forward as to why children, in the opinion of policy makers, are still failing to reach their full potential. Thrupp (2005) talks about outcomes being affected by school policies and practice rather than school mix. Brookover et al., (1979) assume that school climate rather then family background has more direct effect on outcomes. Coleman (1966) believes school makes little difference to outcomes. This was reinforced by other researchers, in particular, Jencks (1972), Bowles and Gintis (1976), Sewell and Armer (1966) and Hauser (1970) who concluded that peers made a difference to pupil's performance and achievement and not school. In the following decade, researchers such as Mortimer (1991) disputed this and school effectiveness research argued that the school can and does affect pupil's performance and achievement and that the education process, environment and structure are important.

To date, interventions seem to show that these government policies and interventions bring some improvement but it is not always sustainable and it is dependent on different contexts and school factors. In addition, many interventions are costly and some seem to be returning to what has been done previously, such as the drive to get back to the method of teaching reading using phonics. Some of them are heavily dependant on people and most worryingly some of them are highly demotivating and stressful, such as Ofsted and league tables, whilst others are highly demanding of teacher input and time. Some realise that the child has a role to play but only background, culture and socio-economic effects are taken into account, not the child himself. None seem to be targeting the child or investigating the underlying cause of some children's failure to learn. Most seem to be external to the child and as Chapman (2005, p 135) states: 'there is little evidence to suggest that external interventions have made a significant difference to examination results'.

This leads to questions about the importance of interventions to date and there needs to be an understanding not only of how schools, teachers and other factors interact to raise standards and improve learning, but also how to identify and alleviate the underlying problems that children may have. Thus, there seems to be an opportunity for enhancing learning and raising standards in schools. It appears that gradually people are looking towards alternative ways which will put the child at the centre of all endeavours. Schools are complex organisations and there are no single solutions or quick fixes. Of course there are facilitating factors that affect children's performance such as the management, pedagogy, the school environment, resources, leadership and teachers. However, most of the focus, to date, has been on external conditions or on the enablers to providing effective learning experiences. There appears to be little research looking at the child in terms of:

- The challenges to raising standards.
- Understanding the underlying problems which constrain effective learning.
- Developing customised strategies that can help unleash potential and enable learning in different contexts.

1.1.1 Learning and Effectiveness Challenges

It has become more and more important to try to identify the factors that influence and predict children's outcomes in numeracy and literacy as Local Education Authorities (LEA) report the levels of attainments in these core areas of the curriculum. Such reports inevitably influence parental choice and the popularity of schools and hence the morale and teaching of those schools. The literacy hour, launched in 1998 to raise standards has still left concerns that reading standards are poor generally. The recent Primary Review found that standards had 'barely improved' since the 1950s (Tymms and Merell, 2007). In the past some politicians and policymakers have found it possible to deny their role in 'failure' by shifting all the blame onto individual schools (Myers and Goldstein, 1997 in Stoll and Myers, 1998). This could have been due to the frustrations of trying to understand why some strategies implemented did not produce the results expected and that the cause was not identifiable. Coe and Fitz-Gibbon (1998) argue that some schools are be characterized as 'ineffective' which is unhelpful since

schools are blamed for outcomes over which they have very little control. This once again highlights the need to identify underlying causes.

It is well established that phonemic awareness is a prerequisite for learning an alphabetic writing system. McGuiness (1997) advocates that phonics must be explicitly taught to new readers and in remedial reading courses. It seems common sense to make sure that the processes for allowing this to happen are in place i.e. an efficient auditory processing system through the use of sound therapy. Studies in the past have shown that manipulating sounds in language as in the teaching of phonics is vital (Torgesen 1997). The new Early Years Foundation Stage that will be implemented from 2008 and 'require high quality work' (phonic). Recognition, intervention and management of poor auditory processing skills, through the use of sound therapy, could strengthen early literacy skills since it will make the teaching of phonics more effective. In order for these strategies to be effective more consistently, these underlying functions have to be effective and functioning at an optimum level.

A further challenge to learning effectiveness is the issue of raising aspects of memory, which is vital; a study that evaluated the Literacy Pledge Initiative to improve reading led to the conclusion, from teachers, that retention ability and poor memory of the children accounted for the poor progress (Cuckle and Shorrocks-Taylor 1999). This has huge implications in learning complex skills such as reading. In addition, Gathercole and Pickering (2001) investigated the relationship between children's performance in national curriculum assessments and working memory. Their study provided evidence for a direct link between working memory abilities and pupils' performance on national curriculum assessments. Children with learning difficulties in the area of literacy exhibited marked deficits in complex working memory (de Jong 1998; Siegel and Ryan 1989; Swanson and Alexander, 1997; Gathercole and Pickering, 2000), and suggests that the capacity to process and store material is vital.

The high reliability school project (Reynolds et al., 1998) to generate 'failure free schools' based on the premise that air traffic controllers are given no leeway for failure still did not generate the expected outcomes. There seems to be an assumption by the government that, once the interventions are put into place, the children will receive the benefits and yet this is not always the case. The question needs to be considered as to

whether teachers are having difficulties because of 'unreliable equipment', in this case the reliability of the ability of the children to process the learning and take in the information.

It has been ten years since Barber's (1997) preliminary report of the literacy task force proposed a ten year programme to raise the standards of literacy, making specific suggestions about the time that should be spent on it in schools and how schools should work together towards achieving targets for every child by 2006. In 2007 it was reported that reading standards for schools had fallen from third to nineteenth place even though more than £600 million had been spent on literacy schemes in primary schools since 1998 (Daily Mail, 2007).

Against this background of emerging literature on movement interventions, research shows links between reading difficulties and motor coordination (e.g. Dewey et al., 2002; Fawcett and Nicolson, 1992; Kadesjo and Gillberg, 1998; Kaplan et al., 1998; Theberge, and Zvi, 1995; Nicolson and Fawcett, 1990, 1994, 1999; and Ramus et al., 2003). Palmer (1984), in his study, found a link to the implementation of a movement programme and reading. Other studies have linked the reflexes with children's learning studies (such as McPhillips et al., 2000; McPhillips and Sheehy, 2004; McPhillips and Jordan-Black, 2006; and West et al., 1998). Morrison (1985) linked the lack of reflex integration into the developmental/coordination/sensorimotor debate and stated that there was a link between reading problems and learning difficulties, and primitive reflexes. These primitive reflexes are involved in the development of the central nervous system and develop in a regular sequence. Each reflex plays a part in the development of the child and prepares the way for the next stage of development. In terms of the other intervention in this research, sound therapy, there may be difficulties with auditory discrimination – important for reading and spelling – and this may be due to 'distortions' of speech sounds at the cortical level (Mencher et al, 1997). Further, the ability to automatically notice, think about, or manipulate the sounds in language has been linked with child learning (Torgesen 1997). There may be auditory distractibility, or hypersensitivity to loud sounds and large differences between verbal and performance IQs (Musiek and Geurkink, 1980) which can also affect the ability to learn. Some children with auditory processing weaknesses may have difficulty perceiving and discriminating sound, attending to sound, localizing sound as well as other problems

(Bellis, 1996). Nicolson and Fawcett (1998) concluded that children with dyslexia suffered deficits in skills not only including phonological skill, but also picture naming speed, bead threading and balance.

1.2 RESEARCH PROBLEM

There have been suggestions that movement programmes can help with learning disabled children (Farnham-Diggory, 1992; Kephart, 1971) and studies have shown that interventions involving a movement skills programme have resulted in improvement in motor tasks (Cammisa, 1994). Rigorous scientific research in this field has been limited and there is a scarcity of evidence on the effect on academic skills and improving children's learning. However, the work of McPhilips et al., (2000, 2004, 2006) with 'normal' children on primitive reflexes, has begun to lead the way in this hugely important and unexplored area. Their positive and significant findings on the reflexes and their link with learning has led to the use of movement programmes in schools in Northern Ireland, indicating the importance of neuro-development (normal childhood developmental stages) in raising child learning, indeed, in Sweden children are assessed for developmental aspects when they enter school.

Suggestions have also been made that movement programmes may have had some kind of positive impact on the cerebellum which is where movement is initiated. Links have been noted between the cerebellum and language, and Fulbright et al., (1999) have identified evidence from PET scans investigating brain functioning, that the cerebellum is involved in both language and cognitive skill, including specific involvement in reading. There has also been evidence of the importance of the cerebellum in language (Ackermann and Hertrich, 2000; Fabbro et al., 2000; Silveri and Misciagna, 2000), including findings of specific cerebellar involvement in reading (Fulbright et al., 1999).

Another area in which movement programmes have an impact is the vestibular system. The vestibular system, located in the inner ear, provides information about gravity, balance and movement. Several studies have linked this to reading and writing in children with learning disabilities. Ayres (1973), Frank and Levinson (1973), and Levinson (1980) found a correlation between vestibular problems and reading and writing in children with learning problems and suggest that such children require a specialized therapy before they can benefit from academic input. De Quiros (1971) and

Levinson (1984) theorised that evidence of a vestibular disorder is predictive of learning disabilities and that the therapy can prevent these problems.

In the field of sound therapy links have been made between sound therapy and learning (Beelan et al., 2005). Erickson et al. (2005), when investigating the relationship between auditory processing and attention and memory, showed that auditory processing measures significantly correlated with each other as well as with some measures of attention, memory and behaviour ratings, whilst Jeyes (2004) and Calhoun (2006) showed links with learning. One of the aims of sound therapies is to develop auditory processing and this fits in line with the government's aims to develop listening and speaking skills as well as the drive to use phonics to teach reading. Kraus et al. (1999) found that auditory discrimination skills are largely developed by age six. Consequently, it is vital to make sure this is on par at this stage.

Pianta and La Paro (1990) stated that responding to literacy difficulties early means the achievement gap is less and the potential for bridging it is increased. The National Literacy Strategy recognized this and introduced teaching that tried to focus on children's needs for their learning. The Early Literacy Support group intervention for children in Key Stage 1 was evaluated (e.g. Soler and Paige-Smith 2005) and demonstrated some success with children who experienced mild difficulties in literacy. Other group teaching responses, focusing mainly on early phonic training, have also reported success with children with less challenging problems, (e.g. Hatcher's, 2006, 'Reading Intervention' and in Clackmannanshire, the Johnston and Watson research, 2005). However none of these evaluations of group intervention report success with the very lowest achieving children and in some cases these were deliberately excluded from studies. Early intervention is important and Vellutino et al. (2004) reviewed intervention studies over forty years and offered positive outcomes for effective early intervention. They concluded that successful intervention can return children to a normal growth trajectory, and those studies that include follow up provide a check on maintenance of this trajectory.

McPhillips (2000; 2005; 2006) provides significant insight into the application potential of the movement interventions for schools in Northern Ireland. He provides some examples of design and implementation. Nevertheless, there is insufficient evidence of

implementation of the two together as a holistic integrated intervention in an investigation for the purpose of verifying whether it can be successful in raising child learning and performance, and to see if basic cognitive capacity to learn can be enhanced either individually by the interventions or together as an integrated approach.

1.3 RESEARCH AIMS

The aim of this study is to contribute to the growing body of knowledge in the field of learning effectiveness and improvement by:

- Exploring the theoretical foundations underlying the raising of child learning and performance.
- Developing a better understanding of this process based on a holistic view.
- Trying to assess the impact of movement and sound intervention.
- Gaining more understanding of the underlying causes that affect children's learning.

In addition, the aim is to propose a holistic model for raising child learning and performance which capitalises on the work of school effectiveness and school improvement research to date.

The two interventions studied in this research are not part of the top down or bottom up approaches that have dominated school effectiveness and school improvement policy to date, but an innovative approach that is child-centric and therefore targets the child. This research attempts to fill this gap by investigating these approaches in school in the hope of furthering knowledge in this field. Skills such as being able to read are highly complicated skills that depend on many facets. It was the ground level factors – the underlying causes and foundations – that were investigated in this study, in an attempt work out ways of raising children's learning in school and to evaluate why so many interventions put in place by the government have failed to yield the expected benefits and results.

1.4 RESEARCH OBJECTIVES

This research was conducted with the following objectives:

- To study the impact of a movement programme (SIMPLE) on children's overall performance.
- To study the impact of sound therapy (The Listening Program) on raising children's overall performance.
- To study the impact of both programmes together in order to see if they made more of an impact than the individual programmes on raising children's overall performance.
- To develop an integrated model that is based on a child-centric approach.

In order to try and ascertain whether there was an impact on child performance and learning, several tests were used to try and obtain an overall profile.

The Suffolk reading scale 2 tests (nferNelson): This is a school based test for reading ability and the results estimate the reading ability of individuals in relation to nationally representative standards.

The non verbal reasoning test (nferNelson): This is a measure of reasoning processes which are widely accepted as being fundamental to understanding and assimilating new information and ideas. It assesses the overall reasoning ability of the children.

Digit span subtests: Components of working memory tests (forward digit span and backward digit span) were used to try and measure cognitive processing skills that could have an impact on a child's abilities to learn (Baddeley and Gathercole 1999).

There were four dependent variables which were combined to give an overall profile of the child's performance and measured different elements of performance. An attempt was made to take into account measures of fluid intelligence and crystallised intelligence, as well as to counter the effect of factors such as ethnic background

(Dollaghan et al., 1997) and maternal education level (Gathercole et al., in preparation, 2002) and various other influences.

1.5 RESEARCH HYPOTHESES

In order to ascertain whether the individual interventions or the combined interventions had an effect on child performance the following hypotheses were stated:

- H1: Class B (movement intervention class) will perform better then class A (comparison class).
- H2: Class C (sound intervention class) will perform better then class A (comparison class).
- H3: Class D (integrated intervention class) will perform better then class A (comparison class).
- H4: Class D (integrated intervention class) will perform better then class A, class B and class C.

1.6 RESEARCH METHODOLOGY

This study represents an exploratory research project which aims to enhance existing theories, and understand the movement concepts and sound therapy from a holistic perspective in relation to enhancing children's performance. To achieve this objective this quasi experimental, exploratory study (as explained below) uses quantitative methods of data collection. The method of data collection for this study was selected on the basis of the outcomes of a pilot study. A more detailed account of all these issues is in chapter six.

The study was divided into three stages:

Stage 1 was concerned with scrutinising the wider body of literature and a pilot study which sought to verify the first set of hypotheses. The first set of hypotheses was concerned with observing the effects of the movement programme (Ansua Developmental Programme) and whether an integrated approach was required in order to raise child performance. The pilot study was also concerned with the feasibility of running the movement programme in the school situation, as well as the response of the

parents and the teachers. The pilot study also helped to inform the next stage of the study which was the main experiment.

Stage 2 consisted of a new set of hypotheses to observe the effect of a new therapy based on sound (The Listening Program) and the impact of an enhanced movement programme (SIMPLE) and of an integrated approach combining the two.

Stage 3 was concerned with the development of an effective learning strategy derived from the key findings of the research which formed the foundations of the suggested strategy that could support the positive performance of children.

1.7 OUTLINE OF THE THESIS

This thesis is organised into nine chapters (Figure 1.1). The following is a brief description of each.

Chapter One provides the researcher's overview of the study, and the background for the later chapters of the thesis.

Chapter Two presents the first part of the literature review of this study. It provides relevant literature from the distinct approaches of school effectiveness and school improvements as well as a merger of these two fields. This chapter discusses these approaches as a context to this study and concludes by opening the discussion on a complementary approach, where the focus is on the individual child's needs which is the main focus of this study.

Chapter Three presents the second part of the literature review. It details the development, the theory and various issues related to movement interventions.

Chapter Four presents the third part of the literature review. It details the development, the theory and various issues related to sound interventions.

Chapter Five is a general chapter on research methodology and presents a classification of the different types of research such as exploratory, descriptive and analytical. It presents the quantitative and qualitative research paradigms, inductive and deductive

research, as well as issues related to applied and basic research. There is a section on general ethical considerations as well as a more specific section on research ethics in relation to children. Various aspects of sampling are also discussed, as well as data analysis and aspects of validity and reliability.

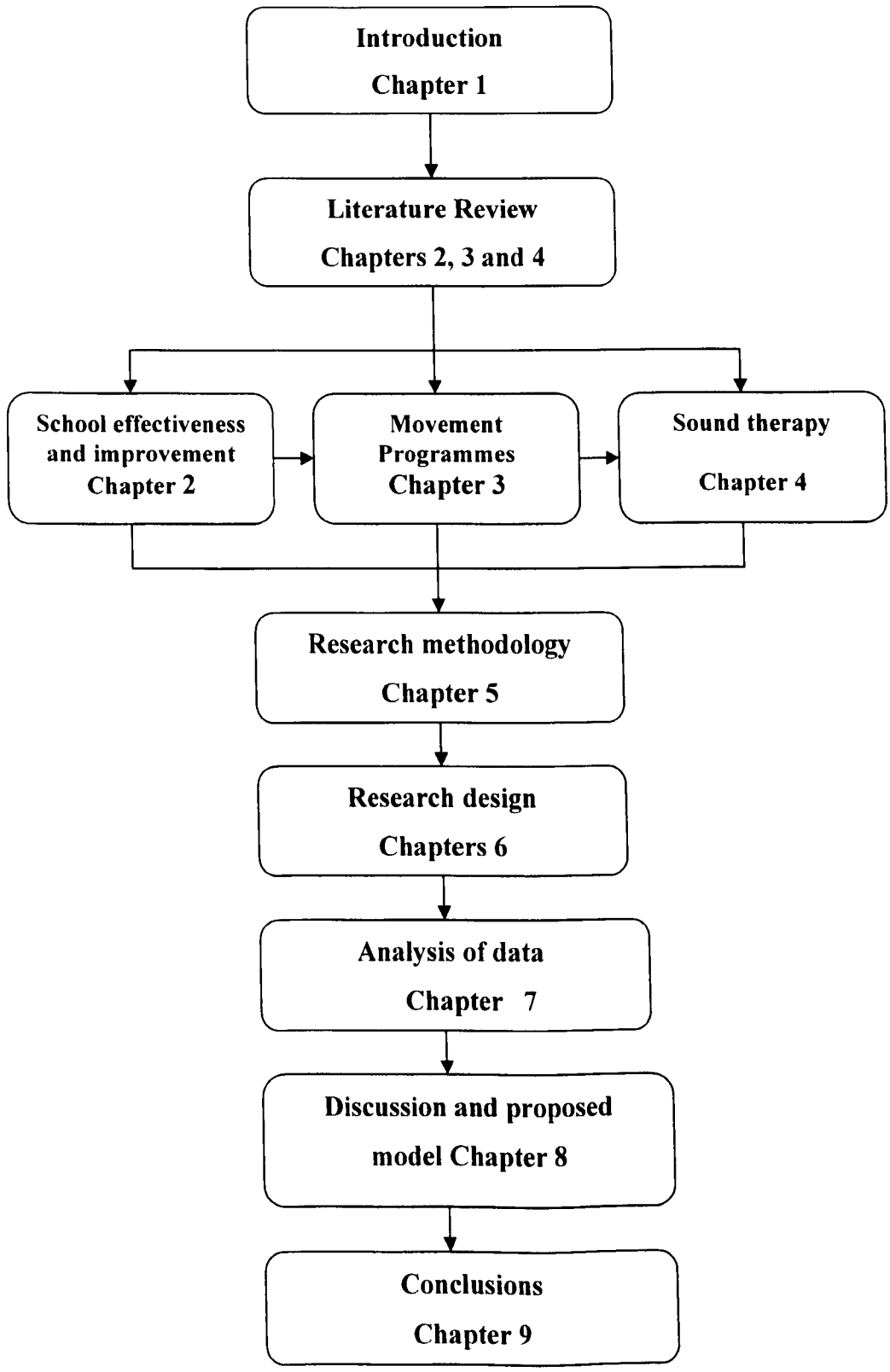
Chapter Six outlines the development of the research methodology used in this exploratory study including the research design and the relevant approaches adopted. In addition there is discussion of the pilot study. Included are issues related to reliability and validity sampling and the ethics of the research, and finally, a detailed description of the Integrated Therapy Experiment Design Model.

Chapter Seven describes and analyses the results from the quantitative data collected from four parallel classes and 119 children in a school.

Chapter Eight provides a comprehensive discussion of the analysis of the results and findings of the data presented in chapter 7, in the light of relevant literature. Based on this discussion, it proposes a child centric model for raising child learning and performance.

Chapter Nine discusses the conclusions drawn from the findings. Furthermore, the limitations and the contributions of the study are discussed, and suggestions made for future research.

Figure 1-1 Organisation of the thesis



1.8 SUMMARY

This chapter introduced the research topic by describing the literature of the study. The learning effectiveness challenges were then discussed and this was followed by the research problems, aims and objectives. The purpose of the study was discussed, which concerns raising children's levels of learning and performance through impacting on underlying problems. Next, the research hypotheses were outlined, followed by the methodology adopted for this study. Finally the outline of the thesis was explained. The next three chapters provide a review of the relevant literature upon which this study is built.

CHAPTER TWO: SCHOOL EFFECTIVENESS AND SCHOOL IMPROVEMENT

2.1 INTRODUCTION

Traditionally, the drive to raise children's academic performance and achievement has focused on two distinct approaches, school effectiveness and school improvement. Educational research, philosophy and ideology have paralleled these two approaches. In the last decade a third approach evolved; effectively a merger of the two approaches. This chapter discusses these approaches as a context to this study. These approaches form a policy framework operating at the national or macro level where the focus is primarily on 'school' and 'teacher'. This could be described as a 'top down' approach. The chapter concludes by opening the discussion on a complementary approach, where the focus is on the individual child's needs, and is child centric, which is the main focus of this study.

2.2 SCHOOL EFFECTIVENESS

According to Mortimer (1991) school effectiveness was initially concerned with refuting the idea that schools made no difference, (Coleman et al., 1996; Jencks et al., 1972) and the view that background factors are the most important factors on pupils' performance (Reynolds and Cuttance, 1992). According to Mortimer (1991), an effective school is one in which pupils progress further than expected when taking into consideration its intake. Further elaboration was made on this by Stoll and Fink (1996) 'each pupil, achieving the highest standard possible, enhancing all aspects of pupil achievement and developing and continuing to improve from year to year.'

The paradigm of school effectiveness originated from the work of Edmonds (1979) and Brookover et al., (1979) and the work of Rutter et al., (1979). This focused on academic outcomes, on studying the formal organisation of the school rather than cultures; a focus on looking at schools and establishing the things that made them effective and using quantitative methods for collecting data. Included in this was 'value added' comparisons of educational authorities in terms of academic outcomes

(Gray et al., 1984; Gray and Jesson 1987; Williams 1987; Woodhouse and Goldstein 1988) and work on the 'scientific properties' of school effects such as size (Gray, 1981, 1982; Gray et al., 1986; Rutter et al., 1979; Tymms 1992). Another aspect was on effectiveness studies to identify the characteristics of more effective schools (Rutter et al., 1979; Sammons et al., 1995).

School effectiveness studies also looked at the difference in terms of socio economic backgrounds or different levels of prior attainment (Jasson and Gray 1991; Goldstein et al., 1993; Simmons et al., 1993). Further studies investigated the effectiveness of departments (Harris et al., 1995; Sammons et al., 1997), school effectiveness (Rutter et al., 1979; Sammons et al., 1997), the quantification of school effects for different pupils (Smith and Tomlinson 1989; Nuttall et al., 1989) and teacher effectiveness in the classroom (Muijs and Reynolds 2002). Mortimer et al., (1988) studied classroom and school processes and concluded that the differences in standards of primary schools were large while Smith and Tomlinson (1998) showed that there was a large difference in effectiveness between secondary schools. Muijs and Reynolds (2002) also focused on the classroom level effectiveness.

One of the main aims of school effectiveness research is the exploration of explanatory and outcome factors using appropriate models (Goldstein 1997). According to Mortimore (1999) it is important to develop reliable ways of measuring the quality of schools. Basically school effectiveness has concentrated on improving effectiveness of schools rather than on systems. The concentration has been on the importance of issues such as the influence of socio-economic background, gender, ethnicity, culture, importance of curriculum and assessment, aspects of effective teaching such as leadership, achievement, orientation-shared visions, and goals. One criticism of this strand is that research based on school effectiveness has not looked at how to make ineffective schools into effective schools and less research has been undertaken on 'ineffective' schools (Reynolds 1996; Stoll and Meyers; 1998 Elliot 1996; Slee at al., 1998; Reynolds et al., 2001; Hopkins 2001; Chapman 2002; Teddlie and Stringfield 1993). In contrast, research on school improvement has focused on the factors that help schools to improve over time; however, data has not been collected to show the extent of evidence about factors.

2.3 SCHOOL IMPROVEMENT

The term school improvement can be used in two ways: as a common sense term connoting making schools a better place for pupils; or in a technical sense to describe the processes that help raise achievement, where, according to Hopkins et al., (1994), the focus is on the teaching and learning processes. Van Velzen et al., (1985, p169) define it as:

> 'a systematic, sustained effort aimed at change in learning conditions and other related internal conditions, in one or more schools, with the ultimate aim of accomplishing educational goals more effectively'.

As far as the school improvement strand is concerned, the tradition of research led away from the top-down approach and externally driven changes in curriculum and organization (Reynolds 1988). The children and teachers became the focus of improvement efforts (Fullan 1991; Hopkins et al., 1994). This paradigm emphasised schools and staff driving the change and taking ownership (Fullan, 1991; Hopkins et al., 1994). The roles of the teachers, head teachers, governors and parents were part of the process of improvement (MacBeath et al., 1996; Rudduck, 1996; Rudduck et al., 1996; MacGilchrist et al., 1997; MacBeath, 1998). The end destination was not important but rather the journey was the focus, and because of this processes were important. The research was qualitative and rather than looking at snapshots, it was more sustained and was longitudinal. There was a focus on school culture rather than school structure (Gray et al., 1999).

School improvement attempted to develop organizational culture and capacity and this has been a very important element of school improvement research and practice (Barth 1990; Harris 2002; Brighouse 2000; MacBeath et al., 1996; MacBeath, 1999; and Fullan 1992; 1993). Several studies on school improvement have focused more on the effect of managing change and its conceptualization and the role of change agents in positively affecting the outcomes of change programmes on school effectiveness. Hopkins et al., (1997) on the other hand argued that it was important to understand school improvement from a system perspective, both at overall school level and in the classroom situation. They advocated models and frameworks which could facilitate this process. Descriptive analyses of in-school cultures and power

relationships have also been studied (Ball 1987; Hargreaves, 1994, 1995; MacGilchrist et al., 1997; Stoll, 1998; Bishop and Mulford, 1999; Freiberg, 1999). Individual improvement initiatives have also been evaluated (Stoll and Fink, 1992; Myers, 1995; Earl and Lee, 1998; Hopkins et al., 1997a; Slavin et al., 1992).

The table below shows a summary of the separate traditions of school effectiveness and school improvement.

Table 2-1 Separate traditions of school effectiveness and school improvement

School effectiveness	School improvement
Focus on schools	Focus on teachers
Focus on organisation	Focus on school processes
Data-driven, with the emphasis on outcomes	Empirical evaluation of effects of changes
Quantitative in orientation	Qualitative in orientation
Lack of knowledge on how to implement to change strategies	Exclusively concerned with change in school
More concerned with change in pupil outcomes	More concerned with journey of school improvement than its destination
More concerned with school at one point in time	More concerned with schools as changing
Based on research knowledge	Focused on practitioner knowledge

(Reynolds et al., 1996 in Chapman, 2005 p 9)

2.4 A NEW PARADIGM FOR IMPROVING SCHOOLS

In the main, the paradigms of school improvement and school effectiveness traditionally remained separate, not only in their methodology but in their focus. School effectiveness focused on outcomes and characteristics of schools and

classrooms associated with these outcomes, without looking at the processes that are needed to bring about the change. School improvement, in contrast, was mainly concerned with changing the quality of teaching and schools, without looking at outcome. Stoll et al., (1998) in Harris and Chrispeels (2006, p 91) stated that:

> '...in short, school effectiveness was trying to find out what needed to be changed in schools to become more effective while school improvement was trying to find out how schools brought about the process of change.'

In more recent years the trend has been to incorporate both the aspects of school effectiveness and school improvement together in a more pragmatic approach, such as the Halton "effective schools" project (1986) and the "Schools make a difference" project (1983) and researchers have tried to link the two (Gray et al., 1999; MacBeath and Mortimore 2001). The Effective School Improvement Project (Stoll et al., 1998) ran from 1998 to 2001 in eight European countries, and attempted to construct a model towards integrating the paradigm. The following definition was used for this project: planned educational change that enhances student learning outcomes as well as the school's capacity for managing change (Hobe, 1998 in Harris and Chrispeels, 2006). Stoll et al., (1998) in Harris and Chrispeels (2006), p 91) proposed that in order to evaluate effective school improvement an 'effectiveness criterion was needed (does the school achieve better student outcomes?), as well as the improvement criterion (does the school manage to change successfully from old to new conditions necessary for effectiveness?)'.

They concluded in their research that actual improvement processes and the improvement outcomes are essential.

> 'The improvement culture is the background against which the processes are taking place; the improvement outcomes are the goals that the improvement school wants to achieve. The concepts of culture, processes and outcomes are all interrelated and will constantly influence each other.....in a cyclic process.' (Stoll et al., 1998 in Harris and Chrispeels, 2006 p 101).

So, although historically school effectiveness and school improvement have developed as separate disciplines based on different approaches, there was now a move towards integrating the two. This has been spurred on by practitioners and

policy makers using both bodies of knowledge to improve their practice. Many LEAs have borrowed from both traditions blending insights depending on the circumstances (Myers 1996; Reynolds et al 1996; Stoll and Tomlinson 1996). In addition, external funding bodies expected robust findings more and more with high levels of generalization that incorporated the processes, principles and strategies needed in order to implement and supplement improvement (Chapman 2005). Researchers became interested in school effectiveness as to how and why rather than focusing on their attention on correlations of effectiveness (Chapman 2005). In addition, researchers on the school improvement side attempted to develop higher levels of generalization within their research and therefore elements of effectiveness traditions had to be incorporated within the improvement philosophy and practice.

What has emerged is a new paradigm of effectiveness/improvement concerns that focus on the practical problems of improving schools (Gray et al., 1999; MacBeath and Mortimore, 1994) which adopted more 'mixed' methodologies and used both quantitative and qualitative data. This paradigm is more concerned than previously about relating the processes of school improvement to outcomes than studying all the variety of changes going on within the school – including changes at classroom level. There is recognition of the advantages of mixing methods to study them and this has led to other studies (Gray et al., 1999; Day 2003; McMahon et al., 2003).

Another aspect of this third phase is the awareness of the nature of the context and political influence on school improvement. This has led to a shift towards looking at what makes ineffective schools into effective schools (Gray et al., 1999; Stoll and Myers 1998; Gray 2000; Reynolds et al., 2001; Hopkins 2001; Harris and Chapman 2002). This has led to interventions such as Schools Facing Challenging Circumstances (Reynolds et al., 2004) and an emphasis on the processes of schools and the outcomes they generate and the need for a time scale of medium to long term for school development. There has also been more awareness about 'context specificity' and therefore about the problems of transferring from one context to another. University departments too started working together on research projects that are located in both traditions (Gray et al., 1999; Harris et al., 2003). These 'third wave' improvement programmes (Hopkins and Reynolds 2001) seem to be popular with teachers, schools and policy makers, since an increasing number of schools are

taking part in the programmes, for example, the Schools Facing Extremely Challenging Circumstances Project (Reynolds et al., 2004).

According to Hopkins and Reynolds (2001) combining the two elements of the effectiveness tradition and the improvement tradition, enhances the robustness of the projects. There has been more of a focus on student outcomes, on generating change at multiple levels, including the classroom level, on sharing best practice and research as well as on building for the short, medium and long term, such as staff development and leadership. This has led to a mixture of qualitative and quantitative data collection to judge educational quality and the importance of sustaining improvement has been taken into account. The 'Effective Schools Improvement Project' is an example of this attempt to model more of a comprehensive framework by looking at classroom and school processes and outcomes (Harris and Chrispeels 2006). Along with this, projects such as 'Success for All' and 'High Reliability' have emphasised fidelity implementation to guarantee maximum effect (Harris and Chrispeels 2006). There have also been efforts to make sure that projects relate to and impact on the staff through training, coaching and developmental programmes (Hopkins and Reynolds 2001).

However, there were some tensions and issues as these two paradigms merged. According to Harris (2000), the nature of development activity can be either mechanistic (the effectiveness tradition) or holistic (the improvement tradition), resulting in polarisation of the two camps. According to Chapman (2003), there can be philosophical and practical differences between the camps resulting in tensions between them.

The trend of merging the two paradigms together came about because of the many shortcomings of the two traditions that were in existence. Some of these were as follows:

- Research on school improvement has looked at what causes improvement over time but has rarely sought or processed data to show the evidence. School effectiveness on the other hand has concentrated mainly on schools that have been effective with the exceptions of case studies commissioned by the National

Commission on Education (1996) and studies by Teddlie and Stringfield (1993) and Louis and Mills (1991). Research on school effectiveness has not traditionally looked at the factors that helped the school become effective or improve (Gray et al., 1999).

- Historically school effectiveness was not concerned with school/classroom processes and outcomes and although the school improvement tradition has been interested in this area the effects of the improvement programmes have not been tested, partly because of the lack of agreement in judging what effectiveness is (Gray et al., 1999).

- Most of the school effectiveness studies have been snap shots or cross-sectional in manner. In contrast, although school improvement has been associated with long term processes often their research designs are not long term in nature.
- Ineffective schools have not been studied except in some cases, such as Reynolds (1991; 1996); Gray and Wilcox (1995); Stoll et al., (1996); and Stoll and Myers (1998). As far as the school improvement tradition was concerned, again there was little research undertaken in this area.

The new 'third wave' paradigm has led to an enhanced focus upon the importance of pupil learning outcomes and classroom level change. Teachers have also been targeted with a focus on their skills, attitudes and behaviours in order to bring about effective change (Hopkins and Reynolds, 2001). Also, there has been a change in the knowledge base in that both 'best practice' and research findings are better utilized (Hopkins and Reynolds, 2001). In addition, there have been collaborative patterns of staff development and external strategies for dissemination and networking (Fielding and Eraut, 2003); this has led to another intervention of networking, which will be discussed in later sections.

To summarise, effectiveness is a process for achieving better results and is concerned with the results that are achieved and the gaps that are identified. Improvement on the other hand is a mindset based on the classical iterative process (closed loop) and is concerned with making things better. One paradigm was concerned with absolute standards and league tables. These help to identify gaps in children's performance

but are unable to drive the improvement ethos itself. The other paradigm is based on the injection of new ideas, change initiatives and the implementation of new practices. This is also done through an iterative (closed loop) approach. In the third phase there has been a realisation of the shortcomings of both paradigms and the drive has been to start to combine the two paradigms. Effectiveness has to be seen as a consequence of the enablement of processes and the strengthening of practices while improvement can only be verified and validated if the measurement of the outcome is a part of this approach. This present study falls into this third paradigm.

2.5 TYPES OF INTERVENTIONS FOR IMPROVEMENT

Since the New Labour government came into power in 1997 under the promise of 'education education, education', it has put into force many interventions focused on a zero tolerance approach to educational failure, meaning that all should have a right to achieve their academic potential (Barber 2003). School improvement initiatives became an integral part of government policy aimed at raising educational standards (Hopkins et al., 1994). In the following sections some of these interventions and initiatives put forward for raising child performance will be discussed. They are split into the following categories: management and drive for leadership, curriculum strategies, quality assurance and performance evaluation, measurement of standards, and accountability and resource based interventions.

2.5.1 Management and drive for leadership

These interventions were implemented in order to raise children's performance included some which were based on the idea of coordination and facilitation, such as the Leadership Incentive Grant (LIG) and the Networked Learning Communities and specialist schools trust, and benchmarking.

2.5.1.1 Leadership

The National College for Leadership, set up in November 2000, was established to ensure that school leaders developed the skills, the capability and capacity to lead and transform the school education system into the best in the world (NCSL, 2001a). It was set up to serve the needs of school leaders across the whole country (Newton, 2001). Different kinds of school leader programmes were run and funding from the Department for Education and Skills (DfES) increased from 29.2 million in 2001-

2002 to 111.3 million in 2004-2005 in order to try avoid a narrow focus (Southworth, 2004) and to 'be a focus for national and international debate on school leadership issues'(Blunkett, 2000). From April 2004 head teachers had to have the National Professional Qualifications for Headship (NPQH) or be enrolled on it before they could take up headship posts.

Leadership has been identified by Sammons et al. (1995) as a key characteristic of effective schools and has been associated with improving schools (Hopkins et al., 1994; Stoll and Fink 1990). Research by Chapman (2005) showed that where schools showed more distributed forms of leadership there was a greater level of trust and collaboration. Hargreaves (2000) argues that schools with high levels of social capacity, that is, those with the ability to generate trust, will strengthen their intellectual capacity. Harris et al. (2003) suggest from their research that successful schools tend to trust leadership and develop innovative and evidence based strategies. Reviews of findings such as those of Teddlie and Reynolds (2000), Mortimore (1980), Sammons (1999), and Scheerens and Boskewr (1997) have tried to agree on leadership qualities found in 'effective' head teachers or principals. Three main duties were seen. Rutter et al., (1979) noted that firm leadership and teacher involvement led to better outcomes in secondary schools, while Mortimore et al. (1988) came to the conclusion that headteachers who consulted others and shared power were the most effective.

Although there seems to be generally common attributes that characterise good leaders there are hints in the studies that one should be wary of assuming there is one right way (Reynolds 1998). According to Groan (2003) this focus on leadership developed as a way that government could regulate education from a distance. He was concerned with the fact that leadership standards emphasised an ideal leader rather than shared leadership. The path to good leadership does not seem to be as clear cut as the government seemed to initially think. Studies suggest that in socially difficult schools, leadership may need to be more initiating whilst in effective schools more managing, and that it may be different at different stages of the school's development. Concentration on creating order in a school may be necessary for effectiveness in a disadvantaged school, whilst a more sophisticated approach to

do with the quality of pupil experience may be more effective in a socially advantaged school (Gray et al., 1999).

Although there is some empirical evidence, such as by Earley and Evans (2004), regarding the efficacy and impact of leadership intervention, research to see whether school effectiveness is enhanced is still scare. Brundrett (2006) in a study that included both a questionnaire survey and case studies of 10 schools, required school leaders at all levels to reflect on the impact that national programmes were having, both on their personal professional development and their schools as a whole. The results suggest that leadership programmes are impacting positively on leadership in schools, although the level of impact appears to be variable across programmes.

2.5.1.2 Networking

Another intervention under this category was networking. The Network Learning Communities placed teachers and pupils and school leaders at the heart of innovation and knowledge creation. The aim was to create professional knowledge networks to disseminate good practice and good process and support innovations. The theory being that networking allows for flow of knowledge and responds to the 'twin challenges of knowledge economy and ubiquitousness of change' (OECD, 2000). Research by the Organisation for Economic Cooperation and Development suggests that internal networking i.e. internal organisation and internal organising and external networking (inter-firm networks) can help change and generate innovation. Fullan and Miles (1997) claim school developments benefit from external facilitation and networks seen as driving innovative change and contributing to large school reform (OECD 2000, in Hopkins, 2001). Working 'smarter together rather than harder alone' was a mantra for the initiative. Research by Chapman (2005) suggests that when schools are given the opportunity to network they receive invaluable experience. According to Anderson (2003) in Harris and Chrispeels (2006, p17):

> 'through infusing fiscal resources and new knowledge about best practices into the school improvement processes and assisting teachers in learning how to apply the knowledge in their classrooms, LEAs increase their potential to guide improvement across a wide array of schools'.

Legislation supported knowledge creating processes such as Beacon Schools, Specialist Schools, Training Schools, Advanced Skills Teachers, Best Practice Research Scholarships, and Education Action Zones - Excellence in Cities, 2002 etc. There were three levels of learning networks: within school networks; school to school networks; and system wide practice to encourage transfer of learning. Although networking is regarded as a powerful transformative approach to school improvement (Hargreaves, 2004; Fullan, 2005) according to Chrispeels and Harris (2006) there are a number of conditions for networking to reach its full potential. There is little research on systematic evaluation of whether it works or not.

2.5.1.3 Benchmarking

Another intervention that falls under this category is benchmarking, which is seen as part of the 'best value' approach. The Office for Standards in Education, for example, sees the best value strategy as involving comparing, challenging, consulting and competing. The comparing part of the approach involves the use of Performance and Assessment (PANDA) reports and other data to provide suitable benchmarks (www.Ofsted.gov.uk). According to Kelly (2001, p 1), 'benchmarking is the analysis and comparison of performance across organisations or parts of organisations with a view to improvement'. Whilst, Zairi (1994, p 35), states that benchmarking is, 'to emulate the best by continuously implementing change and measurement performance'.

The theory is that it leads to action and eliminates complacency. Benchmarking is not measurement itself but is a process for establishing a degree of competitiveness and inducing action for closing any identified gaps. The government used benchmarking as another intervention to raise standards and the DfES and Ofsted advocate an approach based on the statistical comparison of different schools with similar socio economic characteristics (Kelly 2001).

According to Weller (1996) benchmarking can identify what is done particularly well in a school and then replicate this. However, according to Gann (1999), in Kelly (2001, p 4), 'when benchmarking is used in business it is well established but the process itself is little understood in schools and colleges'. Taking this into account, Kelly advocates the form of benchmarking more commonly used in business –

comparative benchmarking as a tool for self-assessment in school and colleges which he states, is a proven tool in business. Brennan (1996) too argued for collaborative benchmarking as the best approach in schools and colleges.

2.5.2 Curriculum strategies

Another category of interventions that the government set up in order to improve schools and make them more effective was under the heading of curriculum strategies. Some of these will be discussed in the following sections (National Literacy and National Numeracy intervention and also reading based interventions such as Reading Recovery and Success for All). The first phase of school improvement was concerned with the production and dissemination of exemplary curriculum materials in both England and America and this was intended to have a major impact on raising performance. However, overall, according to Reynolds et al. (2000) although the materials were of high quality and produced by academics and psychologists they had minimal impact.

2.5.2.1 National Numeracy and National Literacy

One form of intervention under this guise was characterised by the National Numeracy and National Literacy strategies. The National Literacy Strategy implemented in 1998 and the National Numeracy Strategy which followed in 1999 and represented a centralisation of authority and curriculum and this moved away from local control, which had been the norm. This was echoed in America with the government initiative of 'No child left behind' in 2002 which was very similar. According to Pianta (1990), if problems with literacy are tackled early there is more potential for bridging since the achievement gap is less. The National Literacy Strategy recognised this and introduced the concept of waves of teaching responses matched to children's needs intensity and with a particular focus on their learning. This was brought about because of several 'predisposing' influences such as the international data on primary school pupils' reading performance, school effectiveness research and the findings from literacy programmes with underachieving pupils in the USA and Australia. School inspections provided additional evidence.

The early success of the National Literacy Project provided a 'precipitating' influence as it reflected much of what was implied in the other sources of research evidence (Beard 2000). There were two major influences on the form and content of the National Numeracy Strategy and the National Literacy Strategy. The earliest was Ofsted and the effective direction of the National Numeracy and Literacy on projects based in thirteen poorly achieving LEAs. The approach was allied with the 'back to basics' policy in holding that what was needed was a return towards clearly structured whole class teaching, of the type that Ofsted judged 'good' (Askew at al., 1998). Whole class teaching targets were set and teachers were trained; initially, settling for lesson templates, yearly sets of detailed teaching objectives and guidance on teaching and planning.

The second major influence was educational research. A task force was set up to advice on national strategy in terms of what works, with the claim that this would improve teaching and raise standards, with national targets for attainment in the Key Stage 2 tests set for 2002. Some people questioned whether the task forces, although each led by professors of education, did genuinely review and interpret the research in an unbiased fashion (Brown et al., 1998, 2003).

An independent evaluation of National Literacy Strategy reported limited longer term impact due to a platform effect, despite encouraging signs from early gains in student outcomes (Earl et al., 2003). According to Fullan (2000) the National Literacy and Numeracy strategies only showed partial success at the lowest levels of the basic skills in closing the achievement gap. Chapman (2005) also talked about technology based interventions and their impact being questionable. In terms of the National Numeracy Strategy, Myhill and Brackely (2004) were concerned about the pressures of accountability which are seen as having a negative impact on learning and an over emphasis on pace, hampering learning.

Overall the findings suggest that 'top-down' curriculum initiatives like the National Numeracy Strategy, while bringing about a scenario of change in curriculum design, often leave deeper levels of pedagogy untouched (Smith et al., 2004). The strongest criticism of this strategy came from Hughes (2003) who labelled it a '£400 Million

Failure'. English (2002) argues that the National Literacy Strategy offers contradictory pedagogical advice to teachers on 'interactive teaching'.

2.5.2.2 Reading Strategies

Along with the literacy strategy the government, in trying to raise literacy standards, targeted reading. Reading became an established part of schools provision and of national educational policy (National Reading Panel, 2000; Earl et al., 2003; DfES, 2003). Research evidence on the effectiveness of literacy interventions with differing theoretical bases and various implementation characteristics produced varied conclusions (e.g. McIntyre et al., 2005; Vellutino et al., 2004) with 6% of children (including nearly 1 in 10 boys) leaving primary schools in England without the most basic skills in reading (DfES 2006). This percentage has remained broadly static since the introduction of the National Literacy Strategy. The Early Literacy Support group intervention for children in Key Stage 1 has been evaluated (e.g. Soler and Paige-Smith, 2005) demonstrating some success with children who experience mild difficulties in literacy. Other group teaching responses, focusing mainly on early phonic training, have also reported success with children with less challenging problems, (e.g. Hatcher's, 2006 'Reading Intervention' and the Clackmannanshire research by Johnston and Watson, 2005). But none of these evaluations of group intervention report success with the very lowest achieving children, and in some cases these were deliberately excluded from studies.

One such intervention for reading, Reading Recovery was developed as a short-term intervention for children who have the lowest achievement in literacy. The goal was for children to develop effective reading and writing strategies in order to work within an average range of classroom performance.

Research on the sustainability of gains made in Reading Recovery was completed by Moore and Wade (1998); Schmitt and Gregory, (2001); Fraser et al., (2001); and Briggs and Young (2003). One of the criticisms is that it is far less interested in average gains and focuses attention on the proportion of children receiving the programme who reach age-appropriate literacy levels, but it is important to establish that these reported gains would not occur naturally for these lowest achieving children without the intensive, and sometimes considered expensive, intervention of

Reading Recovery. Whilst every year for the last thirteen years, data on the literacy progress of all children who received Reading Recovery literacy support has been collected and reported publicly (Douetil 2006), there has been no evaluation which has included comparison groups since 1995 (Sylva and Hurry, 1995; Hurry and Sylva, 1998; and Plewis, 2000).

Other research has documented that those children who complete Reading Recovery and return to the class do not continue to learn at the same rate as average children in the class, but seem to immediately begin falling behind again (DeFord et al., 1990; Glynn et al., 1989; Shanahan and Barr, 1995). The learning rate of returned Reading Recovery children was slower than that of other low-achieving children (Glynn et al., 1989). Independent evaluations have compared Reading Recovery with other common compensatory programmes (Battelle, 1995; Fincher, 1991) and found no advantage for Reading Recovery on measures using authentic text (the natural text used in the reading comprehension passages of standardised measures). One frequently cited study found Reading Recovery superior to other interventions (Pinnell et al., 1994). The study compared specific variations of Reading Recovery and found approximately equal results regardless of whether the teachers had less training or the instruction was delivered in groups of four. Overall school achievement scores are not improved with the use of Reading Recovery (Hiebert 1994). Both Reading Recovery advocates and critics agree on this point (Hiebert 1994; Pinnell and Lyons, 1995).

Despite the implementation of a programme with 78,000 students from 1984-1993 in the United States, data from the three primary Reading Recovery sites and from the longitudinal study (DeFord et al., 1990) produce an unconvincing scenario of the effects of Reading Recovery on an age cohort. Children not meeting entry level requirements were not accepted on to the programme, neither were those already identified as special education children.

Reading Recovery research does not report the number of low-performing children who are rejected before lessons because they are not expected to benefit from the programme. However, Battelle (1995) included the number of eligible children who were never served in an independent evaluation in Ohio. Eligible children who were

never served included the number of rejected children as well as the number of children who never got a turn in Reading Recovery. Battelle's data indicate that together these children represented 19% of the children originally eligible for Reading Recovery. Battelle (1995) also compared Reading Recovery with other compensatory programmes on independent measures. He found that at the end of the first year, Reading Recovery students scored only 3.4 percentile points higher than children receiving other common non-individualized compensatory services in comparison schools. (These services varied considerably from pull-out programmes to occasional assistance in the regular classroom.) Even though the small difference was statistically significant, it was not educationally significant according to Battelle (1995).

2.5.2.3 Success for All

Another reading strategy to raise reading standards was called 'Success for All' and the impetus was the need for schools to move away from remediation to an emphasis on prevention and early intervention. This strategy emphasised academic readiness, phonemic awareness, alphabet awareness and non academic activities, music, art and movement in a series of thematic activities using a reading curriculum based on research and effective practices in beginning reading (Adams, 1990; National Reading Panel, 2000) and on the use of cooperative learning (Stevens et al., 1987; and Slavin, 2000). Strong emphasis was placed on phonic awareness to develop auditory discrimination and phonetics. The whole programme was very structured and set and based on research such as Steven et al., (1987); Slavin (1987) and Gutierrez and Slavin (1992).

A study in Baltimore found that these groups in five schools did better than matched controls averaging around 50% of a standard deviation for students in general, and more for those who began in the lowest range (Slavin et al., 1990; Madden et al., 1993 and Slavin et al., 1996). Similar findings were obtained by Dianda and Flaherty (1995), Livingston and Flaherty (1997), and Nunnery et al., (1997). The American Institute for Research found 'Success for All' to be one of the two with the strongest evidence of effectiveness (Herman 1999). This was supported by Traub (1999). A meta analysis by Borman et al. (2005) identified 41 experimental controlled comparisons done to evaluate 'Success for All' and it was listed as strong evidence

of effectiveness. Pearson and Stahl (2002) in America gave it the highest rating for effectiveness. This was supported in England by Harris et al. (2001) although two studies by Hopkins et al., (2002) and Tymms and Merrell (2001) found more mixed results with improvements on Key Stage I reading but not performance indicators in primary schools; comparison of gains on Key Stage 2 assessments for all 11 schools found gains of 6.6 % points in pupils scoring level or better (Slavin and Wordsworth, 2003).

2.5.3 Quality assurance and performance

This was another category that the government used to try to raise standards and the performance of children. One intervention was improving the Quality of Education for All (IQEA).

2.5.3.1 Improving the Quality of Education for All (IQEA)

This began in the late 1980s, involving Cambridge university academics working in partnership with networks of schools in order find ways of learning which could be enhanced (Clarke et al., 1983 in Harris and Chrispeels, 2006). The idea of quality experience for a pupil was central. School groups developed areas of focus to improve standards, then teaching and leadership practices could be analysed to bring improvements. There is some evidence, over a period of fifteen years, from IQEA which shows the importance of developing a school culture that fosters positive attitudes towards the study and development of practice (Ainscow, 2005). Also, this is evidence that school development is helped by IQEA work (Hopkins et al., 1996). However, according to Chapman (2005, p 17) 'tensions relating to programme origin can emerge at both project and school level'.

2.5.3.2 Performance related pay

A performance-related pay scheme for teachers was introduced in 2000. It was argued that higher rewards for those who could prove their ability as teachers would be an effective way to attract, retain and motivate good teachers. Hanushek (2003), believes that there is little evidence to suggest that this intervention was effective. Early studies by Ladd (1999), Cooper and Cohn (1997) and Boozer (1999) found a positive relationship between incentive schemes and pupil attainment. However the results of these studies were not conclusive. Studies by Eberts et al., (2000), Figlio

and Kenny (2003) and Dee and Keys (2004) assessed the relationship between incentive schemes and pupil attainment but they evaluated schemes which did not directly link rewards to pupil attainment. Promotion was based on overall good performance, which included time spent in the classroom, evidence of skills and classroom evaluation; test results were not the major deciding factor in measuring 'success'.

Kingdon and Teal (2002) evaluated the impact of a performance-related pay scheme for teachers using teacher level data, matched with test scores and value-added, to test whether the introduction of a payment scheme based on pupil attainment increased teacher effort. The results showed that the scheme did improve test scores and value added, on average by about half a grade per pupil. However, in their review, Dolton et al., (2003) stated that there were many factors involved and that it was difficult to know objectively whether PRP had positive effects on pupil learning outcomes. In addition, Mahony et al., (2004) found that the introduction of performance related pay disillusioned, rather than motivated, most teachers.

2.5.4 Measurement of standards and accountability

Assessment measures were another way in which the government hoped to raise achievement in schools. Along with this there were interventions such as introducing performance tables, target setting and league tables. All of which led to a set of further category-labelling schools. The Education Act 1996 included measures to raise standards in schools. These required schools to set targets for improving their performance, and gave the Office for Standards in Education (Ofsted) powers to inspect the effectiveness of Local Education Authorities (LEAs). These external measures continue alongside measures which are more internal to the school, such as school self-improvement initiatives. In the 1990s, one of the interventions used to bring about school improvement was accountability based, in the form of Ofsted – a national standardised inspection system. Another was the introduction of league tables and increased LEA categorisation and monitoring of schools. It was deemed that these measures were highly objective and rigorous, but in reality they were underpinned by a lot of pressure and resentment.

2.5.4.1 Ofsted

In 1990 Ofsted was created to inspect every school in England and Wales on a four year cycle. The inspection could identify a school as underachieving or having serious weaknesses. Schools that were considered to be failing were put into special measures and further interventions were put in place. It was claimed by Ofsted that through inspection there would be improvement, but initially it was mainly concerned with appraising and evaluating schools, reporting on quality and standards of education provided (Chapman, 2005).

In 1996 there was revision of the scheme in as much as the focus was to 'promote school improvement by identifying priorities for action' (Ofsted, 1995) as well as to assess the schools capacity to manage the change process and review its systems for institutional improvement (Early et al., 1996). However, according to Cullinford, (1999) there was lack of respect and willingness to work together between Ofsted and schools and therefore the improvement made by the inspection was questionable.

The claim of improvement through inspection is disputed by many academicians who argue that Ofsted has only made a limited contribution towards developments (Taylor Fitz –Gibbon, 1996; Lonsdale and Parson, 1998; Fitz-Gibbon, 1998). Cuckle and Broadhead (1999) too, disputed whether schools improved after inspection and were interested to see whether schools were highlighted for same issues again. Ofsted, however, claims to have documented many successes (Ofsted 1997, 1999, 2000) in improving the lowest attaining schools. Evidence to support Onsted's key role in raising standards is scarce (Chapman, 2005). Wilcox and Gray (1996) suggested that data obtained by Ofsted could be based on unreliable methodologies. The British Education Management Administration Society (BEMAS) suggested that schools find Ofsted useful (Early 1996) but the same study also found that school development remained unchanged or slowed down in the year after inspection. In 2002 a group of seventeen education professors led by Fitz-Gibbon called for a royal commission into Ofsted and a halt to classroom observation by inspectors until it was independently evaluated (Shaw, 2000). In reply to the Ofsted commission an independent evaluation was held, in which Matthews and Sammons (2004) reported that Ofsted made a substantial contribution to school improvements although this was immediately disputed by teachers and headteacher organizations (Macleod 2004).

2.5.4.2 Performance tables

Performance tables were introduced in 1992, 'to help parents make informed choices' (John Patten, 1992, in The Times, 19 November). However, Gray et al., (1999) purport more authorities entered more pupils for examinations and so they seemed to reach better overall results in 1996. According to Reed and Hallgarten (2003) performance indicators change an organisation as this is their intention. The Government would argue that the Literacy and Numeracy strategies and target setting were more responsible for this improvement than league tables. They argue that in fact, Key Stage 2 results have:

> 'followed the classic exam pattern: first, artificially low results as teachers and pupils confront the unfamiliar; second, an artificially rapid rate of improvement, as schools adapt to teaching techniques to fit the tests; finally, a levelling off of improvement, the point where accurate judgements can be made about year on year changes' (Reed and Hallgarten, 2003, p 12).

Initially there was a positive effect but this could be due to the narrow conception of learning promoted by league tables, producing what Perkins (2000) calls 'tactical learning', rather than 'deep learning'. This is likely to occur as schools and teachers feel pressurised to concentrate their efforts on exams and are teaching for the test. Gray (2000) identifies three distinct forms of school improvement: the tactical, the strategic and the capacity-building. His team found many schools followed the tactical route and other schools a more strategic path, seeking to raise student achievement over time. Only a few schools showed evidence of seeing improvement in terms of building the capacity of the organisation, developing staff, increasing resilience and creativity.

The schools most affected by league tables were those at the bottom of the league which introduced initiatives such as booster classes. One effect has been the over-targeting of resources on pupils who are on the borderline of whatever success measure is given most prominence in performance tables (Reed and Hallgarten, 2003). They go on to say that in recent years, Year Six pupils on Level Three and Year Eleven pupils at the GCSE grade C/D interface may have had more money spent on them than any private school pupil. Barber (2004) in Cuckle et al. (1999, p10) argued that:

> 'These measures can certainly help if you have a few months to go before the exams; they are not to be sniffed at, but they don't amount to a long-term improvement strategy. They won't make up for weaknesses in the core job of the school.'

There has also been a narrower focus on subjects chosen not to be measured for performance tables, for example, Physical Education, Music and Art.

> 'A final complaint is that performance tables ensure that summative assessment or "freeze-frame education" is prioritised over formative "assessment for learning", despite our knowledge that the latter, if done well, contributes far more to children's learning' (Reed and Joe- Hallgarten, 2003 in Cuckle et al., 1999, p10).

In addition, the National Audit Office, emphasised the degree of contextualisation needed for performance data to accurately reflect the performance of schools and, hence, the considerable misrepresentation of the current data. They analysed, in 2002, Key Stage 3 and GCSE/GNVQ results, adjusting for external factors including prior attainment, gender, ethnicity and eligibility for free school meals. Their results showed that variations between schools diminished substantially once many of these adjustments had been made. Applying this to the newspaper league tables for GCSEs they found, for example, that of the 621 schools ranked in the bottom 20%, just 272 remained in this category once performance had been adjusted for the influence of external factors. Further, 60 of the schools moved up to the top 20%. The converse occurred for some high ranking schools (Reed and Joe- Hallgarten, 2003). Lupton (2002) supported this, quoting at least 80% of the variance in pupil performance to be due to factors lying outside the school. The data takes no account of this.

2.5.4.3 Labelling schools

Another intervention to raise standards was labelling schools. The School Standards and Framework Act, 1998 gave LEAs a statutory role in raising standards. In 1999 Circular 06/99, outlined powers for LEAs and the Secretary of State as empowered to intervene in schools causing concern. Ofsted decided which schools required special measures. However, according to Chapman (2005), the government policy on labelling schools and categorising different schools was unhelpful.

Mortimore and Whitty (1997) stated that one of the problems of being labelled is that it can be demotivating and the other is that it can be problematic to get staff. Also, the ongoing pressures created by the label can cause the teachers to burn out very quickly (Stoll and Myers, 1998). This can also apply to school leaders: Earley and Collerbone (2002) found most wanted to move to schools facing less challenging circumstances. Reynolds (1998) found that there was a high level of turnover including heads in labelled schools. Confidence was also affected in schools, mainly by negative reporting from the media if the school was labelled (Clarke 1998). So although this intervention was supposed to raise standards and bring about school improvement, it seems to have had a negative impact.

2.5.5 Resource based interventions

Resource based interventions were introduced in 1997 based on a simplistic view that schools had been underperforming because of lack of resources. Therefore, this intervention was put into force and initiatives such as – 'Schools facing Challenging Circumstances' (SfCC), 'Education Action Zones', and 'Excellence in Cities' were launched. There were also interventions such as funding learning support assistants, learning mentors, booster classes and reading interventions. A great many of these interventions were characterized by targeted resources, and the production of plans were mainly focused on the national agenda, but also with some of the decision making going on at the local level.

2.5.5.1 SfCC- Schools Facing Challenging Circumstances Initiative

The SfCC was launched in 2000 by the Government in an attempt to support the lowest attaining schools and those faced with particularly challenging circumstances. In a survey by Chapman (2005) data was collected from 30 interviews with school staff as well as documentary evidence. The key findings were that schools welcomed additional resources and the opportunity to spend it where they thought it was necessary; they viewed it as an opportunity to improve teaching and learning, however, the visits by HMI were viewed negatively by staff (Chapman, 2005). They also felt that the quality of RAPS (Raising Achievement Plan) was variable and in fact developing the plan, which was mandatory, was more valuable than the plan

itself. The quality of LEA support was also variable. Forty six percent of teachers changed their practice as a result of SfCC (Chapman, 2000). Chapman (2005) concluded that schools appeared to experience a number of common barriers to improvement. He went on to suggest that more highly developed; context specific approaches to improvement were needed to support the development of SfCC. According to Gray (2000) the groups of schools deemed to be facing challenging circumstances remained at a similar level of performance. And other proxy indicators including the percentage of SfCC returning to special measures remained high (Chapman, 2000). In 2004, for example, 160 schools were placed in special measures (Ofsted, 2004).

2.5.5.2 Support Assistants

Learning support assistants in schools were used as another way to raise achievement in schools. One strategy was the deployment of Learning Support Assistants to provide additional support to low achieving pupils. To date, studies of teaching assistants have usually focused on quantitative rather than qualitative issues (Cremin et al., 2003). Though some studies have indicated that teaching assistants working with children improved the pupil's outcomes, there are difficulties in establishing statistical evidence to demonstrate conclusively the nature of the relationship between the impact of teaching assistants and improvements in children's educational progress and/or well-being (Blatchford et al., 2002). A number of studies indicate identified benefits associated with teaching assistants in the classroom (Ofsted 2002, Neil, 2002; Farrell et al., 1999). Neill (2002) suggested that the use of support assistants reduced teacher load. On the other hand, he went on to say that teachers have increased management responsibilities and increased work planning responsibilities (Neil, 2002). There have been pilots of models of working with teaching assistants to improve pupil achievement (Blatchford et al., 2002; Cable, 2003; Cremin et al., 2002). The findings from research into effective practice of teaching assistants such as by Farrell et al., (1999) and Blatchford (2002) focused on effective working of teaching assistants rather than demonstrable pupil outcomes.

A report by HMI, "Teaching Assistants in Primary Schools: An Evaluation of the Quality and Impact of their Work" [HMI 434] was published in April 2002. Ofsted's aim was to monitor and evaluate the impact of the use of primary teaching assistants

on the effectiveness of the National Literacy and Numeracy strategies. 434 failed to give an explicit evaluation of the quality and impact of the work of teaching assistants in primary schools. Rather, it primarily devoted itself to highlighting problem areas in the employment and deployment of teaching assistants, indicating possible ways forward in order to overcome such problems (Cook-Jones, 206).

Mortimer and Thomas (1994) published research on support staff. They concluded that the 'sea of change' in teaching assistant responsibilities, duties and performance, created by government policies and strategies to overturn the school workforce, has led to the need for updated research in this area. However, so far, research on the effects of this strategy is very limited.

2.6 A REVIEW OF KEY STUDIES ON IMPROVEMENT

Below are some examples of studies completed to try and ascertain some of the impact of these interventions.

2.6.1 High Reliability Schools Project (HRSP)

One intervention that was utilized was based on the idea of consciously building high reliability into school reforms (Reynolds et al., 2001) with a focus on functioning correctly 'the first time, every time' (LaPorte and Consolini, 1991; Roberts, 1993), like, for example, organisations such as traffic control towers. In America, for example, out of a hundred students beginning first grade approximately fifteen will not obtain their high school diplomas, whilst in Britain less than half will not gain the benchmark of five or more GCSE passes.

The High Reliability Schools Project (HRSP) began in 1995 with eight secondary schools in area A; the second, in 1997, was conducted in area B; and the third in 1997 in Area C. The focus of the study was whether the schools who utilized more of the HRS technology showed more gains in outcomes in time and whether the HRS schools did better than the national totality of schools in their gain in outcomes over time (Reynolds et al., 1997). Case studies and audits of the results of 25 schools showed that there was a variation between schools with regard to the quality of the intervention, though in some schools it was promising. For example, one

comprehensive school identified the poor readers at age 11 and rectified the problem by Reading Recovery. However, this did not work in all the schools and in fact in one school little effort was made to pull up the students who were lagging behind. Yet in another school, gains were significantly higher in GCSE than other comparable schools. The authors concluded that variation existed because of context and school factors and:

> 'what has been regarded as historically ambitious goals is indeed possible if the optimum combination of local contextual factors and school factors is obtained'. (Reynolds et al., 2001, in Harris and Chrispeels, 2006, p 74).

2.6.2 Reading Recovery

Burroughs-Lange (2006) evaluated the impact of Reading Recovery in 2005-6 of the lowest achieving children in forty two schools in London. Children who received Reading Recovery were compared to other children who received other interventions to raise levels of reading. The other interventions were carried out by teaching assistants whilst the tutoring of the Reading Recovery scheme was done by trained staff. A word recognition and phonics skills test was used with all the children in Year 1 at class level whilst the lowest achieving children (234) took part in Reading Recovery and other interventions. In total 605 classes completed Reading Recovery and there 566 went without. At the end of the year the children who had received Reading Recovery had an average reading age of 6 years 7 months. The comparison group were 14 months behind, with an average reading age of 5 years 5 months. Reading Recovery schools ended the year with an average class reading age 4 months above that of comparison schools.

2.6.3 Manitoba School Improvement Programme (MSIP)

The Manitoba School Improvement Programme (MSIP) was a whole school approach (Earl et al., 1998) to improve the learning experience and outcomes of secondary schools. It was based on the school effectiveness literature. Schools had to apply for support from consultants and grants. MSIP also gave schools support. The project had to be school based and teacher initiated, it focused on secondary school students and addressed issues from 'at risk' students that had the potential for long term impact on school and for replication and adaptation in other schools. It included appropriate evaluation content. In addition it was to be designed or developed to

incorporate a collaborative and participatory approach within the school and include an appropriate evaluation component (Earl and Lee, 1998). Data was collected in twenty two schools and questionnaires were given to students, parents and staff. There were also interviews with project coordinators and principals and summaries from school records. The MSIP was a resourced based intervention. Earl et al., (1998) concluded that where significant change was accelerated it was not sustained. MISP as an intervention was not strong enough to effect lasting change.

2.6.4 Building instructional quality (Darling–Hammond et al., 1998)

The initiative was based on research on learning and teaching, such as Resnick (1995), Bransford et al., (1999) and Resnick and Hall (1998). It was based on setting clear goals and higher order thinking skills, assessing student learning by evaluation and a mix of teaching strategies that explicitly modelled and demonstrated key skills. It also had a place for multi-pathways for accessing content and taking cultural and prior knowledge into account. Basically the drive was to make the teachers more effective – an attempt to 'professionalize teaching' (Darling–Hammond et al., 1998). Also the belief was that literacy is the gateway for other learning to take place. This study was conducted in San Diego, California. The researcher conducted 200 observations in schools and district level and reviewed documents. School data came from three middle, three higher and four elementary schools. There were also interviews with 20% of the principals from a number of schools across the district. Teachers were trained through professional development opportunities and networks, through field trips and workshops. Literacy strategy was reinforced, including pedagogical teaching components and reading initiatives. Initially literacy was the prime focus but in the third year numeracy was added as well.

The project was based on teacher learning research (O'Day and Smith, 1993; Fopuntas and Pinnel, 1996; and Darling–Hammond, 1996). Initial results showed an increase in the state assessment (SAT-9) results. The proportions scoring above the 50th percentile increased from 41% to 48% in reading and from 45% to 53% in mathematics. Early elementary grades increased from the 50th percentile increased from 43% to 53% in reading and from 50% to 61% in mathematics. The number of pupils taking the tests also increased. However the rate of improvement for high schools was not as good. Half of the students in eighth grade scored at or above the

50th percentile in reading in 2002, whereas only 37% of students in ninth grade did so (Darling–Hammond, 1998). At college level, a significant number of students of grades 3.2 still needed remediation when they were at college. One outcome was that the quality of reading policies improved in the state.

2.6.5 District M study

Gallucci et al., (2003) conducted a study in three urban middle schools in America in an area referred to as district M (pseudonym). The theory behind District M was of opposites – the development of small schools against centralised control for standard-based instruction improvement. The aim of the study was to see if these two opposing approaches could work together. The theory was one of personalised relationship with teacher and learners, teacher collaboration and ownership of school design and curriculum, and finally parental involvement and choice.

The second reform was 'active instructional leadership' from district level (Murphy and Hollinger, 1986; Petersin, 1999; Resnick and Glennan, 2002. This was linked to 'standard based reforms' and was in line with national standards for reform (McCoughlin and Sheperd, 1995; Furham, 2001). There were ambitious learning standards and accountability mechanisms that tracked performance on mandated assessment and other indicators and investment in professional development (Gallucini et al., 1998). The aim was development of innovative small schools of choice and a district-centralised push on standards-based instruction improvement. In addition, teachers' professional development was investigated, principals were supported and this was tied in with an explicit accountability system. Finally, literacy and numeracy skills were highlighted. The results varied across schools. It was concluded that:

> '...the purposeful combination of the two theories in the large part worked. Also due to the standards based idea, there was a high degree of content alignment such as a balanced literary strategy.' (Gallucci, 1998 in Harris and Chrispeels, 2006, p 211)

But it was also pointed out by the researchers that the positive results were not consistent across all schools.

2.6.6 The impact of leadership interventions

A study by Brundrett (2006) on the impact of leadership interventions was conducted in two phases. The research consisted of a questionnaire survey and case studies of ten schools. The study looked at the extent of leadership programmes impacting on leadership practice in schools and the combinative impact of multiple leadership development interventions in schools. In the first phase, the sample included seven different infant schools, four junior schools, 29 primary schools and 10 secondary schools. Phase 2 included: seven primary schools and three secondary schools. The following programmes were studied:

- Impact of individual leadership development programmes on leadership practice Leading from the Middle (LftM). This was the first major programme which focused on middle managers.

- Headteacher Leadership and Management Programme (HEADLAMP) and Headteacher Induction Programme (HIP); HEADLAMP was the first national programme for school leadership development to emerge.

- National Professional Qualifications for Headship (NPQH)

- Leadership Programme for Serving Headteachers (LPSH).

The HEADLAMP/HIP programme got the fewest responses and considerable variation was found in quality and impact (Gunraj and Rutherford, 1999; Blandford and Squire, 2000). The conclusion was that the NPQH programme on the facilitation of strategic thinking was particularly strong. On the other hand the LPSH programme was viewed by many as an experience that had changed their professional life for the better. There was also some evidence that the combined effect of the programmes sustained leadership and leadership learning beyond the level of individual programmes (Brundrett, 2006). However, Brundrett concluded that there was uncertain initial indication of a positive association between the programme and enhanced leadership performance.

2.6.7 Different Learning styles

Slack and Norwich (2001) evaluated the reliability and validity of an available inventory designed to identify learning styles (visual, auditory and kinaesthetic) with 19 children, aged 7-10 years, with different styles as identified by the inventory. The children took part in a class experimental evaluation of their differential response to the teaching of word spelling using different teaching methods. The results showed that that the visual and auditory scales, but not the kinaesthetic scale, were reliable (internally test and re-test). The three groups of pupils, with different learning styles – visual only, auditory only and mixed visual and auditory – showed different gains to teaching that matched these styles (visual and auditory teaching approaches). Retention of word spelling was higher one week after the teaching when the teaching matched the learning style. The authors concluded that findings in their exploratory study suggested the significance of learning style for classroom-based teaching.

2.6.8 The Leverhulme Numeracy Research Programme Study

The Leverhulme Numeracy Research Programme was conducted from 1997 to 2002. The study was a longitudinal survey with over 2000 children in each of two different age-cohorts in 40 different primary schools, 10 in each of four varied local education authorities (LEAs) in different regions (Brown et al., 2002). It helped to generate some data for evaluating the National Numeracy Strategy which was implemented in the middle year of the five years during which the Leverhulme team observed mathematics lessons in the selected 40 schools, interviewing teachers and heads and monitoring the progress of the children in the two cohorts. Children were tested towards the beginning and end of each school year. A sequence of tests, one for each year group, was used which were derived from instruments developed from earlier research by members of the team (Hart (Ed.), 1981; Denvir and Brown, 1986; Askew et al., 1997). The data suggested that the percentage of pupils reaching Level 4 was only 4% higher than in 1999, and the Year 4 data showed that the average percentage of successful children rose by only 3%. However within this there were large variations between gains in curriculum areas, reflecting the changes in curriculum. There were significant rises in mental addition and subtraction and slight falls in performance in word problems. Brown et al., (2002) concluded the average attainers had done better than the low attainers and that overall there had been little effect.

2.6.9 The Literacy Pledge

The Literacy Pledge (LP) evaluated by Cuckle and Shorrocks-Taylor (1999) focused on good practice in schools and improvements made in reading in relation to LP. The aim was for children in Year Two to reach level 2. Schools were selected according to a formula based on those who failed to reach level 2. Eighty nine percent of the children were withdrawn and taught in groups. Eighty three percent of the teachers thought that children targeted by LP improved to some extent. However Cuckle and Shorrocks-Taylor (1999, p 9), concluded that:

> 'Until we can compare the profiles of the LP and non-LP children at the beginning of the initiative, and compare their rates of Level 2 scores we cannot draw very firm conclusions about the success of the Literacy Pledge.'

Table 2-2 A sample of studies of different interventions used by the government.

Study Ref.	Objective	Methodology	Performance effectiveness	Consequential outcomes
High reliability Schools Project (Reynolds et al., 2001)	Did the schools show more gains in outcomes in time and did the HRS schools do better.	Data collected through 25 audit visits, questionnaires, and collation of material. Case studies.	Variation between schools in quality of the intervention though in some schools it was promising.	Reading improved in some schools. GCSE higher in another but variations existed.
Different learning styles (Slack and Norwich, 2001)	Evaluated reliability and validity of different learning styles.	Identifying learning styles (visual, auditory and kinaesthetic) with 19 children, aged 7-10 years.	3 groups - visual, auditory and mixed visual and auditory - showed different gains to teaching that matched these styles.	Suggested the significance of learning styles in teaching.
Primary strategy (DfES 2003)	Linking curriculum areas to provide wide range of learning experiences.	Professional development resources.	Enhancement of existing strategies, enablement to explore further.	Providing broader and richer learning experience.
National Literacy policy (1998). National Numeracy (1999)	To raise literacy levels.	Prescribed curriculum, structured lessons.	Modest rises of maths and English from 1995-2000.	Test/Target/Inspection of performance.
MSIP Manitoba school improvement programme (Earl et al., 1998)	To improve learning experience and outcomes of secondary schools.	Resource based grants, support, interviews and surveys. Training, weeding out poor leaders.	Positive but not strong lasting changes. No deep impact.	Where change was accelerated it was not sustained.
Building Institutional quality (Darling-Hammond et al., 1998)	Raise qualities of teachers and literacy methods, accountability.	Training teachers, especially in literacy. Weeding out poor leaders.	Increased 41% to 48% in reading. 45% to 53% in maths. Early grades 43% to 53% in reading. 50% to 61% maths.	Reading policies improved but at college level significant number of students still needed remediation.

Table 2-3 More studies of different interventions used by the government.

Study Ref.	Objective	Methodology	Performance effectiveness	Consequential outcomes
Impact of National leadership programmes in England (Brundrett, (2006)	To see combinative effect of leadership practices in schools and effect of multiple leadership.	Questionnaire survey and case studies of ten schools.	Suggest leadership programmes impacting positively in schools although level of impact appears variable.	Tentative initial positive association between programme and enhanced leadership performance.
District M study (Galluci et al., 2003)	To see whether two hybrid strategies, school differentiation and centralised leadership can work.	Three schools, three years visited, three times a year.	Varied impact but showing the reforms can work.	Effects of combination of theories were not realised equally across the schools studied.
Reading recovery (2005)-Burroughs-Lange).	To raise reading standards using Reading Recovery.	42 schools in London comparison with Reading Recovery and other interventions. pre and post tests.	Children who received reading recovery on average 14 months ahead. Classes ended the year with four month higher average.	Reading improved, therefore literacy level increased.
The literacy Pledge, (Cuckle and Shorrocks-Taylor (1999).	To increase children in Year 1 to achieve level 2 by 1999.	Schools who failed to reach level 2, teachers trained in literacy pledge.	83% of teachers said it had some impact.	Authors said hard to make causality judgement.
The Leverhulme Numeracy Research Programme (1997 to 2002) conducted by (Brown et al., 1997).	To take forward understanding of the nature and causes of low achievement in numeracy and provide insight into effective strategies.	Children in the two age-cohorts in 40 primary schools, in 4 LEAs.	Pupils reaching Level 4 was only 4% higher than 1999, and Year 4 data showed percentage of children only rose by only 3%.	Little effect.

2.7 RESEARCH GAP

Researchers and practitioners still need to find the answer as to what helps effectiveness and improvement. The very fact that so many studies have tried to combine the paradigms shows there is space for a third alternative and thus a gap that needs to be filled. The other problem has been that school effectiveness and school improvement movements concentrated on effective schools and Teddlie and Reynolds (2000) noted the lack of attention shown to ineffective schools, although there have been exceptions, such as Louis and Miles (1990); Reynolds (1996); National Commission on Education (1996); Thrupp (2001); Maden (2001); Stoll and Myers (1998).

Blame has been ascribed to disadvantaged backgrounds (Whitty 2006), although Hargreaves (2003) showed that students can be materially rich but educationally poor. Some of the blame is laid at the feet of the teachers (Whitty, 2006). Maden (2003) in the study 'Success against the odds', showed that often the improvement is not sustained. Stool and Fink (1996) and the literature base suggest that school improvement comes from within the school. Chapman (2005) was critical of whether external interventions can overcome some challenges and said that in some cases they were demotivating for staff. He was highly critical of Ofsted as a way of improving schools.

This kind of statement shows that there is a gap in the field of research and therefore an opportunity for further research. The review of the literature, which examined various interventions and strategies for enhancing learning and raising standards and effectiveness, seems to indicate a gradual and positive shift towards looking at alternative ways which target the child and make them the centre of all endeavours. In addition, analysis of previous research studies indicates that most of the research focus is on external conditions or on the enablers to providing effective learning experiences. There is little research looking at the child in terms of:

- The challenge for raising standards.
- Understanding the underlying problems which constrain effective learning.

- Developing customised strategies that can help unleash potential and enable learning in different contexts.

The studies in this chapter showed some improvement, but it was not sustainable and it was dependent on different contexts and school factors. Also, many of the interventions were costly and some seemed to resort back to methods used previously, such as the drive to get back to teaching reading using phonics. Some were very people-dependent and most worryingly, some were highly demotivating and stressful, such as Ofsted and league tables, whilst others were highly demanding of teacher input and time. Some realised that the child was the core but only background, culture and socio-economic effects were taken into account. All seemed to be external to the child and Chapman (2005) doubted whether external interventions have made a significant difference.

Other approaches need to be considered, indeed Harris et al. (2003) support this idea; they point out that the schools at the bottom of league tables are culturally very different. This seems to infer that underperformance is a complex issue and that there is no single answer; other approaches need to be considered. This is reinforced by Chapman (2005) who commented that externally imposed reforms have limited effect on SfCCs, and Gray (2000) who suggested that government led reforms are failing to significantly improve SfCCs.

According to Elmore and Sykes (1992), even when interventions are relatively straightforward they are implemented differently in different schools, localities and classrooms. When interventions fail to produce the expected results, the blame is laid on the school and the teachers i.e. on they way that they were implemented. According to Chapman (2005) the context matters and this is backed up by other studies, so the idea of the 'one size fits all' model is likely to return a sub-optimum result. Stoll et al., (2003) point out that the individuality of the school needs to be considered. Gray et al., (1999) point out that a large number of schools target borderline pupils for additional counselling, encouragement and sometimes formal tutoring or work. This seems to be a huge resource drain and it would suggest that identifying and remediating the cause of problems is more effective. If the child is metaphorically looked at as a computer, the scenario is to improve the computer

rather then putting more and more powerful software into a computer that does not have the capacity to run it. As previously mentioned, Harris and Chrispeels (2006, p 6) believe that although well intentioned, many external interventions have had patchy and variable success. They believe: 'The evidence supporting the relationship between school improvement and increased student achievement remains weak and contestable.' They go on to say that 'the twin components of accountability (inspections, test scores and leagues tables) and standards (target setting monitoring and raising achievement plans) have been unable to yield the increases in school performance sought. Hopkins and Reynolds (2001, p 15) stated that:

> 'the achievement gap between pupils from disadvantaged backgrounds that seemed to initially narrow in the 1980s stayed the same or widened raising alarm among national governments in Canada, England and United States, showing again that improvement had not been sustainable'.

Chrispeels and Harris (2002) talk about 'improvement fatigue' and about how more work is needed to understand the kinds of conditions and support needed both within school and with the broader community to sustain school improvement and close the achievement gap. They also talk about major practice and research blank spots in the school improvement field. It seems that the achievement gap between children of poverty and those for whom English is a second language has an impact and more often than not these children are not achieving to their highest capabilities. They are therefore more tightly controlled, monitored, labelled, and morale is low. It could also be that some of the children in these schools have other problems.

2.8 SUMMARY

This chapter was concerned with reviewing critical aspects of school improvement and effectiveness by focusing on two major schools of thought that propose strategies and interventions for improving standards within schools. In addition the third wave or paradigm was also discussed which brings together both of these strands. Types of interventions by government policy makers and some studies were also included.

Although the two traditions of school effectiveness and school improvement are now working together to produce joint programmes of research and development, it is

clear that there is no single 'right' recipe for improving schools and teaching, as indicated by Harris and Hopkins (2000), who argue that in many school systems there is despair at the failure of both top-down and bottom-up reforms to significantly enhance the learning of students. Fullan and Miles (1992) imply the gap needs to be addressed and has led to reappraisal of the role of the school based approaches.

There does not seem to have been an investigation of the underlying reasons of why some children fail to learn despite numerous interventions and strategies put in place by schools and the government. This study is an attempt to fill this important gap by focusing on the children; thereby targeting various holistic interventions in the form of sound therapy and movement (to try to remediate the underlying causes) and studying the resulting impact on learning. Chapter 3 and 4 discuss the specific intervention strategies implemented in this study. The next chapters will discuss alternative interventions, in the form of sound therapy and movement therapy, for raising performance standards in schools.

CHAPTER THREE: LITERATURE REVIEW - MOVEMENT PROGRAMMES

3.1 INTRODUCTION

Movement programmes have been used with a view to helping children with learning and behavioural difficulties. The aim of a movement programme is to treat the underlying causes of learning and behavioural difficulties by using activities and movement patterns to develop neurological organisation, and in some cases to integrate reflexes, while in others, address coordination difficulties. In some cases it will help all of these factors. The structure of the movements follows similar patterns to those naturally developed in very early childhood. This approach is, largely, based on the assumption that children with learning difficulties have developmental immaturities, including poor neurological organization and retained primitive reflexes. According to Hawke (2000), the replication of early movement patterns enables children to gain the sensory motor processes that they may lack.

This chapter constitutes the second part of the literature review. The introduction will be followed by a brief review of the role of movement in learning. Following this, there will be a presentation of the different types of movement programmes that have developed, such as patterning, sensory integration programmes and specific programmes aimed at addressing primitive reflexes. There have been various theories and hypotheses put forward as to how and why these motor programmes work. These may be attributed to the integration of the reflexes, the role of the cerebellum, the vestibular system and the plasticity of the brain. Each of these will be discussed in turn. Finally, further studies will be presented to see the impact of movement programmes on behaviour and on children with more specific problems.

3.2 THE ROLE OF MOVEMENT IN LEARNING

Piaget (1952) first noted the importance of motor ability in the development of cognitive functions, and this has been supported by Thelen (2000). Since Piaget, other researches have found that the neurologically disorganised child responds to

remediation based on movement (Ayres 1973, 1982; Bender 1976; Bernhardson and Davidson 1983). It seems that even very simple movement has an effect on development. Prechtl et al., (1997) studied the fidgeting movements in normal infants. The study tested the predictive value of absent or abnormal movements in young infants for the later development of neurological deficits. The study found that 96% of infants who had normal fidgety movements had a normal neurological outcome, whereas abnormal quality or total absences of fidgety movements were followed by abnormalities in 95% of infants studied.

There is some evidence that movement programmes may be able to help learning, as children grow. According to Capon (1993), children are born with the tissues of biological intelligence, the brain structure, but these only become fully activated when children move, explore and manipulate the world. He postulates that these actions are the foundations and building blocks for learning and this relationship between movement and learning is critical. Getman (1984) supports this and states that directed movement and motor coordination is linked to intellectual activity.

Babies are born with reflexes which aid the actions of crawling, walking and jumping to develop in a normal sequential way. It seems that with increased physical development improved messages flow to the brain from all the senses and coordination, body awareness, balance and the matching of motor sensory input (integration), lateralization, speech maturity and perceptual motor development all improve. Educators assume that the skills of writing, spelling and reading are the basics of learning - but these are now beginning to be viewed as very complex neurological processes that develop easily when there is good sensory motor development. Without this essential basis, it seems that the foundations are poorly organised and this leads to various problems later on. Shiel (1984) p 2 states that:

> 'The skills we need to read and write are the top of the pyramid. If the bottom of the pyramid has not been built properly, the top layer of the pyramid will not be perfectly made.'

The theory holds that disordered sensory integration accounts for some aspects of learning disorders and that enhancing sensory integration will make academic learning easier if this is the case (Ayres 1980).

Coordination develops through three basic levels: reflex-motor, gross-motor and fine motor. The first level provides the basis, or foundation, for all motor development. Reflex development comes first, followed in order by gross motor development and then fine motor development. These levels build upon each other and if any level is not properly developed there will be a knock on effect on the other levels. Children go through certain developmental stages and if they have not gone through the necessary stages it can have a detrimental effect on children's learning (Sasse 1980). Researches such as Houston (1982), Ayers (1972) and Hannaford (1995) verify that sensory motor integration is linked to school readiness. In support of this, Palmer (1980) documented gains in attention and reading from activities such as spinning, crawling, tumbling, and rocking.

3.3 THE LINK BETWEEN MOVEMENT AND THE BRAIN

Current research points to the premises that the mind and body are connected and physical activity affects the brain (Hendy 2000). Research has shown that students who spent an extra hour each day in the gym performed better in examinations than less active children (Hannaford 1995). Brain research studies have also shown that the development of motor skills facilitates academic readiness and learning (Hendy 2000). Goddard (1988) suggested that physical activity may be a primary feature in the early development of the brain, and it is through providing experiences that include the combination of vision and gross-motor movements i.e. that through hand-eye coordination that the brain's circuitry is developed to its full potential for specific functions. This is supported by the findings of Greenough and Anderson (1991), Floeter and Greenough (1979), Pysh and Weiss (1979), Black et al., (1990), Kleim et al., (1994), Comery et al., (1995), and Tsukahara et al., (1981).

This link between movement and the brain has also been seen in experiments with rats, in which active rats showed a greater number of connections among neurons than sedentary rats (Greenough and Anderson, 1991). This work suggested that changes in synapse number as well as changes in the expression of the Fos protein may occur

within the motor cortex in association with motor learning. The indications were that the type of experience the rat received increased the number of synapses per neurons.

Black et al., (1990) Kleim et al., (1994) and Kleim et al., (1995) found similar links within the motor cortex. The findings of these experiments seem to suggest that both gene expression and neuronal morphology within the motor cortex can be changed through motor experience. In addition, motor learning may involve structural and functional changes over several brain regions including the cerebellum (Floeter and Greenough 1979; Pysh and Weiss 1979; Black et al., 1990; Kleim et al.,1994), basal ganglia (Comery et al., 1995), and red nucleus (Tsukahara et al., 1981). Pollatschek and Hagen (1996) support these findings, indeed they believe that children engaged in physical education on a daily basis show superior motor fitness, academic performance and attitude to school compared to those children who do not exercise daily.

They went on to say that, physical activity is essential in promoting normal growth of mental function. Marten (1982) also showed that when physical education time was increased to one third of the school time, academic scores went up. This was also supported by Hendy (2000).

3.4 MOTOR DIFFICULTIES AND LINKS TO LEARNING

There is some evidence to suggest that children with motor difficulties are more at risk of difficulties in reading, writing and spelling than children without such difficulties (Dewey et al 2002). Visser (2003), on the other hand, notes that reading difficulty has been 'related to problems with almost any sensory or motor skill imaginable'.

The relationship between soft neurological signs, that is, neurological abnormalities in sensory and motor performance (Griffiths et al., 1998) which point to a delay of children's gross- and fine-motor development, such as poor balance and coordination difficulties, and measures of cognition, coordination and behaviour in 169 school-aged children were studied by Fellick et al., (2000). Their results showed that there was a relationship and that that children who showed impairments on soft neurological signs performed significantly worse on tests of cognition, coordination, and behaviour. Similarly, O'Hare and Khalid (2002) explored the existence of distinctive patterns of soft neurological signs associated with children with Developmental Coordination

Disorder (DCD) alone, and children with DCD and reading/writing difficulties. They found that all children with DCD demonstrated difficulties on most test items measuring soft neurological signs related to cerebellar function. However, Polatajko highlights the controversy in the literature; he believes the significance of soft neurological signs indicating non-specific cerebral dysfunction, or their association with specific neurological structures, must be interpreted with caution as they are frequently seen in children without notable problems.

Practitioners have suggested that motor skill intervention can help learning disabled children (Farnham-Diggory 1992; Kephart 1971). Research studies into motor deficits show that motor training produces direct improvement in motor tasks (e.g., Cammisa, 1994; Knight and Rizzuto, 1993). However some studies have shown that improvement is often found in the control group as well (Bluechardt and Shepard, 1995), suggesting that improvements are largely attributable to the Hawthorne effect. Regardless of this, Nelson (1988) suggests that neurological and sensory motor delays can be addressed; he believes that one of the marvels of the central nervous system is that it recognises the 'normal' and can latch on to it. He believes it is possible to think of it as a system that gets 'stuck' in an abnormal pattern, and is just waiting for the message it needs to activate normal responses.

Walsh (1980) states that children who do not crawl are more likely to be hyperactive and have learning disabilities. Research by Taylor, cited in Pheloung (1997), showed that spelling, reading, auditory short term memory, arithmetic and visual attention to detail were significantly improved among a group of children with learning problems who took part in a Perceptual Movement Programme.

3.5 THE IMPORTANCE OF DIFFERENT DEVELOPMENT STAGES

Pheloung (1997) stated that there is a normal sequence of development that is followed in infants' early years. Difficulty learning in later years can be linked to a missed step in this sequence. She recommended that following a movement routine, can over time correct learning difficulty. She also stated that infants who did not go through the motion of crawling properly or did not crawl at all experience learning difficulties as their coordination and focusing of eyes is underdeveloped. This also supports Stein (2000) magnocellular hypothesis which is discussed in section 3.6.4. This is supported

by Bender (1975), who believes that the motor skills that are developed with crawling, provide the basis for good vision, handwriting, balance and integration of both sides of the brain (Pheloung 1997).

In the study of learning disabilities, there are two main strands that have developed. According to Lazarus (1990), the first is related to problems in language abilities, shown mainly in the form of difficulties in reading and writing (e.g., dyslexia) and the second is concerned with problems with non verbal aspects such as sensory integration and neuro-development and with children who have problems with complex motor movement, poor coordination and balance, and below average fine motor ability. From a cognitive perspective, they usually have arithmetic difficulties, problems in motor components of writing and spatial problem solving, with possible linguistic difficulties in the productive domain (Rourke 1989).

3.6 THE THEORY BEHIND THE PROGRAMMES

There have been various theories and hypotheses put forward as to how and why these motor programmes work. These may be attributed to integration of the primitive reflexes, the neuro-plasticity of the brain, the impact and role of the cerebellum and the vestibular system. These will be discussed in the next sections.

3.6.1 The integration of the reflexes

More than seventy primitive reflexes have been identified (Illingworth, 1987). They are critical for the survival of the newborn ensuring that the baby can breathe and feed (e.g. infant suck and rooting reflexes). They are present during the first six months after birth (Capute et al,. 1981) and primary reflex tests are used by paediatricians to assess the neurological integrity of the newborn baby. As the nervous system develops, however, they are inhibited or transformed and the persistence of primitive reflexes beyond their normal time span (12 months) interferes with subsequent development and indicates neurological impairment (Holt 1991). Severe persistence of primitive reflexes indicates predominantly intractable organic problems as in cerebral palsy (Bobath and Bobath, 1975), while milder persistence is associated with less severe disorders including reading difficulties (Morrison, 1985).

3.6.1.1 Studies related to the role of the reflexes.

According to Capute et al., (1978) there are very close links between the inhibition of primitive reflexes and the attainment of gross motor milestones in young children. Bobath and Bobath (1975) have shown that severe persistence of primary reflexes indicates predominantly organic problems as seen in children with cerebral palsy, while milder persistence has been associated with less severe disorders including reading difficulties and motor problems (McPhillips et al., 2000). Research on the effects of reflex persistence with children who have not been diagnosed with specific neurological difficulties is scarce, and the question as to whether reflex persistence affects the attainment of reading and learning in mainstream education needs to be investigated further.

Research has shown that retained primitive reflexes may have a detrimental effect on behaviour, motor control, sensory perception, eye-hand co-ordination, and cognition. Certain combinations of retained reflexes exhibit themselves in ways that affect emotional and social well-being and academic progress according to Goddard-Blythe and Hyland (1998). If development of the reflexes is normal, these primitive reflexes are progressively inhibited and gradually superseded by postural reflexes (Gold, 1997; Wilkinson, 1994.) If, however, they are retained beyond the normal three-year developmental period, the primitive reflexes have the capacity to upset the maturation process and decrease the brain's ability efficiently to process sensory information (Goddard, 1996). According to Ames and Ilg (1964), children's development is patterned, lawful and sequential. Larger underlying sensory integrative problems occur when previous developmental stages have not matured properly.

The Institute of Neuro-Physiological Psychology has shown that approximately 85% of children with average to above average intelligence that have specific learning difficulties/disabilities have a cluster of primitive reflexes (Blythe 1992). Two recent studies have demonstrated improvements in reading (McPhillips et al., 2000) and in eye movements (Bein-Wurzbinski, 2001) as a result of integrating specific reflexes. Bender (1976) supports this and quotes 75% of learning disabled children to have retention of the symmetrical tonic reflex. According to Bender, the tonic reflexes form the reflex substructure of learning. Each plays a specific role in preparing the child for acquisition of manipulative and locomotive skills. Bender (1976), in a study of retained

Symmetrical Tonic Neck Reflex (STNR), suggested that a retained STNR appears directly related to the problem of learning difficulties:

> 'When these children are placed on a training programme specifically designed to help them suppress the abnormal level of reflex response, the efficiency of their information processing improves and their rate of learning accelerates'. (Bender, 1976, p22)

O'Dell and Cook (1997, p21), discussing another reflex, suggest that, 'the immature reflex generally hampers the production of rhythmic, co-ordinated movement and specifically interferes with the postures generally required for reading and writing'. They go on to suggest that:

> 'Many children with immature STNR are diagnosed as hyperactive or as having attention-deficit disorder because of the difficulty demonstrated in sitting still for long periods of time'. (O'Dell and Cook, 1997, p 51)

Goddard (1996, p2) suggested that, 'reflex chronology and normal child development can be combined to predict which later skills may have been improved as a direct result of retained primitive reflexes.'

Research completed by Taylor (1997) and Hawke (2000) showed positive improvements in learning and behaviour. The preliminary report stated that sensory motor movement programmes help develop the brain for learning; they enable children to concentrate and stick at tasks better. The stereotypical movements a baby makes can be recognised and this knowledge can be used to help inhibit the primitive reflexes found in older children with developmental problems. Crawling promotes integration of the brain by using both sides of the body and developing visual skills.

3.6.2 Brain plasticity

A further explanation as to as to how and why these motor programmes may work could be due to brain plasticity. Recent knowledge from neuro-science about the brain has changed in the last twenty years. This knowledge and the relationship between development in the early years and learning is beginning to challenge the belief that numbers of neurons in the brain and the pattern of neurology was set at birth and could not be changed.

3.6.2.1 The new paradigm of brain plasticity

Over the last decade this paradigm has been overturned and neuroscientists have discovered that the neuron can grow new connections in response to different experiences. Doidge (2007) states that recent findings point to the fact that the brain is adaptive and therefore plastic. Frostig and Polley (1999) identified behavioural manipulations as causing a substantial impact on the cortical plasticity in that system.

It seems that the greatest opportunity for influencing the brain is during the early years of childhood. By the time an infant is two or three years old, the number of synapses is approximately 15,000 synapses per neuron (Gopnick et al., 1999). According to Durbach (2000), there appear to be at least two types of modifications that occur in the brain with learning: a change in the internal structure of the neurons, the most notable being in the area of synapses, and an increase in the number of synapses between neurons. Scientists have now discovered that a huge amount of brain development occurs between conception and age one and a report by McCain and Mustard (1999), The Early Year Report, summarised current understanding of early brain development. The understanding is that stimuli from a child's experiences before the age of three influence the 'wiring' of the nerve cells (neurons) and neural pathways of the brain and is vital. It seems that early developmental activities and stimulation through the sensing pathways with the basic genetic structure of the brain has an effect on a child's brain development, which has a long-term impact. Diamond and Hopson (1999) believe that new discoveries provide us with ways to help our children reach their fullest and healthiest mental development. Society once viewed a child's brain as static and unchangeable, whereas now experts see it as a highly dynamic organ that feeds on stimulation and experience and responds with the flourishing of branching, intertwined neural forests.

Diamond (1998) also states that, no upper age level limit exists for brain growth. The brain is plastic at all ages in response to new experience and stimulation. Therefore this seems to imply that purposeful systemic stimulation presents the opportunity to enable greater brain maturity and a second change because of brain plasticity.

3.6.2.2 Studies related to brain development

The John F. Kennedy Centre for Research on Human Development state that plasticity refers to how circuits in the brain change (organize and reorganize) in response to experience, or sensory stimulation. It has been widely believed that the sensory cortex matures early in life and thereafter has a fixed organization and connectivity. It is now know that the cortex can be reshaped by experience. In one experiment, monkeys learned to discriminate between two vibrating stimuli applied to one finger. After several thousand trials, the cortical representation of the trained finger became more than twice as large as the corresponding areas for other fingers (Buonomano and Merzenich, 1998).

Merzenich et al., (1993), again using a brain plasticity-based training programme, concluded that because the brain retains a lifelong capacity for plasticity and adaptive reorganization, dimensions of negative reorganization should be at least partially reversible through the use of an appropriately designed training programme.

The manipulation of environmental stimuli and experience can affect brain development and this has been shown in studies by Diamond et al., (1990) and Kosmarskaya (1969) on animal brains. Gesell (1947) in human studies has measured neuro- developmental maturity through developmental schedules. Dekaban (1970) reported permanent neuro functional differences in weight gain, disappearance of primitive reflexes and appearance of emergent as well as improved mental functioning in premature babies who received tactile-kinaesthetic stimulation. Rice (1975) has shown similar results in plasticity of visual and auditory abilities in older groups. Doman and Delacto state that within the concept of neurological organisation, brain growth is dynamic. Research by McCann and Mustard (1999) supports this theory.

The sensory movement programme Ayres (1980) designed is based on the theory of the plasticity of the brain and the changeability of neuronal connections as a consequence of experience. Ayres quotes findings regarding all aspects of the brain and interhemispheric integrating mechanisms. She reports that the therapy is not designed to improve motor skill but that replicating the ontogenetic sequence of the sensory movements allows the brain's neuronal connections to integrate and adapt to the prompts and thereby enhances perception and learning. She also believes that

consciously controlled and coordinated movements stimulate production of neutrophins (stimulate nerve growth), increasing the number of connections in the brain. The more precise the movements, the more developed the networks will become.

According to Hannaford (1995) the reason we find a thing difficult the first time we do it, but easier the more we do it, and with sufficient practice can do it semi-mechanically or automatically, is due to the plasticity of the living matter of our nervous system which is built for change and functions in the environment in which it grows.

3.6.3 The role of the cerebellum

Another reason as to how and why these motor programmes may work could be due to role of the cerebellum. The cerebellum is at the base of the brain, and is associated with motor skill. It is responsible for coordinating movement, planning, motor activities, learning and remembering of physical skills and for some cognitive abilities.

Clinical observations suggest that mental activities are coordinated in the cerebellum. In 1995, at the Annual Society of Neuroscience Conference, 80 studies were mentioned that suggested strong links between cerebellum and memory, spatial perception, language, attention, emotion, non-verbal areas and even decision making. These findings strongly implicate the value of movement in affecting cognition. The paradigm is that the lateral cerebellum is not activated by the control of movement, but is strongly involved during the acquisition and discrimination of sensory information (Pugh and Raman, 2006). This has been confirmed by magnetic resonance imaging of the lateral cerebellar output nucleus during sensory tasks. Therefore it seems that the lateral cerebellum may be active during motor, perceptual, and cognitive performances specifically because of the requirement to process sensory data (Parsons et al., 1977). It seems that the cerebellum "fine-tunes" motor commands.

Dyslexic children have been found to have significant difficulties in the development of motor skills (Fawcett and Nicolson, 1995) and direct evidence of cerebellar impairments in dyslexic children and adults has also been shown (e.g. Fawcett et al 1996; Nicolson et al., 1999). Fawcett et al. (2001), go on to suggest that 'cerebellar' tests for Dystonia might prove a valuable method of differentiating between poor readers with and without IQ discrepancy. Prescott (1977) states 'that if our movements are impaired, the

cerebellum and its connections to other areas of the brain are compromised'. He indicates the involvement of the cerebellum in 'complex emotional behaviour' (emotional intelligence).

As described by Berkow (2000), the cerebellum has three subdivisions. Firstly, the archicerebellum (vestibulocerebellum), which helps maintain equilibrium and coordinate eye-head-neck movements, and is closely linked with the vestibular nuclei; the midline vermis (paleocerebellum) helps coordinate movement of the trunk and legs. Vermis lesions result in abnormalities of stance and gait; the lateral hemispheres (neocerebellum) control ballistic and finely coordinated limb movements, mainly of the arms (Berkow, 2000).

In terms of the brain, some recent suggestions seem to indicate that general cognitive functioning, perceptual (Schweizer and Koch, 2003), visual-motor and gross-motor abilities (Rosenbaum et al., 2001) are strongly linked in terms of neural substrates involved in motor skill execution (Eccles et al., 1967), and have been identified as having a central role in skill automatisation and language-based skill (Allen et al., 1997; Leiner et al., 1989; Thach 1996).

The theory that there is a direct link between the cerebellum and higher cognition is further supported by the evidence that verbal and performance IQ correlate 0.38 and 0.41 with the size of a person's cerebellum. In women the correlation is slightly higher than in men. That is equal to or even higher than any other correlation between IQ and the brain (Andreasen et al., 1993). Cerebellar size in young people also links with 'logical memory' (Paradiso et al., 1995); and this link exists not only in humans: the volume of the cerebellum's outer molecular layer has been linked to the curiosity of rats to new things in their environment (Anderson, 1994).

Another link with cognition is that the cerebellum and cerebral cortex both increased in size during human evolution. In comparison to a primate of our size, we have 2.8 times more cerebellum and only slightly more cerebral cortex 3.2 times (Passingham, 1975). No other part of the brain in human evolution has developed so much. This development has been mostly in the part of the cerebellum, the neocerebellum, which is linked to the cerebral cortex (Leiner et al., 1991). Therefore, it seems that there are new

links with the expanded cerebral cortex which interact with those in the cerebellum. Also, according to Chugani and Phelps (1986) the development of the prefrontal cortex is delayed compared to older parts of the cerebral cortex, and so is the development of these newer parts of the cerebellum which link to it. For example, it has been shown that in holding numbers in the short term memory, not only is the cerebellum active, but also both speech areas (Paulesu et al., 1993). It has been suggested that the links between these areas might be needed for the full development of language.

3.6.3.1 Link of the cerebellum and motor skills

Research with people with damaged cerebellums has provided further evidence of a variety of problems in addition to their motor ones (Leiner et al., 1991). This link is also as noted since imaging showed that when mentally subjects are playing tennis, or saying a word or counting numbers silently, the cerebellum is active (Ryding et al., 1993). The memorisation of short passages or feeling textured tiles causes the cerebellum to be activated along with their cerebral cortex (Barker et al., 1991); the visualtion of somebody else's hand grasping objects does the same (Decety et al., 1994). Chess players, when working out strategies, again show similar evidence (Nichelli et al., 1994).

The cerebellum is activated during phonologically short-term and long-term memory tasks (Andreason et al., 1995, 1996; Paulesu et al., 1993). It is activated when people judge whether a tone is 200 or 400 milliseconds long (Jueptner et al., 1995). Additionally the cerebellum is also activated by repeating words and making word associations (Paulesu et al., 1993), or matching for meaning or real-life size pictures or written words (Vandenberghe et al., 1996). This all shows the importance of the cerebellum and cognition.

3.6.3.2 Studies related to the role of the cerebellum

Several studies with dyslexic individuals point to motor problems and abnormalities in muscle tone as common symptoms in the majority of dyslexic children (Fawcett and Nicolson, 1992, 1999; Nicolson and Fawcett, 1990, 1994, 1999). The conclusions seem to support the automatisation deficit hypothesis of dyslexia. According to those research findings, the cerebellum plays an important role in this type of deficit (Fawcett et al., 1996; Nicolson at al., 2001). This has recently been supported by neuro-anatomical and neuro-imaging findings (Nicolson et al., 1999; Rae et al., 1998). However, other researchers have failed to replicate these findings. While Yap and van er Leij (1994) reported a partial replication, other attempts have been unsuccessful (van Daal and van der Leij, 1999; Kronbichler, et al., 2002).

A link has also been noted between the cerebellum and language. Fulbright et al., (1999) identified evidence from PET scans, investigating brain functioning, and shown that the cerebellum is involved in both language and cognitive skill, including specific involvement in reading. They showed that dyslexic adults produced only 10-20% of the expected level of activation compared with controls and therefore did not show the normal pattern of activation when performing a motor sequence learning task.

In addition, according to the literature, children with DCD are more likely than controls to show an altered pattern of nonverbal intellectual functioning. Studies such as Breen et al., (1985), Crofoot and Bennett (1980), Graf and Hinton (1997) have found relationships between visual-motor integration ability and nonverbal (performance) IQ. In addition, children diagnosed with or at risk for DCD performed worse then a control group on performance IQ (Henderson and Hall, 1982; Lord and Hulme, 1988), even when the groups were matched for verbal IQ (Coleman et al., 2001; Piek and Coleman-Carman, 1995). In most studies the tests used are usually block-design, object assembly, geometric design and involve processes of motor control. Children with DCD find these difficult and Coleman et al., (2001) suggest that the poor performance on these subtests is therefore better explained in the light of the motor components involved rather than in terms of weak nonverbal intelligence.

There still remains controversy over the role of the cerebellum in cognitive skills not involving speech or 'inner speech' (Ackermann et al., 1998; Glickstein 1993), but there is now more and more evidence of the importance of the cerebellum in language (Ackermann et al, 2000; Silveri and Misciagna, 2000), including findings of links between specific cerebellar involvement and reading (Fulbright et al., 1999).

3.6.4 The impact on the vestibular system

The third reason why these motor programmes may work could be due to the role of the vestibular system. One of the claims of many movement programmes is that they have an impact on the balance system, for example, McPhillips et al., (2000) provided further evidence of 'a link between reading difficulties and the control of movement, in children' (Lancet, 2000, p 537) and that children with specific reading problems have problems that extend beyond the range of underlying language-related deficits (e.g. they have difficulties with balance and motor control)'.

The vestibular system, located in the inner ear, provides information about gravity, balance and movement. There is a claim that there is a correlation between vestibular problems and reading and writing in children with learning disabilities. Ayres (1973), Frank and Levinson (1973), and Levinson (1980) suggest that such children require a specialized therapy before they can benefit from academic input. DeQuiros (1971) and Levinson (1984) theorised that evidence of a vestibular disorder is predictive of learning disabilities and that the therapy can prevent these problems.

The vestibular system is well documented as supporting numerous basic functions, primarily: equilibrium, balance, proprioception, (body in space) awareness, muscle tone and audition. This area includes hearing, filtering and focusing auditory attention, sustaining auditory attention, and transmitting the sequence of auditory input and vision The vestibular and auditory systems are linked anatomically by the vestibulocochlear nerve. In addition to this anatomical link, the vestibular and proprioceptive systems, work in tandem with one another (Goetz, 2003).

3.6.4.1 Studies related to the vestibular system

Levinson (1984) suggested that the vestibular system has a causative effect in learning disabilities. He suggested the treatment of dyslexia with anti-motion sickness medication to correct the vestibular dysfunction. This was based on clinical observation and not backed by research. He proposed other interventions along with the anti-motion sickness medication, including many other types of medication plus special education to try and impact the vestibular system. He found over 95% of a large sample of students who had reading problems had balance/coordination/ rhythmic difficulties diagnostic of a previously overlooked inner-ear/ cerebellar dysfunction. This went against the old paradigm of brain damage and language disordered theories of reading problems due to dyslexia and instead implicated the role of the inner-ear in dyslexia.

The role of the vestibular system in the higher cortical functions required for academic performance is still not known. Some of the symptoms generally associated with learning disabilities (faulty eye movements, poor postural coordination, poor balance, and poor spatial orientation) could be linked to vestibular problems. Such symptoms, however, are only indirect evidence for vestibular dysfunction.

The most prominent objective sign of vestibular involvement is spasmodic nystagmus (rapid movement of the eyeball from side to side). Ayres (1972) used the Southern California Postrotary Nystagmus Test - though some question the validity of this test. Frank and Levinson (1985) used 'blurring speed' as evidence for abnormal vestibular function. This was described as the speed at which words passing across the visual field can no longer be recognized. However, because this involves the passing of stimuli across the subject's visual field at varying speeds, it constitutes visual stimulation, not vestibular. Therefore there has not been conclusive evidence for vestibular dysfunction in individuals with learning disabilities from these studies.

A study by Iversen et al., (2005) compared three groups (group of poor readers a group with of dyslexia and one control group) on total motor impairment scores as well as motor function for manual dexterity, ball-skills and balance. More than 50% of the children in both groups of poor readers showed definite motor coordination difficulties

at or below the 5th centile, for which motor intervention is recommended. Children in both groups showed difficulties in manual dexterity in particular and also performed significantly worse than controls on balance, but not in ball-skills. The authors concluded that the high incidence of motor coordination problems in the two groups of poor readers indicated that all children with reading difficulties should be screened for possible motor difficulties.

These results were similar to the findings from other studies (Dewey et al., 2002; Kaplan et al., 1998; Sugden and Wann, 1987). A link between poor readers and problems performing manual dexterity and balance tasks was noted. A similar pattern was reported for children with DCD and learning difficulties (LD) by Jongmans et al., (2003). In this study, manual dexterity was the most difficult area for both groups of poor readers. There was a significant difference between the two poor reading groups and controls.

Other studies on vestibular dysfunction in children with learning disabilities have reported negative or equivocal results. Ayres and Mailloux (1981) conducted single-case experimental studies with four children who had been diagnosed as aphasic, a disorder that impairs expression and understanding of language as well as reading and writing, to support their theory that vestibular function has an effect on auditory-language processing and speech and language. Although results indicated that language comprehension and expression scores improved, significant limitations of this research have to be pointed out. These included how language comprehension and expression were measured, and the fact that each child had received different amounts of speech-language intervention.

In a critique of the studies by Ayres (1972a, 1978) and Ayres and Mailloux (1981), Schaffer (1984) concluded that errors compromised the validity of findings and that possibly the problematic variables were: (a) the Hawthorne effect (b) the use of gain scores to measure change, and (c) inadequate sampling and matching procedures. Schaffer also challenged Ayres' (1978) theory that academic difficulties found in children with learning disorders resulted from vestibular problems and that Sensory Integration (SI) therapy effectively remediates academic failure. Due to the study design

and the types of measures employed, the existence of a Type I error remained a strong possibility.

Polatajko (1982) also studied the effects of vestibular system on academic achievement in 'normal children' and children who had been diagnosed with learning disabilities. He said that a weak relationship existed between the vestibular system and academic learning and suggested that more work needed to be carried out before it could be said that it is an effective way of remediation for learning disabilities.

In another study by Polatajko (1985) he investigated the relationship between children's vestibular function and academic learning using criteria for learning disabilities and measurements for the vestibular system. The evaluation of vestibular function consisted of examination of calibration records, search for spontaneous and gaze nystagmus (rapid involuntary rhythmic eye movement), testing smooth pursuit, and vestibular and optokinetic (reflex allows the eye to follow objects in motion when the head remains stationary) testing. Vestibular nystagmus was induced by a rotating chair. No significant differences were found between the 'normal children' and children with learning disabilities. There was no evidence that children having low, average, or high vestibular responsivity differed significantly on measures of academic performance.

Ray et al., (1998) examined the effect of vestibular stimulation (swinging) on speech sounds in children with autism. The researchers found a 15% increase in vocalizations while the child was on a swing compared to the absence of this vestibular stimulation. Quiros (1976) noted that a number of primary school children, when tested had 'learning disabilities without apparent justifiable cause'. He found that fifty two children out of sixty three had 'abnormal vestibular responses', which contributed, amongst other things, to motor problems in reference to reading and writing, and loss of interest in school learning (de Quiros, 1971). He therefore believes that vestibular disorders (and postural disturbances) can produce learning disabilities associated with motor skills, the acquisition of language and the development of normal competencies in reading and writing. (de Quiros, 1976)

Reynolds et al., (2003) evaluated the effectiveness of dyslexia, dyspraxia and attention deficit treatment (DDAT) - an exercise-based treatment for children with reading

difficulties based on balance principles. Methods of testing vestibular and cerebellar function using an electronystagmography (ENG) system for assessing eye movement control and a posturography balance system was used. The effect of a programme, undertaken with 106 school-age children over a six month period, where intervention aimed to improve balance, was investigated. After six months the children were reassessed using eleven tests of academic ability and skill using tests, which included the DST screening test (Nicolson and Fawcett, 1996) and a range of cerebellar and vestibular tests. These tests involved standard use of the Dynamic Posturography equipment, Sensory Organization Test, a Motor Control Test and the Adaptation Test. The scores indicated whether there was poor vestibular function or not. A score of 50-56 was expected from children between the ages of 9 and 13 years with good postural control (Rine et al., 1998; Shimizu et al., 1994). Eye movements were also tested.

The following tests were also administered - the Dyslexia Screening Test for literacy skills, phonological awareness and verbal memory, motor skill and balance, and memory retrieval fluency. In addition the Romberg test for balance, a test of diadochokinesis (speed of performing rapid alternating movements), a test of finger/thumb dexterity and a test of vestibular ocular reflex (VOR) suppression normally associated with cerebellar problems. The Diagnostic and Statistical Manual of Mental Illness (DSM IV) (American Psychiatric Association, 1994) test for attention deficit, and tests of primitive reflexes (the Moro reflex and the asymmetric tonic neck reflex) were also undertaken, in order to assess the incidence of primitive reflexes in the sample (Goddard-Blythe, 2002; McPhillips et al., 2000).

Over the period of the study, treatment methods were continually refined. Main variations in treatment included 39 of the first clients being prescribed Efalex (a fatty acid supplement), and daily exercises, rather than twice daily. Over 80% showed signs on the dynamic posturography balance test, over 60% showed cerebellar signs, and over 60% showed signs of retained primitive reflexes. Eye movements showed a smaller improvement. All improvements were highly significant, taking the group as a whole; 6 months into the treatment clients showed the expected physiological changes, with substantial improvements in vestibular function and visual tracking. The group started with a mean vestibular score of 41 and improved to a mean of 67; this is above the vestibular score expected for a group with a mean age of 10.4 years (Rine, 1998;

Shimizu et al., 1994). The theory behind the testing was to show improvement and to link it with improvement in reading.

This study was compromised by a number of methodological flaws (Rack 2003; Richards, Moore et al., Rochelle and Talcott 2000; Snowling and Hulme 2003; Stein 2003). The robustness of the experiment had to be questioned as there were no tests measuring the improvement in reading and a presumption cannot be made that one leads to the other. In addition, some of the treatments were changed; some children were initially prescribed Efalex alongside treatment, which was then no longer prescribed, and some of the first children were advised to carry out exercises once per day, rather than twice daily.

The 80% incidence of balance abnormalities is consistent with a similar study of nearly 100 children in specialist dyslexia schools reported by Fawcett and Nicolson (1999). It should be noted that the incidence of balance difficulties found by the objective dynamic posturography was considerably higher than that revealed by the much more limited postural stability test in the DST, indicating that the latter may not be as effective as one would like in identifying balance difficulties.

Rochelle and Talcott (2006) conducted a meta-analysis of 17 published studies that compared balance between dyslexia and control samples and obtained effect-sizes for each. Contrast and association analyses were used to quantify the influence of hypothesised moderator variables on differences in effects across studies. They concluded that although balance deficits are associated with dyslexia, these effects are more strongly related to third variables other than reading ability. Thus, deficits of balance may indicate increased risk of developmental disorder, but are unlikely to be uniquely associated with dyslexia.

In summary, there is no conclusive evidence to either support the theory of vestibular dysfunction or support the proposed treatment approaches. However, the use of this approach for treatment for learning disabilities continues and anecdotal evidence shows that it helps, however, a great deal of further research is required in this field.

3.7 DIFFERENT STRANDS OF MOVEMENT PROGRAMMES

There are three main strands of movement programmes that are designed to help children, Patterning, Sensory Integration Therapies and Primitive Reflex Integration. Patterning basically theorises that a child develops through stages of crawling, creeping, walking, balancing and running. The theory is that each stage is crucial and if a stage is missed out, then it has a huge impact on normal development- a domino type of effect. Sensory Integration (SI) therapy is to do with the interpretation and integration of sensory stimulation from the environment by the brain and was developed by Ayres (1972). Finally, the theory behind the primitive reflexes therapy is that at birth children are born with reflexes which provide an indication of the status of the central nervous system. These three strands will be presented in more detail in the following sections.

3.7.1 Patterning

The first strand of movement programmes is based around patterning. Patterning was initially developed by Doman and Delacato (1968) and is also sometimes referred to as the Doman-Delacato technique. Patterning has been used for more than forty years for treating children with brain damage and other disorders, such as learning disabilities, Down syndrome, Cerebral Palsy, and Autism (Golden, 1980; American Academy of Paediatrics 1982; Landman 1992; Nickel, 1996).

3.7.1.1 The theory behind Patterning

The theory follows the principle that failure to pass properly through a certain sequence of developmental stages reflects poor 'neurological organization'. Doman and Delacato (1979) maintain that efficiency in simple motor activities (cross pattern creeping, cross pattern crawling, cross pattern walking and lateralisation activities) leads to improvement in perceptual motor functioning which facilitates the development of neurological organization. The programme involves repetitive activities using specific muscle patterns in the order the child should have learned if development had been normal, e.g., rolling over, sitting, crawling, standing, and walking. In the more severe cases of proposed brain damage, which is believed to lead to poor 'neurological organization', patterns of passive movement are imposed that have as their goal, 'the production of normal activities which would have been the product of the injured brain

level had it not been injured (Doman, 1979). These techniques can also promote superior development in a normal child in physical and cognitive skills (Doman, 1979).

3.7.1.2 Studies related to Patterning

Sparrow and Zigler (1978) compared three groups of children, all of whom were severely mentally disabled and institutionalized. One group received patterning, a second was treated by motivational techniques, and a third received routine care. Using a wide variety of behavioural measures, the investigators found no significant differences among the three groups. Sparrow and Zigler (1978) concluded that patterning cannot be considered superior to any other method of treatment for institutionalized mentally disabled children. Attention has to be drawn to the fact that this study was carried out on severely mentally disabled children and that using a different sample may have produced different results and therefore general conclusions cannot be made.

In another study of 66 children and adolescents with mental retardation, Neman et al., (1975) found subjects receiving patterning improved more than subjects in the other groups in visual perception, programme-related measures of mobility, and language ability. In contrast MacKay (1987) and Bridgman et al., (1987) found either no or only short lived improvements in children treated with patterning.

The American Academy of Paediatrics looked at neurologically impaired children using patterning (Cohen et al., 1970) for the treatment of children with neuromuscular disorders, behavioural abnormalities and learning disabilities. They concluded that 'the data thus far advanced are insufficient to justify affirmative conclusions about the system of treatment'. According to Chapanis (1982) some disabled children who seemed to benefit from treatment had been given a misdiagnosis or an unduly pessimistic prognosis. He concluded that the course of maturation in children with neurological impairments varies; this can lead to claims that improvements in their conditions were the result of a specific form of treatment.

According to Cole and Chan, (1990) generally, research indicates that there is no reputable research evidence to support the Doman and Delacato training regime and the claim that it will result in improvements in neurological organisation; nor is there

evidence that these methods will lead to a different pattern of growth of motor and intellectual skills. However, they believe that despite the negative reaction of some authorities, there appears to be some benefit in providing motor and perceptual training programmes for children with disabilities. (Cole and Chan, 1990)

In contrast there has been some research evidence that supports the view that motor programmes do result in improved motor skills (Jenkins et al., 1983). In addition, Cole and Chan (1990) claim there are documented individual cases that show that children's motivation on learning tasks is improved; children will work harder on other activities in order to take part in the games aspect of the Doman-Delacato regime.

3.7.2 Sensory Integration programmes

The second strand of movement programmes is based around Sensory Integration (SI) therapy. This is a sensory-motor treatment based upon theories developed over by Ayres (1972).

3.7.2.1 The theory behind Sensory Integration Therapy

The theory is that sensory integration is an innate neurobiological process (Hatch-Rasmussen 1995), and that individuals with developmental delays experience dysfunction in which sensory input is not integrated or organized appropriately by the brain. This theory hypothesizes that some children with learning disorders experience difficulty processing and integrating sensory information and that this, in turn, affects their behaviour and learning. Ayres (1972) theorized that the behaviour and learning problems were, in part, due to faulty integration of sensory information and inability of higher centres to modulate and regulate lower brain sensory-motor centres (Ayres, 1972).

Although new findings and knowledge demonstrate that the nervous system is even more complex and integrated than Ayres (1972) and others believed at the time, many of the principles on which Ayres built the theory of sensory integration upon are still upheld. This knowledge has been strengthened by research demonstrating that structural, molecular, and cellular changes in neural functions are possible and that meaningful sensory motor activities can be mediators of plasticity (Merzenich et al.,

1984; Greenough et al., 1987; Kandel and Jessell, 1995; Kempermann and Gage, 1999; McKenzie, et al., 2003).

Although the original theory was developed for children with learning disabilities, Ayres expanded this and went on to work with other children. Ayres and Tickle (1980) applied the theory to children with autism and noted that SI helped decrease tactile and other sensitivities to stimuli that interfere with their ability to play, learn, and interact.

SI is conducted by occupational therapists or physical therapists that provide sensory stimulation to the patient, often in combination with specific muscle activities. The treatment consists of vestibular, proprioceptive, and/or tactile stimulation. Sensory integration is therefore described as 'the organisation of sensation for use' (Ayers, 1995). The child is provided with levels of sensory information during physical activities that are meaningful to the child, and that elicit adaptive behaviours (Kumar and Bundy 1991). There are also treatment protocols that take a more active approach such as those developed by Wilbarger (1995) that promote the use of increased sensory input e.g., deep pressure to reduce hypersensitivity in addition to the modifications in the child's environment.

SI therapy has been used with a variety of clinical populations across the age span, including 'normal children' (Ottenbacher, 1982) and children with neuromuscular disorders such as cerebral palsy (Price 1977), learning disabilities (Ayres, 1972b; Clark et al 1989; Price, 1977), mental retardation (Clark and Shuer, 1978; Price, 1977), autism (Ayres, 1979), and sensory impairments (Price, 1977). In the past, The American Occupational Therapy Association has supported the application of SI therapy procedures and techniques with children who have been diagnosed with learning disabilities, pervasive developmental disorder/autism, and chronic psychosocial dysfunction (Hinojosa et al., 1982).

In most cases, sensory integration develops as a result of ordinary activities as long as there are no major problems. Motor planning is a natural outcome of the process, as is the ability to respond to incoming sensations in an adaptive manner. But for some children, sensory integration does not develop as efficiently as it should and the process of sensory integration is disordered and therefore a number of problems in development

or behaviour may become evident. Sasse (1980) concludes that it is logical that the child's learning and behaviour may be affected if any of the natural developmental stages of early childhood are disorganised. McEwan et al., (1991) just as Bender (1974) had suggested earlier, proposed that early crawling has an effect on motor and sensory motor skill development during early childhood. The motion of crawling is linked to developmental changes of eye-hand coordination, tactile input and social maturation. They stated that crawling initiates the basis for visual-spatial awareness and is essential for the eyes to practice focusing at a reading distance. Children with such deficiencies should benefit from increased involvement in floor and mat activities requiring tactile, proprioceptive, and kinaesthetic input in order to recreate skill development (McEwan et al., 1991).

Frostig (1970) claims that changing body position to move in space (crawl) is one of four distinct groups of skills that are developed during the sensory motor phase. If a child is not showing an ability that should have been acquired during that phase of development then specific types of movement can be effective in developing that skill (Frostig, 1970).

3.7.2.2 Sensory integration impact on learning challenged children

Grimwood and Rutherford (1980) conducted a study to test the effectiveness of the Ayres programme with a group of learning disabled children. Activities included scooter boards, therapy balls, rolling and spinning activities. Findings showed that the therapy group performed significantly better than the control group. Palmer (1998) also documented significant gains in attention and reading from activities similar to Ayres (1972). Humphries et al., (1992) compared the effect of SI perceptual-motor training (PM) and no treatment (NT) on the performance of 103 children with learning disabilities and sensory integrative dysfunction, aged 58 to 107 months, who were randomly assigned to one of the two treatment groups or to no treatment. After receiving a total of 72 1-hour sessions of therapy for 3 hours per week, PM-treated subjects showed significant gains over the other two groups, mainly in gross motor performance. SI-treated subjects showed an advantage in motor planning. There were no differences in visual perception, handwriting readiness, copying ability, cognitive, academic, language and attentional skills or in self-concept.

Werry et al., (1990) conducted a study on SI and teacher-judged learning problems. The sample consisted of children with significant learning problems inconsistent with their ability. Seventy-four children from 21 schools, referred because of teacher-perceived learning difficulties and pre-screened for sensory integration (SI) deficits, were given tests of SI, reading, vocabulary, perceptual-motor function and motor development, and their teachers rated their classroom behaviour. The results showed that the children suffered primarily from attention deficit disorder without hyperactivity, and from mild deficits of SI. The intervention group received therapy, where as the comparison group received a placebo with the same amount of child-therapist interaction. The groups were roughly matched for school age, sex and degree of SI disability. There were no significant differences for age, sex, or maternal education across the groups. There were significant differences in IQ and auditory memory at baseline. All groups had improved significantly at nine months on word recognition, reading, vocabulary and motor performance. There were, however, no significant differences between groups for IQ, academic achievement, or motor performance. There were no significant differences between the groups on teacher ratings of behaviour, visual association, auditory memory or auditory sequencing. Both early and late treatment groups performed better in visual matching than the no therapy group in follow up. Except on one minor sub-test, Werry concluded, this study failed to show any improvement attributable to SI. It can be only said to support the probability that SI is ineffective for 'learning disabilities'. While there were significant improvements with time in both treated and untreated groups on most measures except classroom behaviour, only one measure showed a treatment effect; this one was most reflective of sensory integration.

One of the weaknesses of the study was that the children were not randomly allocated to groups. The most serious cases were screened out prior to the study; this limits the generalisability of the results to more serious children. Testers were not binded to group allocation. The groups were treated differently with the intervention group receiving therapy and the control group not receiving anything. The intervention group received the treatment during different time periods (half early and half late) so there is the possibility of time effects. The study may not have had sufficient power to detect a difference between the groups.

Paul et al., (2003) conducted a study to evaluate the effectiveness of the Sensory Integrative Treatment Protocol (SITP) in treating children with learning needs. Two groups were used as experimental and control groups. The experimental group consisted of 15 children and the control group consisted of 16 children diagnosed with pre-primary (learning needs) impairments. The DeGangi-Berk Test of Sensory Integration (TSI) and the Miller Assessment for Preschoolers (MAP) were used as the instruments to measure change within and between the two groups before and after the intervention. TSI and MAP scores went up considerably for the children in the experimental group following the intervention. Based on the results, the researchers suggest that 'Sensory Integration Treatment Protocol,' was effective in reducing sensory integration dysfunction and improving preschool performance in children diagnosed with pre-primary impairments.

In a pilot study, Humphries et al., (1990) compared changes in academic related performance among a group of children with learning difficulties and SI dysfunction following SI treatment, perceptual-motor treatment, and no treatment. The findings suggested that SI treatment had no effect for improving academic, language or cognitive performance. However, children who received SI treatment showed increased gains in motor functioning compared to children who received perceptual motor treatment or no treatment at all. In a second similar study, Humphries et al., (1992) again found no impact of SI treatment or perceptual-motor treatment on academic, language performance.

Hoehn and Baumeister (1994) wrote a critique on the application of Sensory Integration Therapy, for children with learning disabilities. They concluded that results of this critique raise serious doubts as to the validity or utility of SI therapy as an appropriate, indicated treatment for the clinical population in question—and, by extension, for any other groups diagnosed as having 'sensory integrative dysfunction.'

Ottenbacher (1982) conducted a meta-analysis of eight studies in which 47 statistical tests were used to evaluate the effectiveness of SI therapy administered to children with learning disabilities, mental retardation, and various other disabilities. The majority of subjects across the eight studies were classified with learning disabilities. Analyses were based on the work of Ayres (1972a, 1977, 1978); Clark et al., (1978); DePauw (1978);

Grimwood and Rutherford (1980); Magrun et al., (1981); and Montgomery and Richter (1977). These studies were selected because they met specific criteria. These included:

- Use of SI therapy as the independent variable.

- The use of measures assessing improved motor and/or reflex functioning, academic achievement, or improved language abilities as the dependent variables; a comparison of at least two groups or conditions.

- The report of findings and results in quantitative forms that allowed further analysis. Effect sizes were analyzed according to each dependent variable as well as each diagnostic label.

Table 3-1: Summary of Ottenbacher's (1982) meta-analysis findings

Study	Significant	Not significant
19 Motor performance /reflex functioning	12 support of groups receiving SI	7 no significant difference in control groups
17 Academic achievements	9 significant effects	8 found no significant difference in control groups
11 Language functioning	4 significant	6 no significant difference 1 in favour of control
17 Mental retardation Average subjects	SI performed better than 70% of subjects in no-treatment control group	
15 Learning disabilities	SI performed better than 75% of subjects in no-treatment control group	
15 "At-risk" for learning difficulties or aphasic	SI performed better than 89% of subjects in no-treatment control group	

Based on this, Ottenbacher (1982) reached two conclusions:

(a) SI therapy was most effective when the dependent variable was some type of motor or reflex measure and least effective when the dependent variable was some type of language measure.

(b) SI therapy was most effective with subjects who had been diagnosed as being 'at-risk' or with aphasia and least effective with subjects who had been diagnosed with mental retardation.

He concluded that these results may suggest that 'the effect of sensory integration therapy applied to the representative population appears to have empirical support' (Ottenbacher 1982).

Some authorities have discussed limitations in Ottenbacher's (1982) research. Hoehn and Baumeister (1994) raised concerns regarding confounding variables, such as the diagnostic category, type of dependent measure, chronologic age of the subjects, insufficient subject sampling, and flaws in group assignment. Densem et al., (1989) also discussed issues related to flaws in the research design and methodology.

3.7.2.3 Sensory integration impact on learning

Lefnoy (1990) looked at a number of other researchers who have studied the effectiveness of sensory motor stimulation programmes. Vincent (1977), Cratty (1975) and Frostig (1969); all showed the effectiveness of these programmes. Vincent (1977) believes that by neurologically organizing a child it is possible to overcome problems in reading and writing. Cratty (1975) suggested such a programme enhances concentration and Frostig (1969) suggested that every school needs to include sensory motor function training to optimise the development of the children. He suggested that movement is particularly good in helping integrate receptive and expressive functions.

Palmer (1984) studied a movement programme that looked at children with a variety of problems including poor writing and spelling skills, poor co-ordination, comprehension and concentration difficulties, and delayed speech development. The study used random sampling; control groups and placebo groups but the considerable limitations on this study have to be noted. Tests were conducted without control groups. Results showed the change in pre and post test in terms of the average improvement in reading spelling

or word recognition. Without a control group there is no basis for comparison of these results except to compare to them to the actual time elapsed between tests. Palmer (1984) believes the study provides evidence to support funding of a thorough scientific trial of the programme. Although the methodology for such a rigorous trial would need further research, it would need to include control groups and non-specific exercise groups to control placebo effects.

A meta -analysis of sensory integration efficacy research studies by Vargas and Camilli (1999) were synthesized and analyzed. Sixteen studies were used to compare sensory integration effect with no treatment (SI/NT), and 16 were used to compare sensory integration effect with alternative treatments (SI/ALT). Overall average effect sizes, comparisons of the effect sizes for different dependent variables, and secondary factors associated with effect size variation were examined. The conclusions showed the following:

a) the SI/NT comparison, a significant effect was replicated for sensory integration treatment effects in earlier studies, but more recent studies did not show overall positive effects.

b) Larger effect sizes were found in psycho educational and motor categories.

c) Sensory integration treatment methods were found to be as effective as various alternative treatment methods.

Smith (1996) examined several investigations evaluating SI's effectiveness for children with developmental disabilities. He concluded that 'SI did not decrease self injury, did not reduce ritualistic behaviours and did not show increases in motor development'.

The relationship between motor coordination, executive functioning (mental processes that helps us connect past experience with present action) and attention in school aged children was studied by Dyck et al., (2004). The aim of this study was to explore the relationship between executive function and motor ability. The sample consisted of 238 children, aged between 6 and 15. Motor ability was assessed using the McCarron Assessment of Neuromuscular Development (MAND), level of inattention using the

Child Behaviour Checklist (CBCL), and Verbal IQ (VIQ) was estimated using subtests of the WISC-III. A reaction time task and three EF tasks measuring response inhibition, working memory and the ability to plan and respond to goal-directed tasks were administered. It was found that motor ability significantly accounted for a difference in tasks measuring speed of performance, whereas inattention appeared to influence performance variability. Despite past evidence linking poor motor ability with inattention, the authors concluded that there was little overlap in the processes that are affected in children with motor coordination or attention problems.

The efficacy of SI therapy was also investigated by Kaplan et al., (1993), who combined the data from measures assessing academic and motor skills from the studies by Wilson et al., (1992) and Polatajko et al., (1991) studies. The authors concluded that SI therapy was no more effective than other, more traditional intervention approaches for remediating learning disorders in children.

Hoehn and Baumeister (1994) and Schaffer (1984) also published a review that raised concerns regarding the work of Ayres (1965, 1966a, 1966b, 1966c, 1969, 1971, 1972c, 1977), including factor analytic studies (Ayres et al., 1987). An examination of the multiple regression analyses led to the conclusion that there was no validity for the SI diagnostic label, the protocol for SI dysfunction, or the hypothesis that SI therapy is an effective approach for improving language function and learning disorders in children.

Results of the studies reviewed in this critique are mixed and inconclusive. Authorities who have reviewed the research concerned with the effectiveness of SI therapy have reached different conclusions as well (Cummins, 1991; Hoehn and Baumeister, 1994; Ottenbacher, 1982; and Polatajko, 1982). According to Cohn and Cermak (1998) in relation to the outcomes, improved scores from standardized measures provide limited information concerning the effects of SI therapy on children and their families.

Bonifacci (2004) examined perceptual, visual-motor abilities and intellectual skills in 144 children with low, average and above average motor abilities. There were three groups of children who were identified on the basis of their performance on the TGMD (Test of Gross Motor Development; Ulrich, (1985). Each child received an intelligence

test (Kaufman. and Kaufman. (1990), and was evaluated for perceptual and visual-motor integration abilities (DTVP; Hammill et al., 1993).

The results showed a significant difference in visual-motor integration between children with high and low gross-motor abilities, in the absence of significant differences in perceptual skills or intellectual ability. Also there were no relationships between gross-motor ability and IQ, although visual-motor integration was significantly related to nonverbal IQ.

Polatajko et al., (1992) evaluated seven treatment studies that were conducted between 1972 and 1992. The authors found that for the learning there was no difference between the SI intervention and other interventions. However, in studies using motor, sensorimotor and visual-motor variables, SI treatment was as effective as other treatment methods employed in improving performance in these areas. The authors concluded that the studies suggested that SI treatment was linked to improving academic, cognitive and linguistic performance but may also improve some aspects of motor and visual-motor performance among children with LD. Moreover, there is no evidence to suggest that SI treatment improved learning better than any other treatment. It was concluded that there was some evidence which suggested that SI treatment has a minimal effect for improving learning among children with LD.

Schaefer et al., 1989) emphasised the importance of sensorimotor foundations in learning. According to Piaget in Munsen (1983), sensorimotor development is a critical stage in the development of cognitive structures which later formed the foundation for leaning. Kephart (1971) also considered a child's ability to integrate sensory information as decisive to learning. Some argue that sensorimotor behaviour provides foundations for learning (Goddard, 1982). Whilst further studies are needed to make this conclusive, it seems that among children with learning difficulties there is evidence that a distinct subgroup exist with SI dysfunctions. These children have been reported to have weaknesses in learning ability and motor performance (Schaffer et al., 1989).

3.7.3 Primitive reflexes

The third and most recent strand of movement programmes is based around the integration of primitive reflexes. These primitive reflexes are involved in the

development of the central nervous system and develop in a regular sequence. Each reflex plays a part in the development of the child and prepares the way for the next stage of development and, there is a sequential occurrence of survival or primitive reflexes. According to Illingworth (1987), they may play an important role in determining central nervous system functioning. Furthermore, Morrison (1985) had a similar view; he said there is a substantial body of literature linking the persistence of primitive reflexes beyond the first year of life to a range of learning difficulties, including reading delay. It seems that retention of primitive reflexes may affect co-ordination, sensory perception and cognition.

3.7.3.1 The role of Asymmetrical Tonic Neck Righting reflex (ATNR) in learning

One of the reflexes, the Asymmetrical Tonic Neck Righting reflex (ATNR), is thought to play an important role in early visuomotor development as it is present when near point fixation is developing (Illingworth, 1987). Evidence has shown that if there is a problem with ATNR there is a possibility of a child experiencing fine and gross motor control problems. As it is inhibited, symmetrical movements become possible with, for example, objects brought to the midline and passed from one side to the other. The transference of objects across the midline is a significant motor milestone usually achieved between 6 and 8 months after birth (Holt, 1991). The persistence of the ATNR also seems to disrupt the emergence of gross motor abilities such as rolling, creeping, crawling, riding a bicycle and catching or kicking a ball. There are very close links between the inhibition of primary reflexes and the attainment of gross motor milestones in young children (e.g. Capute et al., 1978).

The eyes have to cross the midline when reading and there seems to be a link with the ATNR directly interfering with saccadic eye movements when reading and/or disruption of the general development of visual pursuit skills. In a study evaluating the effectiveness of a specific movement intervention programme with children aged 8–11 years old with reading difficulties, it was found that it was possible to reduce the level of ATNR interference at this late stage of development and that this led to very significant progress in reading and writing skills (McPhillips et al., 2000).

The study by McPhillips et al., (2000) looked at the role of the ATNR. It provided evidence of 'a link between reading difficulties and the control of movement in

children', and highlighted how the 'educational functioning of children may be linked to interference from an early neurodevelopment system (the primitive -reflex system)' (Lancet, 2000, p537). From the outcomes the authors proposed 'a new approach to the treatment of children with reading difficulties involving assessment of underlying neurological functioning, and appropriate remediation' (Lancet, 2000, p537).

The study was completed with children (aged 8-11 years) with persistent primitive reflexes and a poor reading into one of three randomized, individually matched, double-blind, placebo-controlled design treatment groups: 20 experimental (children were given a specific movement sequence); 20 placebo-control (children were given non-specific movements); and 20 control (no movements). The children were matched on age, sex, verbal intelligence quotient (IQ), reading ability, and persistent ATNR (60 altogether). The results showed that there was a significant interaction for ATNR levels. The experimental group showed a significant decrease in the level of persistent reflex in comparison to the placebo-control and control groups. The findings showed that there was a significant interaction for reading. Over the 12 months the experimental group gained 19.6 months while the placebo-control and control groups gained 7.3 and 6.9 months respectively.

Further research by McPhillips and Sheehy (2004) investigated retained reflexes in a primary school and how this related to other cognitive and social factors. 409 children (aged 9-10 years) from 11 primary schools were divided into three groups. The three groups represented the bottom, middle and top 10% respectively of readers from the total sample population. The persistence of the ATNR and problems of motor difficulties were assessed for the three groups. The role of verbal IQ, social deprivation, sex, month of birth and religious affiliation in determining the reading level of the total sample was also investigated.

The following tests were used: the Wechsler Objective Reading Dimensions (Basic Reading) (Rust et al., 1993), the Neale Analysis of Reading Ability (Neale, 1989), and the assessment of verbal IQ using the Non-Reading Intelligence Test (Young, 1989). ATNR was assessed by the Schilder test and motor difficulties were assessed using a standardized test of motor impairment, Movement ABC (Henderson & Sugden, 1992), which assessed motor difficulties.

- The results showed that the lowest reading group had a significantly higher mean level of ATNR in comparison with the middle reading group and the top reading group.

- There was significant difference between the lowest reading group and the top reading group on motor ability.

- ATNR but not motor ability was associated with the sex of the child, with boys, in particular, at risk.

- ATNR or motor ability was not significantly associated with social deprivation.

- There were also no significant differences between dyslexic and non-dyslexic children with reading difficulties in motor (including balance) performance.

- Verbal IQ was the strongest predictor of reading level for the 409 (9–10 year old) children involved in the study, consistent with the high correlation between reading level and verbal IQ described in other work (Rust et al., 1993).

According to the authors the study showed an association between reading difficulties and movement difficulties in children and provided more evidence about the link with reflexes of children with reading difficulties. Motor difficulties were also significantly associated with reading delay although the relationship was not as strong as for ATNR persistence. The authors stated that 'it should be of great concern that of the 123 children in the three reading group sample, 11% have a significant motor deficit and should be receiving specific, specialized motor interventions' (McPhillips and Sheeny 2004, p334). Support was also provided for the theory that the inhibition of primary reflexes can be brought about at a much later stage in development (the results were with children aged nine to ten years). Also that persistent primary reflexes (in particular ATNR) extend beyond the obvious disruption of motor development into cognitive areas.

In further research, Black (2005), in a comparative study of 683 children over a two-year period investigated primary reflexes ATNR in children attending primary school and how this related to attainments in a number of academic areas. The Primary Movement Programme in reducing primary reflex persistence and improving academic attainment was also evaluated.

A second, quasi-experimental study followed the progress of four parallel groups in each of two large schools with the experimental side completing the movement intervention programme while the other side acted as the control.

The study found that:

- Boys were more at risk than girls for ATNR persistence. ATNR reflex was significantly associated with level of attainments in reading, spelling and mathematics.

- The movement intervention programme had a significant impact on reducing the levels of ATNR persistence in children in both studies and that this was associated with very significant improvements in reading and mathematics.

The author concluded that there is 'further evidence of a link between the attainments of core educational skills and the interference that may result from an underlying developmental deficit.' (Black, 2005 p101)

In another study McPhillips and Jordan-Black (2006) investigated the ATNR persistence in 739 aged 7–9 years children in primary schools and the degree of reflex persistence and the development of early literacy skills. In addition, core literacy skill in dyslexic and non-dyslexic poor readers was also studied as was home backgrounds using standardised educational tests; a clinical diagnostic test for a primary reflex ATNR was used. Verbal IQ was measured using the Non-Reading Intelligence Tests (Young, 1989), and reading and spelling were assessed using the Wechsler Objective Reading Dimensions (WORD) (Rust et al 1993). The two WORD subtests used in this study were Basic Reading and Spelling. The Graded Non-Word Reading Test (Snowling et al 1996) was used to identify children whose reading difficulties were associated with impaired phonological skills. The ATNR was assessed using the

Schilder Test (Morrison, 1985). Results showed that persistence of the ATNR was significantly predictive of attainments in reading and there were no differences between the performance of dyslexic and non-dyslexic poor readers on any of the outcome measures. Further tests revealed that males had significantly higher levels of persistent reflex than females and those children from socially disadvantaged backgrounds had significantly higher levels of reflex than children who were not socially disadvantaged.

3.7.3.2 Other studies related to the reflexes

Another study on the impact of a movement programme at a school in Birmingham (2000) was supervised by Goddard-Blythe. The results showed a significant improvement. Evaluation and validation by Dr Fiona Fylan of York University stated that 'the results are "significant" and show a marked difference between the control group and the target group of children' (Educational Guardian, July 16th, 2002). It was reported that reading scores across the whole group have been less conclusive, hence the need for further research. Professor Nicholson concluded that 'we need to see the Government carry out a proper evaluation of these techniques.' (Educational Guardian, July 16th 2002).

In order to assess whether neurological dysfunction was a significant factor underlying academic achievement. Goddard–Blythe (2005) used the (INPP) Developmental Test Battery with 810 children with special educational needs. Drawing and reading were also assessed at the beginning and end. The progress of 339 children aged four to five years of age was also tracked through the school year to see whether children with higher scores on the INPP Developmental Test Battery (indications of neurological dysfunction) performed less well academically at the end of the school year. In addition, 235 children in mainstream classes aged 8–10 years completed INPP Schools' Developmental Exercise Programme with teacher supervision for one year. 205 children aged 8–10 years also completed the INPP Tests but did not take part in the Developmental Exercise Programme. A third group acted as a control group. No pre-selection was made among these groups at the beginning of the study. One study included a fourth group of 31, nine year old children who were given non-specific exercises for the same time period each day as the experimental group (INPP exercises) to see whether general daily exercises were more or less effective than the specific INPP exercises.

The results showed that:

- Children who participated in the daily INPP exercises made significantly greater improvement in neurological dysfunction, balance and coordination.

- Children who had scores of more than 25% on tests for neurological dysfunction and whose reading age was less than their chronological age at the start also showed small, but significantly greater progress in reading than children who did not take part in the programme.

In contrast, a recent evaluation of the INPP (Neuro-developmental Therapy, INPP), programme for primary school children showed little impact in a school context (Fylan and Grunfeld 2004).

3.8 RESEARCH ON OTHER AREAS OF IMPROVEMENT

There has been some link with improvement in general behaviour after using movement programmes as well as improvement for children with specific problems. These will be discussed below.

3.8.1 Studies related to behaviour

The aims of the Sherborne Developmental Movement programme study (Marsden et al., 2004) were to see if children who completed the programme showed a greater increase in development in body management, relationship building and the ability to concentrate compared with a control group of children of similar age, abilities and background. All the children did physical education three times per week. 16 children from each class were randomly chosen from the register as research project children (n=48). Each group of 16 children underwent the following tests:

a - Observation of body management abilities of a specific gymnastics session using a physical observation schedule (Sherborne, 2001).

b - Observation of relationship building in both the classrooms and at break times using an adapted observation schedule (Sylva, 1980).

c - Observation of on/off task behaviours in the classroom setting using video recording and observation schedule (Sylva, 1980).

The results for body management showed highly significant differences in body, space, dynamics and relationships for children in both intervention classes as compared to no intervention class. In addition:

- There were no significant differences between the intervention classes.
- The control class showed slight improvement in the four elements.
- The results for social development children in the intervention classes showed the biggest improvements in social development and the control class showed only small improvements.
- There was little difference between the classes in terms of concentration, but boys in the intervention classes had significant change in their concentration scores whereas boys in the control did not.

Kroflic (1998) studied how creative movement can influence some aspects of intellectual, emotional and social development of children of primary school. The study looked at how to apply the creative movement and dance to the content of academic subjects and study the effects of this teaching method. The independent variable was creative movement as a teaching method and the dependent variables were creative thinking, empathy, social behaviour, and mood state. The study was conducted with 37 primary school teachers, 710 children from Slovenia, aged 7-11 and the following tests were used:

- Test for Creative Thinking- Drawing Production (Urban and Jellen 1996).
- Index of Empathy for Children and Adolescents (Bryant 1982).
- Lestvica emocionalnih stanj – Scale of Emotional States (Lamovec1985).
- Non-standardised questionnaires and pupil-behaviour-checklists for teachers were also used. The teachers who were educated in creative movement workshops introduced creative movement as a teaching method into lessons.

Analysis of teachers' experiences showed positive influences of creative movement on children's motivation, understanding, memory, creativity, self-esteem, interpersonal relationships, tolerance, well-being of children and teachers. The comparison of the results between the experimental (independent variable - creative movement as a teaching and learning method) and control group (traditional methods of teaching) showed significantly better creative thinking achievements of children in the experimental group. There were no significant statistical, differences between groups in their social behaviour and empathy.

In a study to test the effectiveness of SI on self-injurious behaviours (SIB), Mason and Iwata (1990) found that SI was less effective than behavioural treatment in reducing SIB; in one case, the rate of SIB actually increased with SI treatment. Although SI therapy is used with a variety of clinical populations, the majority of Ayres' empirical research regarding its efficacy has been conducted with children who have learning disabilities.

3.8.2 Studies with children with specific problems

In the following sections studies carried out with children with specific problems will be presented. These are Developmental Coordination Disorder, Attention Deficit Disorder and Attention Deficit Hyperactivity Disorder (ADD/ADHD) as well as Dyslexia.

3.8.2.1 Studies with children with Developmental Coordination Disorder

A variety of terms have been used in order to describe children with motor coordination difficulties (Barnett et al., 1998; Missiuna and Polatajko, 1995). At a consensus conference in 1994 researchers agreed to use the term 'Developmental Coordination Disorder' (DCD) from the DSM-IV classification system (Polatajko et al., 1995). According to the DSM-IV criteria, the children must present with motor function significantly below chronological age, motor impairment must interfere significantly with activities of daily living and must not be related to a medical condition (American Psychiatric Association, APA, 1994). According to international estimates, the prevalence of DCD is at least 5–6% (APA, 1994; Henderson and Hall, 1982; Kadesjo and Gillberg, 1998).

Researchers have pointed to motor coordination difficulties as a possible indication for a whole range of developmental disorders (Missiuna et al., 2000). This was echoed by (Hadders-Algra, 2002; Kadesjo and Gillberg, 1998; Missiuna et al., 2003) who stated, it was possible to identify motor coordination difficulties early on whereas learning problems, attention deficit hyperactivity disorder and other co-morbid difficulties become more gradually evident. However some researchers would argue that those later problems are caused by the former.

Dewey et al., (2002) investigated the problems of attention, learning and psychosocial adjustment with children with developmental coordination disorder (DCD). Forty-five children identified with DCD, 51 children identified as being suspect for DCD and 78 comparison children without motor problems on standardized tests of motor function participated in this study. The results showed that both children with DCD and those children suspect for DCD obtained significantly poorer scores on measures of attention and learning (reading, writing and spelling) than comparison children. Children with DCD and those suspected of DCD were also found to show a relatively high level of social problems. According to the authors the findings indicated that all children with movement problems are at risk for problems in attention, learning and psychosocial adjustment.

Kaplan et al., (1998) conducted a motor evaluation, using a combination of BOTMP (Bruininks, 1978), M-ABC (Henderson and Sugden, 1992) and the DCD questionnaire (Wilson et al., 1998). They found high prevalence of DCD compared to normal controls within this sample, and a major overlap between reading disorder (RD), ADHD and DCD. O'Hare and Khalid (2002) reported a high risk of reading and writing delay for children with DCD. Results indicated that poor balancing (both as single and dual-task) was found to be associated with ADHD. To support this, Ramus et al., (2003) found motor difficulties in postural stability, bead threading and the finger to thumb tasks in about half of a group of dyslexic children. They concluded that while their study supports the presence of motor difficulties in many children with dyslexia, co-morbid disabilities such as ADHD and DCD might be the main explanation for these difficulties.

Smits-Engelsman et al., (2003) investigated children's motor deficits with 32 children with DCD and co-morbid learning disabilities using kinematic movement analysis of fine-motor performance. Their conclusions supported difficulties with motor control rather then a general slowness hypothesis.

The link between reading difficulties and motor coordination problems has been reported in several studies over the years (e.g. Dewey et al., 2002; Fawcett and Nicolson, 1992; Kadesjo and Gillberg, 1998; Kaplan et al., 1998, Maeland 1993; Nicolson and Fawcett, 1990, 1994, 1999; Ramus et al., 2003). Results from different studies are, however, often difficult to compare due to differences in diagnostic procedures with regard to developmental coordination disorder, as well as research methods and choice of tests. The researchers that focus on DCD usually use standardized and norm-referenced measures (i.e. the Movement Assessment Battery for Children (M-ABC), (Henderson and Sugden 1992) and the Bruininks–Oseretski test of Motor Proficiency (BOTMP, Bruininks 1978).

A pilot study (2005) was conducted to evaluate the effectiveness of a Neuromotor Task Training (NTT) developed for the treatment of children with DCD. Ten children with DCD (intervention group) were tested before and after 9 and 18 treatment sessions on the Movement ABC and a dysgraphia scale in order to measure the effectiveness of treatment on gross and fine motor skills in general, and handwriting in particular. Five children (no-treatment control group) were tested twice with a time lag of nine weeks on the Movement ABC in order to measure spontaneous improvement. No improvement was measured for the children in the no-treatment control group, whereas a significant improvement was found for children in the intervention group for both quality of handwriting and performance on the Movement ABC after 18 treatment sessions.

Niemeijer et al., (2000) evaluated neuromotor task training (NTT), a programme for children with developmental coordination disorder (DCD). A treatment and a non-treatment control group of children with DCD were included. Children were selected if they scored below the 15th centile on the Movement Assessment Battery for Children (MABC). The children in the treatment group had been referred for physiotherapy. After 30-minute sessions of NTT or at least 9 weeks of no intervention, the MABC and the Test of Gross Motor Development-2 (TGMD-2) were administered. Results

indicated that for motor performance NTT was effective and only the treated group improved on the MABC and the TGMD-2. Children improved most on tasks similar to those trained. In older children with poorer motor patterns, NTT's treatment success was higher. The Child Behaviour Checklist subscales; withdrawn, thought problems, anxious/depressed, and delinquency were determinants of effects on motor patterns.

Children with developmental disorders often also have other problems as well pure and isolated problems tend to be the exception, not the rule. More often children present with various combinations of difficulties (Bax, 1999; Dewey et al 2002; Henderson and Barnett, 1998; Kadesjo and Gillberg, 1998; Kaplan et al., 1998; Richardson and Ross, 2000). Longitudinal studies have shown high rates of co-morbidity between motor control problems, ADHD, speech-language deficits, specific learning disorders, perceptual deficits and behavioural and psychiatric disorders (Cantell, et al 1994, 2003; Hellgren et al 1994; Gillberg, et al 1983; Gillberg, and Groth, 1989; Losse et al., 1991; Rasmussen and Gillberg, 2000). Visser (2003) emphasized that although co-morbidity is a widely acknowledged phenomenon, within research there is still a tendency to overlook this issue, perhaps because of the problems in conducting this kind of research.

3.8.2.2 Studies with children with ADD /ADHD

AD/HD is a neuro-developmental disorder of childhood (American Psychiatric Association, 2000) that comprises difficulties with sustained attention, distractibility, impulse control, and hyperactivity (Barkley, 1997a; Houghton et al., 1999; Schachar et al 2000). A number of models and theories have been presented over the years to account for the deficits known to exist in AD/HD, with most emphasizing behavioural problems as the fundamental deficiency (e.g., Barkley, 1997a; Quay, 1988; Sergeant et al 1990; Sonuga-Barke, 2002). In addition Goddard (1996) and Hocking (1997) suggest that retained primitive reflexes have a larger role to play.

In a study by Houghton and Chapman (1999) the overlap of AD/HD behaviours and retention of four primitive reflexes was investigated in 109 boys aged 7-10 years. There was a high degree of similarity in the children with AD/HD, and of children with the Moro reflex and other primitive reflexes when retained beyond the age at which they should have been inhibited (APA, 2000; Goddard, 1996; Hocking 1997; McGoey et al., 2002; Taylor 1998, 2002). In the study the conclusions were that that retention of these

primitive reflexes may also be linked to academic difficulties experienced by children when they reach school age.

Taylor et al., (2000) looked at the relationship between reflex retention and AD/HD and academic achievement. The study examined whether boys diagnosed with AD/HD exhibited higher levels of reflex retention than boys with 'shadow' symptoms of the disorder (CLEBs) and boys with no (or near to no) symptoms of the disorder (Ables). The interrelationships amongst the four reflexes, as well as the relationship between these and AD/HD and academic achievement were also examined. There were two subgroups: a coordination, learning, emotional and behavioural sub-group (CLEBs), of 34 boys and a sub-group which consisted of 21 boys who did not present with any such difficulties (Ables).

The tests used were, The Conners' Parent Rating Scale – Revised (CPRS-R; Conners, 1997), the Wide Range Achievement Test – Third Edition (WRAT-3, Wilkinson 1993), and measures of academic achievement (Spreen and Strauss 1998), which assessed reading, spelling, and mathematics. The INPP Reflex Assessments (Blythe and Goddard 2000) to all 109 boys. Boys with AD/HD were not given prescribed medication for 20 hours prior to the assessment to eliminate medication masking effects (Houghton et al., 1999; West et al., 2002). The differences amongst the three diagnostic groups on the Conners' Global Indices (Impulsive, Emotional and Problematic Behaviours) were examined. Results were consistent in all three areas with the diagnostic group classifications (i.e. significantly higher scores in the AD/HD versus the CLEB and Able groups). The CLEB group also had significantly higher scores across all of the Global Indices than those in the Able group.

The study also investigated retained primitive reflexes within the three groups. There were significant differences in the retention levels of the AD/HD versus the Able group. The Able group had significantly fewer symptoms of reflex retention than the AD/HD group. The AD/HD group also showed significantly higher levels of retention than the CLEB group, although there was no significant differences between these groups on the Moro reflex retention. Retained Moro reflexes did not relate directly to any of the AD/HD or achievement variables. The authors concluded that the results suggest a significant relationship between AD/HD classifications and reflex retention. Apparent

also was an overlap between AD/HD symptomatology and reflex retention. The study thus highlighted the potential significance of reflex retention in predicting certain learning and behavioural problems in children. (Taylor et al., 2000)

Pitcher et al., (1990) compared movement ability and underlying kinaesthetic processes of boys with attention deficit-hyperactivity disorder (ADHD) with a group of control children. Two groups of 16 boys with either predominantly inattentive subtype ADHD (ADHD-PI) or combined subtype ADHD (ADHD-C) were compared with 16 control boys matched on age and verbal IQ. The findings showed that the children with ADHD had significantly poorer motor control than the control children. A high percentage of children with ADHD displayed motor control consistent with developmental coordination disorder. The study also found that the type and degree of motor control differed between subtypes. Children with ADHD-PI had significantly poorer fine motor skill, while children with ADHD-C showed significantly greater difficulty with gross motor skill. The conclusion was that the severity of the children's inattentiveness was found to be a significant predictor of motor coordination difficulties. Kinaesthetic sensitivity was not found to differ significantly between the groups.

3.8.2.3 Studies with children with Dyslexia

Studies have, also, suggested that motor and balance problems are predominantly found in dyslexic children with co-morbid attention deficit and hyperactivity disorder (ADHD) or developmental coordination disorder (DCD) (Wimmer et al., 1999; Ramus et al., 2003). Landgren et al., (1996) stated that motor coordination rarely exist in isolation. In Sweden, children are screened for deficits in attention, motor control and perception at 6 years of age; it was noted that 10.7% of a sample of 589 six year-olds had significant neurodevelopment or neuropsychiatry disorders with evidence of co-morbidity across a number of developmental problems, including motor delay, attention deficit and hyperactivity.

According to Ramus (2003) studies of motor function within the field of dyslexia have utilized only one or two specific motor tasks for assessment, which complicates comparison of findings across studies. Fawcett and Nicolson (1992, 1999) and Nicolson and Fawcett (1990, 1994, 1999) have reported high prevalence of motor difficulties in

balance in children with dyslexia when a secondary interfering cognitive task was introduced, including children without additional ADHD symptoms. In contrast, and applying the same tasks and type of assessment, other researchers have reported that the occurrence of motor problems seemed confined to children with dyslexia and co-morbid ADHD (Raberger and Wimmer, 2003; Wimmer et al., 1999).

In another study with dyslexic children, Reynolds et al., (2004) completed a study of 35 children for two groups and only involved reporting of the results of the experimental group, not of the control group when they became a 'delayed treatment' group too, from Spring 2002. The children, were given the Dyslexia Screening test (DST) in Summer 2001, Spring 2002, Autumn 2002 and Summer 2003, and the national SATs, and a special school administered NFER reading test, in Summer 2000, 2001, 2002 and 2003. The teachers were blind as to which children were in the study. The two experimental or treatment groups improved from an overall risk score of 0.65 at the start of the treatment to one of 0.31. The researchers concluded that the improvements validated the original suggestions of a significant positive treatment effect. This was seen in the second 'delayed treatment' group, which improved when treated, and also in the first experimental group, which remarkably, continued to improve when treatment ceased; an effect not seen before in the literature on dyslexia treatments.

In relation to dyslexia (Stein, 2001, 2003) put forward the magnocellular hypothesis of dyslexia. The magnocellular system plays an important role in mediating steady direction of visual attention and eye fixations. The reflexes are linked with the development of the eyes. Therefore, weak magnocellular function leads to unfocused visual attention and unstable eye-control (Stein 2003). A magnocellular deficit has been reported in several studies, of children with dyslexia (e.g. Sperling et al., 2003; Stein, 2001, 2003; Talcott et al., 2000; Talcott et al., 2003).

3.9 SUMMARY

Examination of previous studies reveals that use of movement programmes can contribute to an improvement in academic performance. However, current research shows diverse findings and since there are variations in the studies such as sample, intervention methods and duration, and tests to measure the outcomes used, and also methodological flaws, it is not surprising there has been no conclusive agreement. The

knowledge base in this field is scarce and rigorous empirical data is required to reach conclusions about the effectiveness of this intervention approach. An example of this is that two Meta analyses by Ottenbacher (1982) and Vargas and Camilli (1999) and four research reports by Palatojko et al., (1992) Arendt et al., (1988); Hoehn and Baumeister (1994) have been published summarizing these outcomes. There was no firm conclusion as to whether the approach is effective or not.

This chapter presented a brief review of the role of movement in learning, followed by the brief history of movement programmes. Different types of movement programmes that have developed were presented, such as patterning, sensory integration programmes and specific programmes aimed at addressing primitive reflexes. Various theories of how these programmes may work were also presented. Impacts have been attributed to the integration of the reflexes, the role of the cerebellum, the vestibular system and the plasticity of the brain. Finally, studies were presented which showed the effects of the impact of movement programmes on behaviour and on children with more specific problems.

The next chapter will present the literature review with regard to sound therapy and how this may affect learning.

CHAPTER FOUR: LITERATURE REVIEW - SOUND THERAPY

4.1 INTRODUCTION

This chapter presents the third part of the literature review – sound therapy. It outlines the development of concepts, theories and generated impact reported by studies on sound therapy. After a brief discussion on the background of sound therapy there will be a review of current approaches as well as the different strands of sound therapy. In addition there will be a discussion on how such therapy might work, in terms of addressing auditory processing, affecting brain plasticity and reducing hypersensitivity. There will also be a brief introduction to the different types of auditory processing problems that may occur. Finally, there will be discussion on the emergent research in this area.

Experiments with sound can be traced as far back as the seventeenth century when Chladni (1786), a musician and physicist, developed the foundation for the discipline in physics that is called 'acoustics' - the science of sound. His fundamental theories pioneered the basic elements of acoustics, including vibration and pitch. He was able to identify the quantitative relationships governing the transmission of sound, using mathematical analysis to interpret his findings.

Sound can be used in different ways for individuals with physical, emotional or behavioural difficulties (Miles and Stipek, 2006; Erickson et al., 2005), or in the form of singing, chanting, toning and what is called 'music therapy'. It can be used for relaxation and pain relief and in some hospitals, sound and music are used to reduce or eliminate pain during major surgery and dentistry and for the relief of pains in the joints. However, the focus in this study is on approaches to 'sound therapy' that are designed specifically to enhance auditory processing, to affect brain plasticity and to reduce hypersensitivity and to investigate how and whether such therapy does have an impact on learning.

According to Frick and Shirley-Lawton (1994), there has also been some evidence to suggest that sound therapy affects the vestibular system; which is one of the reasons

why this study investigates the integration of sound therapy in conjunction with a movement programme (also involvement with the vestibular system). Both of these interventions have been demonstrated to have a positive impact on learning and in some cases on behaviour. Bérard (1993), creator of Auditory Integration Training (AIT) sound therapy, believes everything happens as though human behaviour is conditioned largely by the manner in which one hears, and therefore regards the importance of sound therapies as far reaching (Bérard, 1993).

Nearly all of the current approaches to sound therapy have been based on the discoveries of Dr. Tomatis, while he was researching industrial deafness for the French Ministry of War (Gilmor et al., 1989). Tomatis' research indicated that the ear, when functioning properly, had an impact on listening, language, and learning. He concluded that high frequency sounds (30,000Hz and above) activated the brain and affected cognitive functions such as thinking, spatial perception and memory. According to Tomatis, listening to these sounds increased attentiveness and concentration. He developed "Audio-Psycho Phonology" (Tomatis, 1963; 1996) also known as the Tomatis method.

Tomatis discovered several laws of hearing and was awarded a medal from the French Academy of Medicine and Science for his contribution to auditory knowledge (Brisbane, 1995). He developed a method of auditory stimulation to restore hearing loss. He formulated what is now known as 'The Tomatis Effect', a set of three laws that identified a 'voice-ear-brain' connection. Specifically these laws state:

Law 1: The voice only contains the harmonics that the ear can hear. Tomatis compared audiograms and spectrograms of singers and workers and the results indicated that hearing and voice are part of the same neurological loop; therefore changes to the ear will immediately affect the voice and vice versa (Thompson, 1991).

Law 2: What the voice produces is controlled by what the ear hears and if the ear is given the choice to hear correctly the distorted frequencies of sound that are missing, these are immediately and unconsciously restored into the voice. (Thompson, 1991).

Law 3: A programme of sound input, over a period of time, results in permanently modifying the audition and the phonation (Thompson, 1991).

These laws were validated in 1957 at the French Academy of Sciences. The laws are the foundation for the Tomatis Method. The orthodox view holds that the ear is a passive receptor and that the oval window has the function of reducing the kinetic energy to the cells of the corti (lessening the noise); the listener only needs to be motivated (Weeks, 1989). Whereas Tomatis (1992) believed, that bone conduction is the major route of sound to the ear. He stated that the ossicles provide a way of reducing the sound's amplitude, while the stapedius muscle helps to dampen excessive volume by tensing the oval window.

His view was that it is possible to programme alternating frequencies of sound which work by stimulating the middle ear and thereby causing constant adaptation so that the muscles are strengthened and tympanic pressure increased. The inner ear then becomes able to hear a wider frequency range and this has an effect on health and cognition.

The Tomatis programme allows sound going to each ear in both pitch (measured in hertz - Hz) and intensity (measured in decibels - dbs). The sound is divided into two channels of high and low frequency. Normal listeners have a dominant right ear and this bias to the right provides a more direct route to the left (language) lobe of the brain. This dominance is explained by the fact that the neural links between the sensory fibres of the right ear to the left brain have a shorter pathway than those from the left ear to the left-brain (Maduale, 1993).

4.2 DIFFERENT TYPES OF SOUND THERAPY

The different types of sound therapy come from different parts of the world and have been devised by doctors, ENT specialists, educationalists, physicists and sound engineers. There are two types of programmes; the first one originated in the work of Dr. Christian Volf in the 50s and 60s and was later developed by Johansen (1984). The second was pioneered by Dr Alfred Tomatis, whose work pioneered in the 1950s was further developed by Berard (1993), Joudry (1984) and Steinbach (1997) and Advanced Brain Technologies (ABT 1998) who developed The Listening Programme

which has been used in this present study. These programmes all have the following in common:

- Music - mostly Bach and Mozart are used and the music used induces the types of brain wave patterns which are associated with focusing and calm attention.
- Certain frequencies are filtered or enhanced in order to stimulate the auditory processing system, especially the components of the temporal lobe.
- Ear phones that have specific requirements are mostly required, as are specialised sound systems.
- A bias to the right ear as this is the most efficient way to process sound. Music is louder in the right ear in order to train the right ear to be the dominant ear when listening – particularly when listening to complex fast changing patterns of sound.

The following are types of sound therapies based on Tomatis' (1963) pioneering work.

1- Berard (1993) developed Tomatis' original findings into Auditory Integrative Therapy (AIT) and although he used the same basic concepts he recommended a shorter more intensive approach. Like Tomatis, he controlled selected frequencies reducing the sound to over-sensitive receptors and stimulating reluctant receptors. In order to override the body's defensive mechanisms his system used greater volume. Basically the Berard method is based on a physiologic-educational (Berard 1982), not psychological-emotional approach (Tomatis 1974, 1978). Berard argues the following:

- That behavioural and cognitive problem may arise when certain frequencies are heard in a distorted manner and may lead to difficulties in comprehension and behaviour.
- That distorted hearing and hypersensitivity to specific frequencies can be reduced and that all frequencies, can be heard equally well through auditory training.
- That hypersensitive hearing at selected frequencies can cause problems with learning. Even in the absence of this, people can present with audiograms that have 'peaks' and 'valleys', that is, thresholds for adjacent audiometric frequencies that differ by 5 dB or more and result in atypical perception of sounds.

- That these auditory distortions may result in such behavioural disturbances as autism spectrum disorders, learning disabilities, depression, and aggressiveness.

He suggests that AIT treats these distortions by exercising the middle ear muscles and auditory nervous system in much the same way that muscles are retrained in physical therapy for an injured elbow (Berard, 1993). He claims that after auditory training when children are retested on previously shown peaks and valleys, demonstrating areas of hyper- and hyposensitivity, these peaks and valleys are 'flattened', reflecting the elimination of auditory distortions which in turn have an impact on behavioural problems. The validity of defining these peaks and valleys as auditory abnormalities has however been questioned by others (Gravel 1994; Miller and Lucker 1997; Tharpe 1998, 1999).

2- Joudary (1984) used the higher frequency sounds and emphasised neuro-physiology aspects of the treatment. She developed a portable system (Joudry 1984) and recorded high–frequency, filtered, classical music similar to that of Tomatis. The sound was divided the sound into two channels, high and low frequencies. The higher frequencies were accentuated and frequencies below 8,000 Hz were progressively eliminated. A bias was also created toward the right ear. Joudry's system involves listening to progressively higher frequencies, for approximately 100 hours.

3- Steinbach (1997) a German sound engineer with a broad background in music, physics, and electronics developed his method. All of the recordings used in Steinbach's work are based on the SONAs (system of optimal natural structure) principle, which help maintain elements and structure of natural sounds in the process of recording. His therapy is based mainly on classical music and although some of it includes sounds from nature. Steinbach also developed a special device called the envelope shape modulator which enhances the upper frequency range of the music, thereby 'spectrally activating' the recordings. The higher frequencies provide information about directional distance of sounds as well other detailed information about the sound source. He also uses brief passages with intensive filtering and he called his therapy SAMONAS, an acronym for spectrally activated music of optimal natural structure.

4- The Listening Program (TLP) was created by Advanced Brain Technologies, (ABT) in 1998, and was based on the work of Tomatis. It was different in that it was home-based and required a much shorter time period, originally requiring two fifteen-minute periods each day for five days a week over eight weeks. It was developed with the aim of helping to improve auditory processing skills needed for effective listening, learning, and communicating. It uses many of the techniques developed by Tomatis such as filtering, providing a bias for ear dominance, and a process called gaiting which affects the action muscles in the middle ear to defend the inner ear against very loud or very high frequency sound. It is an ideal sound therapy to use in a school situation as it was used in this present study.

5- Paul Madaule (1993) developed Listening Fitness (LiFT) 'Listening Training' based on the key concepts from Tomatis and directed toward the impact of listening on learning and vocal expression. The listening training programme is designed to replicate, through sound, the various steps of the child's development in relation to listening, vocalization, speech, and language. It is based on an assumption that such a 're-patterning' or 're-run' will fill any gaps that may have occurred during a child's development. This begins with the child's pre-natal life (when the ear is already operational), and continues until his or her acquisition of written language (Madaule 1993). Selected sound information such as the mother's recorded voice and/or selections of classical music (usually Mozart) is listened to. The objective is to reproduce the earlier stages of development, up to the onset of babbling.

The second strand of sound therapies was developed from Volf's work based on the assumption that deficient auditory perception was at the root of many children's reading problems (Johansen 1984).

6- Johansen (1984) developed Hemisphere Specific Auditory Stimulation (HSAS) which is an auditory stimulation programme based on Volf's work. Johansen emphasized the need for right ear efficiency for speech, and the need to increase the ability to perceive form, transitions and rhythmical changes before the start of phonemic coding. He also theorised that ear preference and perception of sounds, in particular speech sounds, can be achieved through sound therapy. He recommended completing a pure-tone audiogram, ear preference and auditory discrimination

evaluation and then specifically tailoring a music programme from this to address the optimal hearing curve developed by Tomatis. Some of these programmes are used under different names Auditory Discrimination Training (ADT) in Europe, Hemisphere Auditory Stimulation (HSAS) in America, and finally, Johansen Sound Therapy in The UK.

Table 4-1 Summary of the key sound therapies

Sound therapy	Tomatis, Audio Psycho Phonology "Listening Training"	Paul Madaule, Listening Fitness (LiFT) "Listening Training"	Dr. Guy Berard, Auditory Integration Training (AIT)	Steinbach, SAMONAS Sound Therapy	Advanced Brain technologies The Listening Programme	Joudry system	Johansen Hemisphere Specific Auditory Stimulation (HSAS)
Theory	Related to hearing in utero and auditory stimulus on all aspects of development sensory integrative value	Based on Tomatis and directed toward the impact of listening on learning, academics and vocal expression.	Emphasized auditory stimulus' impact on behaviour and language.	Based on Tomatis and Temple Fay. Emphasizes physical, emotional, and energetic development.	Based on Tomatis and directed toward producing a home based programme	Based on Tomatis. Tapes are gradually filtered using the Electronic Ear and filtering system.	Based on Volf, who developed soundtracks to stimulate auditory system in areas-
Tests	Speech Language and Processing assessment	Listening Identification System and school records)	Auditory threshold sensitivity (audiogram) other auditory assessment	Dichotic listening test; SCAN and other assessment	Dichotic listening test; SCAN and other assessment	Dichotic listening test; SCAN and other assessment	Audiogram assessment, ear preference and auditory assessment
Music	Mozart, Gregorian Chant, and Mother's voice.	Mozart, Gregorian Chant, voice.	Music processed through the AIT device.	Classical music and Nature sounds.	Mozart, Beethoven and other classical music	Mozart, Beethoven and other classical music	Music by Holbech. and natural sounds
Modality	Gating modulates sound between channels. Filters eliminate sounds of specific frequencies Balance Control. Bone and air conduction	Gating modulates sound between channels. filters eliminate sounds of specific frequencies Balance Control Air conduction	Modulates frequencies Filters out specific frequencies Air conduction .Modulation random	Specially activated music. High pass filtering below specific frequencies. Filtering and Air & bone conduction	Gating modulates sound between high and low channels eliminate sounds below specific sound frequencies,	Gating modulates sound. Accentuates higher frequencies and eliminates frequencies below 8000Hz. Bias to right ear	Enhancing or decreasing speech frequencies Right ear preference Emphasises rhythmical changes

Overall, all the sound therapies are very similar with slight variations. Tomatis (1963) Joudry (1984), Berard (1982) and Maduale (1993) all use high quality recordings and they claim the whole spectrum of sound can be recorded. Steinbach (1990) adapted the work of Tomatis, Berard and others, the objective being to gain greater control over the elements of sound. However, Joudry and Tomatis claim that too much of the important high harmonics detected by our peripheral hearing are lost in the digitisation process.

4.3 HOW DOES SOUND THERAPY WORK

It has been claimed that sound therapy can be beneficial for auditory processing, comprehension, and learning, behaviour amongst others (Berard 1993), but as yet, the actual physiological processes that account for this have not been determined. Researchers have found that the auditory system has a large amount of plasticity, allowing new pathways to develop within the brain (Johansen , 1992). The theoretical basis of any sensory stimulation programme has to include neural plasticity just as in the claims for movement programmes. The premise is that neurons branch out and establish new synaptic connections when stimulated. There has been research which has shown this to be ongoing and this will be discussed more fully.

The auditory system is a very intricate sensory system. The ability to understand what is heard (auditory processing) involves more than the sense of hearing. Hearing is the passive act of receiving sound - an involuntary physiological response (James 1984). Auditory perception, or listening, is a voluntary activity that is learned by repetition and, along with visual perception; auditory perception takes place at a higher cortical level. It depends on the ability to discriminate between sounds (auditory discrimination), to associate and decode sounds (auditory acuity, sound localisation, auditory figure-ground) and to remember what is heard (auditory memory) (Hooper, 2000).

4.3.1 Auditory processing disorders

Essentially, sound therapies are trying to correct auditory processing disorders which are also sometimes referred to as Central Auditory Processing Disorder or CAPD.

Auditory processing problems may affect the processing of information received by the ear although the individual's performance on pure tone hearing tests may be normal. Chermak and Musiek (1997, p3) refer to it as:

> 'a deficit observed in one or more of the central auditory processes.....The processing deficits may reflect a loss of function , disordered function or release of function'.

Whitelaw (1997) believes even though peripheral auditory sensitivity is normal, a breakdown in auditory abilities can result in diminished learning (e.g. comprehension). While Thompson (1993) concludes that problems with memory, laterality, attention span, organization, speech articulation and motor control are often symptoms of poor listening.

According to Bellis and Ferre (1999) there are common symptoms that may indicate auditory disorders in a child or an adult. The most prevalent is difficulty understanding speech in noisy or reverberant environments (Olson et al., 1975). Chermak and Musiek (1997) have also noted that the greater prevalence of auditory processing disorders among boys and girls is a ratio of 2:1. Children with auditory processing disorders have many different problems including sequencing speech sounds, understanding speech in background noise, and in some cases the timing is a problem. In order for children to decode speech adequately they need to be able to process auditory information in less than 100 milliseconds. Many children with auditory processing disorders have processing speeds in excess of 400 milliseconds and sometimes as slow as 700 milliseconds.

In terms of learning some children may experience difficulty reading aloud due to an inability to associate visual and auditory symbols. Therefore any problems in this area may have an effect on reading and thereby reading, spelling and writing skills. There may be auditory distractibility, or hypersensitivity to loud sounds and large differences between verbal and performance IQs (Musiek and Geurkink, 1980).

Auditory discrimination is also part of this syndrome. This is the process used to discriminate among sounds or different frequency, duration or intensity (e.g. high/low, long/short, and loud/soft). It is the ability automatically to notice, think about or

manipulate the sounds in language (Torgesen, 1997). It refers generally to the awareness of words, syllables or phonemes. A problem with auditory discrimination can affect the ability to follow directions, listen, understand, and can affect reading, spelling and writing skills. Mencher et al., (1997) refer to difficulties with auditory discrimination - important for reading and spelling - which may be due to 'distortions' of speech sounds at the cortical level. Bellis (1996) and DeConde and Gillet (1993) also discuss the fact that some children with auditory processing weaknesses may have difficulty perceiving and discriminating sound, attending to sound, localizing sound as well as other problems.

Children with auditory processing disorders are often first diagnosed with attention deficit hyperactivity disorder (ADHD) or learning disabilities. Gravel et al., (1996) in a study with children with and without early ear infections (otitis media) from the first year of life through to nine years of age found that children who experienced the mild, hearing loss associated with otitis media had long-term problems with higher-order auditory-processing skills and learning. A history of recurrent otitis media is also associated with auditory processing disorders (Keith, 1995) as inconsistent auditory input may negatively affect the central auditory maturational process. It may be that some children have auditory learning problems from auditory processing disorders rather than from hearing loss, but this could be 'hidden' because hearing problems are easier to recognize and more easily associated directly with a problems in speech and language.

It is difficult to pinpoint why this deficit occurs since in many cases birth and developmental seems normal and there is no evidence of brain damage. In some children, ear infections have been implicated as a factor. In some cases neuromaturation of the auditory system is often delayed and some professionals consider that auditory processing disorders may be a form of learning disability. Children may or may not have a speech disorder or language problem.

Though an assumption is sometimes made that those children who have auditory processing disorders will also have a language disorder, this is not always the case. Auditory processing disorders can also affect other disorders of language and learning, such as attention deficit disorder (ADHD). Contributions from neuroscience have

indicated that some language disorders and dyslexia may be secondary to deficits in the central auditory processes (Stark and Tallal, 1988; Keith and Novak, 1984; Musiek et al., 1984). Keith (1999) also identifies ten behaviours of children with APD. These include, but are not limited to: difficulties with auditory discrimination; auditory figure-ground difficulties (problems hearing a sound over background) and auditory memory. Additionally, other behaviours and attributes which are associated with auditory processing disorders are: having a family member with similar difficulties (Kinsbourne, 1983; Willeford and Burleigh, 1985); auditory distractibility; or hypersensitivity to loud sounds; large differences between verbal and performance IQs (Musiek and Geurkink, 1980); academic underachievement; poor listening skills; phonological disorder; attention disorder; learning disability; language impairment; neurological problem; difficulty with directions; reading disorder; difficulties with auditory closure (ability to integrate auditory stimuli into whole, meaningful units) difficulties with rapidly produced speech; and hearing difficulties in the presence of a normal audiogram, among others. Martin and Clark (2000) described minimal auditory deficiency syndrome, a language-learning condition associated with erratic auditory input. Among other effects, fluctuating hearing loss may affect a child's categorical perceptions (Clarkson et al., 1989; Werner and Marean, 1996).

4.3.1.1 Subtypes of auditory processing disorders

There are many subtypes of auditory processing disorders. These include:

i) Auditory Decoding Deficit: This may show itself as poorly formed neural representation of acoustic features, particularly phonemic discrimination (Koch et al., 1999) and auditory closure. These children process information in a way that is slow and inaccurate. Interpretation of what they hear is harder for these children.

ii) Associative deficit/tolerance-fading memory: This causes difficulties in listening due to problems with background noise. Usually understanding of speech and or language is affected when background noise is present.

iii) Output-organisation deficit/organisation: Problems with sequencing, recalling, or expressing an answer occur for these children with output-organization difficulties on tasks where success is dependent on motor and or planning skills.

iv) Prosodic deficit: In this case children may sound 'flat' or 'monotonic' when speaking and reading and show little or no expression. They have difficulty with pragmatic communication skills, sequencing, social judgment, gestalt patterning and spatial abilities (Tomkins, 1995).

v) Integration deficit: In this case children have difficulty across modalities with any task that requires efficient interhemispheric communication. There is usually a delay in responding and they may have problems linking auditory and visual information together (Bellis, 2000).

4.3.1.2 Impact of auditory processing problems

According to Gilmor (1989) the way we process sound is of vital importance and the ability to process the sounds of language may affect the ability to interpret the written form of language. Reading is a visual process but it is the sound which gives meaning to the letter. It seems that the process of decoding letters into sound is more efficient when auditory processing skills are not affected. Writing is the reverse process since processing skills are well developed and thereby sounds are translated into written (graphic) form. Poor integration of sounds into language is likely to cause problems with writing and result in poor spelling and comprehension.

Swain (2005) found that children with poor auditory discrimination or acute hearing can tune out some sound, as this becomes a stress for the system. This may develop into a habit and can have an effect on hearing specific frequencies. Tuning out has a huge implication in the classroom situation and in the ability of children's to learn effectively. Based on the results from a research project, Richardson et al., (2004) suggested that individual differences in auditory processing skills are related to individual differences in the quality of phonological representations, reading and spelling.

Jutras (2007) in his study of behavioural audiological testing showed auditory processing disorders in students with learning problems and poor fluency. Electrophysiological test results showed that these students' central auditory system processes worked differently to a comparison group with normal hearing. Also, in

some cases, auditory processing (AP) is linked to attention resulting in the high co-morbidity of auditory processing disorder (APD) and attention deficit/hyperactivity disorder (ADHD). Others have found that selected AP measures share significant links with memory tasks.

Erickson et al., (2005) investigated the relation between auditory processing (AP) and attention and memory in 36 children with a mean age of 7.78 years (SD = 1.61) referred to an outpatient facility. Results indicated that AP measures significantly correlated with each other as well as with some measures of attention, memory, and behaviour ratings. According to the authors this suggested that although AP measures include elements of attention and memory, these measures also appear to assess processes not tapped by other measures of attention and memory. It led them to the conclusion that auditory processing problems may manifest in myriad behaviours across various settings; this was derived from the correlation of AP measures with parent- and teacher-rated withdrawal, parent-rated somatization, conduct, and depression, as well as teacher-rated attention, anxiety, learning problems, social skills, and leadership.

The impact of APD upon language and language-dependent behaviours has been widely examined (Rampp, 1977; Cohen, 1980; Lasky and Cox, 1983; Sanger, Freed, and Decker, 1985; Tallal, 1990; Friel-Patti, 1994; Mody et al., Studdert-Kennedy and Brady, 1997; Cacace and McFarland, 1998). Although many clinicians agree that APD exists and can negatively affect language performance, there is disagreement concerning assessment and intervention. Audiologists generally support a signal-based 'bottom-up' model, while speech-language pathologists tend to advocate a 'top-down' model. The American Speech-Language-Hearing Association's (1996) stance is of an integrated approach.

4.3.2 Brain plasticity

For many years the premise was that the brain, once formed, was static. However having been doubted for many decades, this paradigm has changed and scientists now have solid scientific proof that the human brain goes through measurable structural and biochemical changes particularly in the first years. Neuroscientist Elliot (1999) concluded that brain hardware is not fixed, rather, it is living, dynamic tissue that is constantly updating to meet the sensory, motor, emotional, and intellectual demands. This may be one of the ways that sound therapies may make a difference. Basically, brain plasticity is the ability of the brain to modify its structure and chemistry. It seems that neural activity may be generated spontaneously, especially early in development, but later depends importantly on sensory input. In this way, intrinsic activity or sensory and motor experience can help specify a precise set of functional connections (Kandel and Squire, 2001). Johansen (1992, 1998) verifies that plasticity may also be the fundamental reason for the reported improved results in auditory perception after specific auditory stimulation.

According to Diamond (1988), growth factors can be produced at any age so this leaves the possibility again for the interventions to be effective in the sense of the ability of the brain to receive an intervention. This is supported by the work by Buonomano and Merzenich, (1998) who suggest that the cortex can be reshaped by experience, and that there is no upper age level limit for brain growth. Supporting this view of brain plasticity is research reported in 2006 by the Society for Neuroscience which indicated that after children with reading failure completed intensive phonemic and phonics instruction, their reading skills improved. The Society of Neuroscience (2006) also reported that fMRI studies showed increased activity in the reading brain regions at a level similar to that of typical readers; indeed some showed improvement of reading skills and brain activity at one to two years.

In support of this paradigm of brain plasticity are brain imaging studies and post-mortem examinations of individuals with dyslexia, learning disabilities, ADHD, and normal controls which have revealed functional, morphologic and structural differences in the auditory areas of the brain that are activated when listening to simple tonal complexes, language and music (Galaburda and Kemper; 1978; Hynd et

al., 1990, 1991). This is supported by MEG and PET data (Tervaniemi et al., 2000) which indicate that at the earliest auditory processing stages, there is no difference between speech and music sounds. Recanzone et al., (1993) trained owl monkeys to make fine-pitch discriminations in selected regions of the auditory frequency spectrum. Tonotopic mapping carried out showed that the cortical area tuned to the trained frequency spectrum was enlarged by a factor of two to three compared to untrained monkeys. This supports the theory of the effect on the brain and on the plasticity of the brain.

Merzenich et al., (1993) concur with this and state that it has been found in an animal model that auditory discrimination abilities may progressively improve with practice. These studies show that even in adult animals, the neurons in the brain that map sensory events are highly 'plastic'. They showed that through intensive training, monkeys could gradually improve their identification of faster and faster sounds. When they analysed the brains of these monkeys, researchers found that specific auditory regions had reorganized and significantly expanded their neural circuits. Merzenich and Tallal (1996) hypothesized that the training exercises used for neural plasticity studies with monkeys might be adapted to alleviate some of the sensory processing problems in children.

Tallal et al., (1993) from the findings of this research developed a remediation system (Fast ForWord), with the premise that the brain can be retrained. Consistent with this, other researchers have concluded that some children's discrimination deficits originate in the auditory pathway before conscious perception, and have implications for differential diagnosis and targeted therapeutic strategies for children with learning disabilities and attention disorders (Korpilahti 1996; Kraus et al., 1996).

Johansen (1984), from his work with sound therapy, also stated that plasticity may also be the fundamental reason for the reported improved results in auditory perception after specific auditory stimulation. Compatible with this, Brown (2001) argues about the link in the brain, in that he believes music and language to be homologous functions that evolved from a common ancestor that embodied their shared features and that certain features are still shared.

4.3.3 Reducing hypersensitivity

In order to learn, a child must be able to attend to, listen to, and separate important speech from all of the other noises at school. Many studies support this view of hypersensitivity, for example, Mencher at al., (1997) who mention that difficulties with auditory discrimination may lead to problems with reading and spelling as distortions of speech sounds occur at the cortical level; also auditory distractibility and hypersensitivity to loud noises may cause difficulties.

Martin and Clark (2000) described minimal auditory deficiency syndrome, a language-learning condition associated with erratic auditory input that echoes this premise. Jerger and Musiek (2000) support this and state that if there is any problem with auditory processing this can be exacerbated in difficult acoustic environments and is associated with difficulty in listening, understanding speech, language development and learning. In support of this view Kujala et al., (2004) reported data showing that long-term exposure to noise has a persistent effect on central auditory processing and leads to concurrent behavioural deficits. They found that speech-sound discrimination was impaired in noise-exposed individuals, as indicated by behavioural responses and the mismatch negativity brain response. Furthermore, irrelevant sounds increased the distractibility of the noise-exposed subjects, which was shown by increased interference in task performance and aberrant brain responses.

Consistent with this, neuroscientists Lu et al., (2004) have found that 'noise' (snow on a computer screen) seems to cause problems in figure/ground discrimination in dyslexic individuals. They maintain that difficulty extracting the signal from noise is a general problem experienced by dyslexics in other sensory/perceptual areas as well (Emerson, 2005). All of this has major implications, as schools and classrooms are full of noise when in the classroom, along the corridors or outside.

4.4 EXISTING RESEARCH

The following section presents some of the key research and major findings in the area of sound therapy. These will be presented and categorised under different headings in relation to the major impact they have exhibited.

4.4.1 Impact on improvements in Auditory Processing

Beelan et al., (2005) examined the effects of a sound therapy of Hemisphere Specific Auditory Stimulation (HSAS) on three groups of children: one group of dyslexic pupils, one group of non-dyslexic receiving remedial education and a control group. The first group completed sound therapy and the second group had remedial education and did not listen to sound therapy, but continued their remedial education and the third group had no intervention. Results showed that the pupils in group 1 showed statistically significant changes of hearing curves and improvements in most language related areas compared to the pupils in groups two and three. Improvement in auditory sensitivity was shown by changed audiograms and statistically significant changes of auditory laterality and statistically significant improvements in decoding, spelling, reading aloud, phonemic analysis, rapid naming, visual memory and behaviour.

The most interesting aspect about this study was that nine to ten months after the termination of the stimulation programme eight students from the experimental group were reassessed to control for the long-term effects and the results showed that reading, spelling phonemic analysis and auditory memory had all continued to improve ($p=.005$). In the case of auditory memory, the post-test results, immediately following the sound therapy, showed no significant improvement from the pre-test scores. However, when retested nine to ten months later, the improvement was significant. There was no significant improvement in reading comprehension but there were improvements in the word level ($p=.171$) and sentence and text level. The hearing curves remained the same in the 9 to 10 month period. This led the authors to conclude that apart from normal development in pupils that would be expected, there continued to be a significant improvement 9-10 months after having completed auditory stimulation.

Sohlman (2000), in his retrospective study, age-matched twenty four children with a mean age 10 years and 10 months, with twenty four children with above average reading skills (teachers' assessments) from a comprehensive school. They were tested with a dichotic listening-test (DLCV-108 NF, Hughdal and Asbjørnsen 1990). Based on the tests an auditory laterality index was calculated for all participants. The results showed that 92.3 per cent had a raised auditory sensitivity during the training period with a large effect size. Sohlman (2000) concluded that the study would appear to show that specific auditory stimulation has an effect on auditory laterality and on hearing sensitivity. Generally, auditory laterality became more right-biased and auditory sensitivity was reduced in the low frequency range (< 1000 Hz) and increased in the high frequency range (> 1000 Hz).

Korpilahti et al., (2002) reported in a study using the HSAS sound therapy study that they found better discrimination of consonants and development of naming skills. In these skills the ADT/ (HSAS)-group reached the reference values for the age. Parents and teachers reported noticeable progress in attentive and language skills in those children who's ERPs were normalized after the training. The researchers concluded that ADT/ (HSAS) training can be used to reach better auditory discrimination and, therefore help the LI child to acquire language.

Swain (2004) investigated the effect of the Tomatis Method on 41 randomly selected children with auditory processing disorders ranging from 4.3 years to 19.8 years (mean age of 12.06). The Tomatis Method was administered for 90 hours. There was no control group. After six months each person was re-tested and the comparison of pre and post treatment evaluations indicated that skills of immediate auditory memory, auditory sequencing, interpretation and following directions, auditory discrimination and auditory cohesion had improved. Swain (2004) concluded that auditory processing skill weaknesses results in difficulty in the ability to use auditory information to listen communicate and learn and that the Tomatis therapy had made a considerable improvement. The greatest improvement was made with the skills of auditory discrimination (53.74%). Swain also stated that problems with auditory discrimination can affect auditory memory, auditory comprehension, auditory cohesion and result in processing delays and that as a result of improvement in auditory discrimination all other auditory processing skills had in turn improved.

Wilson et al., (1982) studied pre-school children with language disorders over a period of two years using the Tomatis programme in addition to the remedial 'Wilson programme' for the experimental group. The control group were on the 'Wilson programme' only. A follow up evaluation was also conducted in the children's third year of school. Results of the study found that the children in the experimental group showed statistically significant findings in favour of the Tomatis group in auditory closure and auditory mimicry. It was noted that the Tomatis group were ahead of the control group in expressive language.

Other studies have examined the improvement in auditory processing abilities with intensive auditory stimulation and training (Jirsa, 1992; Merzenich et al., 1996 and Tallal et al., 1996). These studies indicated that direct interventions (i.e. auditory training and more traditional language therapies) can significantly improve auditory processing abilities.

Jutras (2007) case study reported the findings of auditory behavioural and electrophysiological measures performed on a graduate students showing verbal disfluency and learning difficulties. Results of behavioural audiological testing showed the presence of auditory processing disorders. Electrophysiological test results, revealed that that the central auditory system processes acoustic stimuli differently compared to a reference group with normal hearing.

4.4.2 Impact on improvement in learning

In a report by A Chance To Grow/New Visions School (2001) it was stated that a group of 50 students following a HSAS sound therapy programme during the school year 2000/2001 made an average gain of 1.56 years on the Gates-MacGinitie test (measuring vocabulary understanding and reading comprehension skills), while the students who did not participate in this programme made a 0 .93 year gain on this test. Yap and Leij (2005) compared dyslexic 21 children with a mean age 10.2 years with, normal readers of the same reading-age, and poor readers of the same reading-age on tests of phonological decoding and automatic word processing. Three different tasks were used: a lexical decision task, a naming task and an auditory-visual matching task intended to test automaticity in word processing. The findings indicated that dyslexics

have a deficit in automatic phonological decoding skills which is linked to phonological deficit and the automatization deficit hypothesis in dyslexics.

Another study that showed the effect of sound therapy on reading was conducted by Rintel (1995) using the Joudry Sound Therapy Tapes with primary aged children. A group of six children, chosen randomly from a group of 20 identified for remedial assistance, completed the Joudry high frequency music over a period of 16 weeks. A control group listened to the same classical music without the additional high frequencies. The target group showed greater gains in tests of auditory discrimination, reading ability, reading comprehension and spelling than did the control group. The samples in this study however, were very small and should be viewed with caution.

An evaluation of the progress in children on an auditory stimulation programme in order to assess its value as part of the speech and language sound therapy was conducted by Leslie and associates (Leslie et al., 1999; Leslie, 2000). They concluded that some children showed a marked improvement in areas of reading, writing or spelling but there were not enough data to draw any valid conclusions about the cause and effect of the specific auditory stimulation on these.

Jones (2001) studied 14 children between the ages of 8 and 16 years referred to a specialist clinic for auditory processing disorders. The following tests were used: NFER Nelson test, auditory description and auditory memory tests and the Chenille and Salford reading test. The results showed that all the children monitored in this study improved in auditory discrimination and memory and showed improvement in reading scores greater than the 2 months of the programme. Once again it has to be noted that the sample was very small and that there was no control group and therefore it is difficult to draw general conclusions.

Roy (1980), reported on the Tomatis method in a PhD thesis. The study was conducted over a period of 14 months with a group of 5 dyslexic children. No remedial teaching was provided with the Tomatis treatment but pre and post testing was completed. The Santo Stefano's Cognitive Control test measured - focal attention, field articulation, level sharpening and equivalence range. Four of the five boys improved in cognitive control functioning and spontaneous speech. It was concluded

that academic skills and perceptual processing progressed by use of the Tomatis audio - vocal method.

Other studies also showed the link between sound therapy and improvement in learning, such as Beelan et al., (2005) who revealed significant changes of auditory laterality and statistically significant improvements in decoding, spelling, reading aloud, phonemic analysis, visual memory and behaviour. In addition, Korpilahti et al., (2002) reported that parents and teachers reported noticeable progress in children's attentiveness and language skills. Furthermore Neysmith-Roy (2001) conducted a study with six severely autistic boys. Results showed that autistic children seemed to benefit from the Tomatis method. Three of the boys demonstrated positive behaviour changes by the end of the treatment. These included adaptation to change, listening response, non verbal communication, emotional response and activity level. The Tomatis method, Neysmith-Roy (2001) suggested may be helpful in making pre-linguistic behaviours manageable. In this way it may help a child learn basic skills necessary for the development of language and learning.

Consistent with this, Sheil (2000) has shown mean improvements of 18 months in spelling age, 11 months in reading accuracy, 47% auditory processing speed improvement, and 58.5% visual processing speed improvement. Dyson (2001) whose study was discussed in section 4.4.6 reported a 13 to 27 month spelling gain, 24 to 40 month gains in reading comprehension and a 25-month gain on reading accuracy that sound therapy improves raises children's ability to learn.

4.4.3 Impact through the implementation of the Listening Program

The Listening Program was used in this present study; sound intervention and the following are studies that have investigated the impact of the Listening Program. Treharne (2002) conducted a pilot study to investigate the impact of the Listening Program with children with auditory processing difficulties. An audiogram was completed for each child. The SCAN-C revised (Keith, 2000) was used to scan for auditory processing difficulties and the Ravens Matrices were also completed. In addition, the Auditory Skills Battery (Goldman et al., 1974) and a selective attention subtest (Woodcock, 1974) were also used. TAPS-R digit span forwards and backwards

(Gardener, 1996) was also used as a test of temporal pattern perception and recognition and prosody of language.

After completion of The Listening Program results showed an improvement in the ability to distinguish speech against a variety of background noises. Greater improvement was shown against a constant steady-state broad spectrum 'pink' noise (fan), significant at p= .010 levels than with the intermittent distraction provided by compressed cafeteria noise and verbal distraction (Treharne, 2002). Improvement was also was shown with the children in temporal pattern perception and prosody recognition and in forward and backward digit span. Tests at the end of the eight week programme and then eight weeks later all showed improvement in one or more of the areas studied. She concluded that improvement continued over a variable length of time after the programme was completed.The findings showed that the greatest changes were found in selective attention, and those with the severest difficulties made the greatest improvement. However, it has to be pointed out that the sample consisted of only ten children and there was no control group.

Another study that investigated The Listening Program was a small scale study conducted by Jeyes (2001). Her study showed that the children improved in auditory discrimination and memory and showed improvement in reading scores greater than the two months of the programme. In 2004, Jeyes conducted another study in a school with groups of children over a two year period with 38 children aged between 7yrs 0mths and 11yrs 5mths. These children were underachieving in the annual school NFER progress tests and group reading tests. Before and after intervention the auditory discrimination and memory of the children were tested using the Quest test of pre-reading skills and a standardised reading test was administered. The annual NFER test scores for English, mathematics and group reading were recorded and compared with scores for tests after the intervention. The findings showed that all children improved their performance in the auditory discrimination and memory tests after intervention: 79% of the children showed progress well above average in at least one area of mathematics, language and reading.

Similarly, Minson (1999) conducted a small study of thirty children with two groups using The Listening Program. Minson concluded that the positive changes are often

correlated with improved listening skills, improved reading, writing and both receptive and expressive language.

Another study investigating The Listening Program was conducted by Butler and Clarke (2003) in their pilot study with twenty students (11 boys and 9 girls), aged from 5 to 10 years using The Listening Program. The following tests were used: Quick Neurological Screen Test, Version Two SCAN-C, and Test for Auditory Processing Disorders in Children, Auditory and Visual Digit Span, Primitive Reflex Testing (Institute of Neurophysiological Psychology) and Lindamood Bell Auditory Conceptualization Test. Low scores in Primitive Reflex and QNST scores reflected significant changes in the reduction of neurological inefficiencies which may have been inhibiting the children's ability to learn. However, the greatest changes were seen in areas of primitive reflexes, neurological readiness for learning, filtered words, auditory figure-ground, and auditory maturation.

The interesting aspect about this study was the use of a sensory motor programme utilised alongside the Listening Program. This connection is based on the role of the vestibular system in both balance and in auditory processing and the implications of these for raising children's learning.

4.5 STUDIES SHOWING INCONCLUSIVE OR NEUTRAL RESULTS

In a study conducted by Kershner et al.,1990), one group of children received the Tomatis programme for 100 hours as well as standard remedial procedures (teaching), whereas a control group received only standard remedial procedures. The tester, who conducted the two-year follow-up assessment, was unaware to which group the participants had been assigned. Post-treatment measures assessing verbal and arithmetic abilities did not reveal any differences between the two groups. On the Seashore Rhythm test, which measures auditory attention, auditory discrimination, and short-term auditory sequential memory, the control group children did significantly better than those trained via the Tomatis approach. The Seashore Rhythm Test had been, in particular, expected to show the benefit of Tomatis training.

Gilmour (1995) conducted a meta-analysis of the data he obtained from the studies conducted in the 1980s, each of which looked at the efficiency of the Tomatis method (Gilmour1984; Gilmour and Mould, 1994; Kershner et al., 1990; Rourke and Russell 1983; Wilson et al., 1982). These studies involved 231 children. In his analysis Gilmour found positive results in the following five areas, linguistic; psychomotor; personal and social adjustment; cognitive and finally auditory. He stated however that none of these studies could be considered conclusive, again owing to their design weakness and the small numbers but considered that in light of the context in which these studies were carried out the outcome was supportive of the efficiency of the Tomatis method (Gilmour 1995).

Kreshner (1990) conducted a study with learning disabled (LD) children which showed that there were no significant gains in reading. However LD children improved significantly in visuo-spatial conceptualisation and constructive abilities. A critical flaw in the study design was that the experimental group was withdrawn from classes for five hours per week but the control group for only one hour. Thompson (1993) found the study had methodological shortcomings in that the two groups were treated differently. The children in the study attended private school with an intensive individual remedial programme and low teacher to student ratios. Thompson concluded that it is probable that sound therapy could not add significantly to such an intensive programme which was so well supported by staff and parents. This limits the extent to which the results can be generalised.

Bettison (1996) completed a study on AIT for use with 80 children diagnosed with autism, or Asperger syndrome. A behavioural checklist completed by the subjects' teachers and parents, and audiometric measures were administered before treatment and at 1, 3, 6, and 12 months after treatment. There was no control group, but two treatment groups. An experimental group received the Berard method of AIT, and a placebo group received the same treatment with unmodulated music. The results showed no between-group differences on any of the behavioural checklists or audiometric findings. These findings led Bettison (1996) to conclude that both the traditional Berard method of AIT and the use of unmodulated music (placebo) are effective interventions for children with autism spectrum disorders. There was,

however, a weakness in that the design of the study as it had no control group, therefore, it is very difficult to draw conclusions from the study.

Zollweg et al., (1997) studied the impact of AIT with children and young adults (N=30) with multiple handicaps. Two study groups were used: an experimental group (N=15) that received AIT sound therapy and a placebo group that received unmodulated music. Behaviour rating scales, pure tone thresholds, and loudness discomfort levels test were used and data collected four weeks before treatment and at 1, 3, 6, and 9 months post-treatment. Zollweg et al., (1997) found no significant differences in either group in pure tone thresholds or loudness discomfort levels following treatment. They observed a slight improvement in behaviour for both groups, suggesting that a non treatment effect was responsible for the behavioural improvement. Again, there was no control group and the researchers acknowledged the difficulty in determining whether listening to music, modulated or unmodulated, or the attention given to these children in the therapeutic situation could explain the behavioural improvements. The authors acknowledged that their small sample size and diverse subject population may have contributed to their negative findings.

Similarly, Yencer (1998) evaluated the effectiveness of the Berard method of AIT with thirty-six children diagnosed with central auditory processing disorders (CAPD) He used behavioural tests of auditory processing, neural responses to auditory stimulation and parental questionnaires about auditory problems. There were three groups: an experimental group that received treatment, a placebo group exposed to unmodulated music, and a control group that received no treatment. There was pre testing and post testing after seven weeks. The study concluded that there were no differences among groups, indicating that AIT was no more beneficial for children with CAPD than listening to regular, unmodulated music or receiving no treatment at all.

The Tomatis method has also been the subject of other research studies, the results which have been summarised in three research evaluations papers: Stutt (1983); Van Jaarasveld and Du Plessis (1988); and Gilmour (1995). Stutt (1983) reviewed five studies that involved preschool children with language delays (Wilson et al 1982) and school age children with learning disabilities (Rourk et al, 1982; Gilmour, 1982, Roy

and Roy 1980). Stutt (1983) assessed these studies in terms of implication for learning. He stated that a definite conclusion on the value of Tomatis method of sound therapy to the treatment of learning difficulties and dyslexia could not be made.

Van Jaarsveld and Du Plessis (1988) reviewed a series of studies conducted between 1973 and 1983 on the respective subjects of laterality (Van Wyk, 1974; Babderhost 1975); stuttering (Van Jaarsveld 1973; 1974) anxiety and depression (Peche, 1975: Botes 1979: Du Plessis 1982: Du Plessis and Van Jaarsveld 1988) and profound mental retardation (De Bruto, 1983). It was agreed that none of the findings could be considered conclusive because of weaknesses in experimental design; however they noted that each study drew positive results.

Sinha et al., (2004) looked at the data resource of The Cochrane Central Register of Controlled Trial (2003) sound therapies for autism spectrum disorders. Six randomised controlled trials (RCTs) of AIT, including one cross-over trial, were identified with a total of 171 individuals aged 3 to 39 years. The selection criteria were RCTs of adults or children with the treatment being auditory integration therapy (AIT) or other sound therapies. The control groups were no treatment, usual therapy or placebo equivalent. They attempted a meta-analysis but it was not appropriate. There were no trials assessing sound therapies other than AIT. A range of tests were used: cognitive ability, basic autistic symptoms (social communication and behavioural problems), sound sensitivity, the ability to concentrate, level of activity, school and home quality of life, and any adverse reactions to treatment. Some of the studies used standardized testing, some used questionnaires, and some used checklists. Follow-up was measured at one month, three months and twelve months of therapy. Four trials had fewer than 20 participants. Three studies (Bettison 1996; Zollweg 1997; Mudford 2000) did not demonstrate benefit of AIT over control conditions. Three trials (Veale 1993; Rimland 1995; Edelson 1999) reported improvements at three months for the AIT group based on improvements of total mean scores for the ABC. Rimland (1995) also reported improvements at three months in the AIT group for ABC subgroup scores. No significant adverse effects of AIT were reported. The main conclusion was that all of the trials had problems with the way in which they were conducted (methodology). There was little or no consistency among trials in the tests used to measure

effectiveness of the treatment, making it impossible to synthesise the results. The following observations were reported:

Behavioural problems: No significant differences were found between the treatment groups and controls. Rimland (1995) reported improvement, but the follow-up period was only 3 months.

Cognitive ability: Only Bettison (1996) reported improvements at 6 and 12 months.

Sound sensitivity: Bettison (1996) reported improvement; however, a non-standardized test was used.

Listening skills and comprehension: Rimland (1995) reported improvement, but had used a subgroup of questions from the Fisher's Auditory Problems Checklist, a use of the test that has not been shown to be reliable.

The aforementioned authors concluded that more research is needed to make decision making of parents, carers and practitioners more informed with regard to this therapy for individuals with autism spectrum disorders. An assessment conducted by the National Academy of Sciences (NAS 2001) concluded that there is insufficient evidence of the effectiveness of sensory integration therapy for autism, as these interventions have not yet been supported by empirical studies. Further support came from Mudford et al, (2000); and Dawson and Watling, (2000) who concluded that auditory integration therapy has also recently been subject to careful analysis, and again the results indicate that the effects are no greater than for placebo conditions.

Fuller (2000) investigated the effectiveness of a sound therapy in the enhancement of the social skills of children with moderate intellectual disability. Thirty-two children (age range 5 -10 years) participated. Four centres took part and at each, four children were randomly selected to participate in the music therapy programme, four children were assigned to a non-music control group. Five social skills were targeted for intervention: turn-taking, imitation, vocalization, initiation and eye contact. Measures of effectiveness involved comparison of pre- and post-intervention scores on five target skills using a social skills test specifically designed for the study. Feedback on

the effectiveness of the intervention was also provided by teachers. The results showed significant improvements in the five target social skills across both conditions. However, this difference was found to be independent of the music/non-music intervention.

4.6 IMPACT ON BEHAVIOUR

Du Plessis and Van Jaarsveld (1988) examined the effectiveness of the Tomatis method on anxious children attending an elementary school programme. There were three groups:

- children and their mothers received auditory training for 51 ½ hours;
- children and their mothers received conventional counselling;
- children and their mothers did not receive any intervention.

A number of variables, such as anxiety, personality, cognitive ability and listening skills were examined. The study showed that the children who received the Tomatis training did significantly better than the two other groups; and children who received counselling did significantly better than those children who did not receive any form of intervention. A limitation in this study was that it was not 'blind'.

Rimland and Edelson (1995) conducted a pilot study of AIT (Auditory Integrative Training) effectiveness with in a group of 17 children and young adults with autism (ages 4–21 years). Using a matched-pairs design, eight experimental subjects received traditional AIT and seven subjects listened to the same music that was not filtered or modulated. Two parental questionnaires of adaptive behaviour were used and the authors concluded that behaviour was improved following treatment compared to subjects in the control group. No differences between groups were found in measures of post-treatment pure tone sensitivity, pure tone discomfort levels, or parental rating of hearing sensitivity. It is important to note, however, that an analysis of pre-treatment data also revealed significant differences between groups on these measures. Thus, because the experimental group started out so much poorer on these measures than did the control group, this is a limitation.

Some studies reviewed by Stutt (1983) and Gilmour (1995) identified positive outcomes in the following areas: improved general adjustment, reduction of anxiety, improved self control and self concept, improved interpersonal relationships and finally improved achievement.

A study by Erickson et al., (2005) investigated the relation between auditory processing and various neuropsychological measures presumed to measure attention and memory in 36 children with a mean age of 7.78 years referred to an outpatient facility. Results indicate that auditory processing measures significantly correlated with each other as well as with some measures of attention, memory, and behaviour ratings. Results suggest that although auditory processing measures include elements of attention and memory, these measures also appear to assess processes not tapped by other measures of attention and memory. There was also a correlation of auditory processing measures with parent-and teacher-rated withdrawal, parent-rated somatization (physical complaints), conduct, and depression, as well as teacher-rated attention, anxiety, learning problems, social skills, and leadership. This suggested to the authors that auditory processing problems may manifest in various behaviours across settings.

De Bruto (1983) conducted a controlled study to investigate the efficacy of the Tomatis Method on people aged 4 to 14 years diagnosed as severely developmentally delayed, but with the ability to sit and walk. They were randomly assigned to three groups. The tests used were the Bailey Scales of Infant Development and a measure of responsiveness.

Group A - the children received sound therapy (Tomatis effect) and a sensory stimulation programme.

Group B - the children received music only and a sensory stimulation programme.

Group C - the children received no treatment.

The results indicated that both experimental groups showed an increase in mental age, but the increase in the Tomatis sound therapy group (group A) was significantly

higher than in group B. No change was found in group C. There was no significant difference in terms of responsiveness in group A and B before the stimulation programme; however after the Tomatis programme the group showed a statistical significant reduction of self-directed responses, together with a significant increase in object-directed responses.

Rimland and Edelson (1994) conducted a study with 445 adults and children with a primary or secondary diagnosis of autism. The Berard method of AIT was used, but three different devices were used to provide the modulated music. An audiogram (before, at the midpoint, and after the completion of treatment) was conducted as well as loudness discomfort tests, and parent questionnaires. The results showed that there were no differences in test results across the three devices or if filtered versus no-filter conditions were used. However, a reduction in problem behaviours was reported by parents between pre- and post-AIT. The authors acknowledged that the lack of an appropriate control group was 'a serious limitation'.

Edelson et al., (1999) used the Berard method of AIT with BGC equipment with children and adults diagnosed with autism (N=19). Three behaviour questionnaires were completed by parents before and once a month for three months following treatment. Pure tone threshold testing was used before treatment, after five hours of treatment, and one day following treatment. In addition, two central auditory processing tasks and P300 evoked potentials were obtained one month before and three months following AIT. The experimental group completed Berard AIT with modulated music, and the placebo group listened to the same music without modulation on the same schedule as the experimental group. There was no control group but parents and examiners were blind as to each child's group assignment until completion of the study. Audiometric results were not analysed because a sufficient number of subjects could not complete the tasks. The authors reported that improvements were noted in the P300 evoked potentials of subjects in the experimental group, but only three members of the experimental group and two members of the placebo group were able to perform the P300 task.

4.7 COMBINED IMPACT FROM SOUND AND MOVEMENT

The following section presents a group of studies which investigated the combined effect of sound and movement. The cerebellar and vestibular system is responsible for the integration and processing of all sensory information (including hearing, vision, taste and smell), coordinating voluntary and involuntary motor movements including eye movements), and controlling the sense of balance, direction, time and rhythm. It also regulates anxiety (Levinson, 1984, 1986; Goddard 1990); sound therapy claims to provide stimulation to the cerebellar and vestibular system to help reorganize a dysfunctional system. Claims have been made of improvements in the areas of better balance and motor coordination. According to Frick and Shirley-Lawton (1994) those with known vestibular processing dysfunctions appear to make the greatest gains from sound therapy. These improvements typically occur in movement perception and security, overall arousal, organization and social/emotional response (Frick and Shirley-Lawton, 1994).

Sangster (2000) and Dyson (2001) claim that auditory re-training (sound therapy) has been shown to improve motor coordination (visual perception and visual/motor skills. The improvement in motor coordination is also thought to be a result of a general improvement in time order processing.

The link between auditory and motor skill tasks was also noted in the study by Calhoun (2005) and by Butler and Clarke (2003) in their pilot study using The Listening Program, where results showed a significant improvement. In addition to this the connection is based on the role of the vestibular system in both balance and in auditory processing and the implications both of these have on raising child learning.

The following table 4.2 shows a sample of studies and their reported impact.

Table 4-2 A sample of some studies and their reported impact

	Testing used	Method adopted	Sample size	Results	Limitations
Beelen et al (2005)	Audiogram non-word-test Phonemic analysis. Technical reading auditory memory test	Hemisphere Specific Auditory Stimulation (HSAS) with music	Two groups 1; N=10 and 2; N=10.	Improvement in hearing and language areas .Retest 9 months later showed more improvements in areas not first shown.	Each group had small samples.
Sohlman 2000	Hearing threshold test. DL-tests an auditory laterality index (ALI)	Pre and post tests in 3-18 month period. ADT sound therapy. Matched against control	Twenty four age-matched students	Results showed that 92.3 % had a raised auditory sensitivity with a large effect size.	No objective tests for the teachers' reports that children's learning had improved.
Leslie et al (1999)	Speech and language therapy assessments	Johansen sound therapy	Thirty six children	Improvements in aspects of speech and language	No control sample
Rintel Brisbane (1995)	Neale reading and comprehension. Rosner auditory processing. Golman-Fristoe-Woodcock test of auditory discrimination.Westwood Spelling test	Joudary tapes Control group music only. .Experimental group Joudary tapes (high frequencies.)	2 groups of 7 children in each (experimental and control group)	Experimental group showed greater gains in auditory discrimination, reading, Comprehension and spelling then control group.	Very small sample. Testing was not independent.
Keshner et al (1990)	Reading test. Test for visuo spatial conceptualisation and constructive abilities.	Experimental group withdrawn for 5 hours a week. control group withdrawn for 1 hour a week		No significant difference in reading but improvement in visuo-spatial conceptualisation and constructive abilities	Methodological shortcomings; control and experimental group treated differently.
Rimland and Edelson (1992)		Bernard auditory integrative	17 autistic children in experimental group 9 in control group	Significant difference favoured experimental group.	Sample too small
Swain (2005)	Auditory perceptual skills test WRAT test LACT test Phonemic awareness test Token test for children	Tomatis sound therapy	41 children with auditory processing problems. Pre and pots test and t test comparison.	Improvement in all areas of auditory processing skills.	No control sample.

Author/date	Testing used	Method adopted	Sample size	Results	Limitations
Wilson et al (1982)	Test for auditory closure and auditory mimicry.	Tomatis and remedial Wilson programme. Control on Wilson programme only. Experimental on Wilson and Tomatis		Statistically significant findings in favour of Tomatis group in auditory closure and mimicry.	
DeBruto (1983)	Bailey scales of infant development. Measure of responsiveness	Tomatis	A Tomatis and sensory stimulation programme. B Music and sensory stimulation programme. C control	Both experimental groups increased in mental age but group A higher	
Treharne (2002)	Pure tone audiogram. Scan-C (Keith2000). Ravens matrices test of temporal patterning	The Listening Program.	Children with auditory problems	Showed improvement in one or more of the areas studied.	Only 8 children in the sample and no control group.
Du Plessis Van Jaarsveld 1988	Anxiety test Cognitive ability Listening skills test	Tomatis	3 groups of children and mothers a) Tomatis. b)counselling c) no intervention	Children who did Tomatis showed more improve than the other two groups	Study was not blind
Jeyes (2001)	NFER Nelson tests. Auditory discrimination and memory tests. Schonell and Salford reading test	The Listening Program	14 children	All the children improved in the areas tested.	Testing was not consistent s the children used two different reading tests
Jeyes (2004)	NFER progress tests and group Quest test of pre-reading skills reading tests.	The Listening Program.	38 children between 7yrs and 11yrs 5mths	All children, improved in the auditory discrimination and memory tests. 79% showed progress above average in at least one area of math language and reading.	No control
Bettison (1996)	Behaviour checklists Audiometric tests	AIT Bernard	80 children with autistic aspergers label. 2 groups 1 Berard AIT. 2 Placebo	Both effective	No control

4.8 MUSIC AS BACKGROUND

In the present study sound therapy was based on a highly specialised form of music specially modulated and not as background music. However, two studies were conducted just with the use of music as a background, by Hallam and Price (1997). The first study involved children aged between 9 and 10 attending a school for children with emotional and behavioural difficulties and the second was conducted in a junior school. In Study 1, with children with highly disruptive behaviour, music was played in the background. The music was suggested by Giles (1991) as mood calming and short excerpts were played to 26 children. Children completed arithmetic problems whilst the music was played in the background. Each pupil acted as his or her own control; the first four trials with music and the next four with a gap of a week without music. Results showed significant differences for background music and less rule breaking when the music was on. The correlation showed negative associations which according to the researchers, suggested that the improvement in the behaviour was to do with music. Overall it seemed that the music had a beneficial effect on the pupils and this prompted the researchers to study in a normal school.

Study 2 involved 31 children aged 10 and 11 in a junior school randomly allocated to two groups. They did mathematics on four consecutive days. For the first fifteen minutes of each period, Group B (no music) completed their arithmetic work. This was followed by general mathematics work. During this time Group A worked on general mathematics tasks. Later in the session, group A (music), completed their arithmetic work for 15 minutes while group B continued with general mathematics. This pattern was repeated over the four sessions with the order alternated so that no group had a practice advantage. In each session, for each individual, the number of attempted maths problems, the number correctly completed and the accuracy rate was recorded. Results showed for the mean number of problems completed during the 15 minute session revealed that the mean for those listening to the background music was 34.9 (SD 7.7) problems and for those without background music 27.3 (SD 7.8). This difference was statistically significant ($p = .02$). When performance was considered for each day separately, this pattern was repeated. The conclusion was that playing background music, rated by the pupils as 'relaxing' had a positive effect on pupil performance on mathematics problems. These studies show that the results apply for children aged 10-

11 years, both in a mainstream school and for children in a school for emotional and behavioural difficulties.

4.9 SUMMARY

This chapter presented the development of concepts, theories and generated impact reported by studies on sound therapy. After a brief discussion on the background the chapter reviewed current approaches as well as the different strands of sound therapy. In addition, there was a discussion on how they might work, in terms of addressing auditory processing, affecting brain plasticity and reducing hypersensitivity. There was also a brief introduction to the different types of auditory processing problems that may occur. Finally, the chapter discussed the emergent research in this area in the findings of studies that impacted auditory processing, learning, and behaviour. In addition, the link between sound therapy and movement were covered in this chapter, including studies that showed little or no effect.

A great deal of research conducted in this area has been with children who had either specific problems such as autism, ADD, ADHD or dyslexia, and so the intervention has had to address quite severe problems and therefore further studies are needed using 'normal' samples. It has to be pointed out that a vital problem in researching and evaluating the results of a sound therapy programme is the breadth and diversity both of the initial problems and the areas in which progress may clinically be demonstrated. As well as this there are so many different types of sound therapies, which obviously affect the outcomes. In addition, many quantitative research studies could be missing the more qualitative aspects of the results observed in the study. Therefore there is a gap in the literature and in the studies. Bellis (2002, p 318) summarized this by saying:

'I believe that, if we continue to look for a simple answer to Auditory Processing Disorder (APD), it will continue to elude us. As long as we try to agree on easy, concise definitions, methods of diagnosis, and methods of treatment for APD, we will never reach consensus on anything. The brain is infinitely complex. Any disorder that involves the brain will, likewise, be infinitely complex. Therefore, until we let go of the hope for a simple answer, we may find ourselves never asking the right questions'

The following chapter will discuss the research methodology and design issues.

CHAPTER FIVE: RESEARCH METHODOLOGY

5.1 INTRODUCTION

This chapter is a general chapter on research methodology and presents a classification of the different types of research such as exploratory, descriptive and analytical. It presents the quantitative and qualitative research paradigms, as well as triangulation. In addition, inductive and deductive research is presented, as well as issues related to applied and basic research. There is a section on general ethical considerations as well as a more specific section on research ethics in relation to children, since this study involved experimentation with children. Various aspects of sampling are also discussed, as well as data analysis and aspects of validity and reliability.

5.2 DEFINITION OF RESEARCH METHODOLOGY

Research is usually undertaken to seek new knowledge or add to existing knowledge and this is conducted in a scientific and systematic way. According to Sekaran (1992) it has to be scientific organised and systemic whilst trying to find a solution of a problem. Macleod et al., (1989) talk about research attempting to increase knowledge and by discovering either new relationships or facts through scientific methods.

Research methodology refers to the overall approaches and perspectives to the research process as a whole and is concerned with the following main issues: why data is collected, what data is collected, where it is collected, how it is collected and finally how it is analysed (Collis and Hussey 2003). The role of research methodology is to direct the research process through a system of procedures and logical study (Gould and Kolb 1964). Behrooz (1998) states that the methodology directs the research whereas Nachmias and Nachmias (1996) state that the methodology is concerned with rules that help to direct the research.

5.3 CLASSIFICATION OF DIFFERENT TYPES OF RESEARCH

Hussey and Hussey (2003) classified the types of research into four categories, based on the purpose, process, logic, and outcome of the research. Table 5.1 shows the different classifications.

Figure 5-1 Categories of research

Type of Research	Basis of Classification
Exploratory, descriptive, analytical or predictive	Purpose of research
Quantitative or qualitative	Process of research
Deductive or inductive	Logic of research
Applied or basic	Outcome of research

Source: Hussey and Hussey p 24 (2003)

This section now aims to provide a further understanding of the different categories.

5.3.1 Exploratory, descriptive and analytical

Exploratory research: As in this study, is usually undertaken when few or no previous studies exist. The aim of this type of research is to look for patterns, hypotheses or ideas that can be tested and that may form the basis for further research. The general objective in exploratory research is to gain insights and ideas for further research. Typical research techniques could include case studies, observations and review of previous related studies and data (Hussey and Hussey 2003). Exploratory research is flexible in relation to the methods used for gaining insight and developing hypotheses because of the lack of knowledge, whereas descriptive research is more structured and has clear and precise specifications of the research question. In exploratory research, the formal design and detailed questionnaires are not of the utmost importance since often the researcher change the research procedures as the vaguely defined initial problem metamorphosises into a more precise and meaningful one. This kind of research can be used in establishing priorities among research questions. Also, it is used for learning about the practical problems of carrying out the research.

Sekaran (1992) stated that exploratory studies are important for obtaining a good grasp of the phenomena of interest and for advancing knowledge through good theory building. In this study it was decided to use a quantitative form of collecting the data, both in the pilot and main study. Additionally, in the pilot study limited qualitative data was also collected to add towards making a case for the main study to take place.

Descriptive research: A large proportion of social science research uses descriptive research (Aaker et al., 1995). It identifies and gathers data on the characteristics of a particular problem. It mainly describes phenomena as they exist, and examines the problem further than an exploratory study (Hussey and Hussey, 2003). According to Hussey and Hussey (2003) there are four major purposes for descriptive research:

- To provide a clear picture of some aspect of the social environment.
- To describe the characteristics of certain research problems.
- To estimate the proportion of people in a specific population who behave in a certain way.
- To make predictions.

Analytical research: Takes the descriptive research further, and goes on to provide explanations on how and why the problem exists. Thus, it seeks to determine the causal relationship in the variables identified in understanding the phenomenon or problem that is studied (Hussey and Hussey, 2003).

5.3.2 Quantitative and Qualitative research paradigms

According to Huberman and Miles (2002) and Blaxter et al., (2001), data collected can be classified as qualitative if they come in word form and describe situations, individuals, or circumstances surrounding a phenomenon, while they are viewed as quantitative if they are in the form of numbers, often counts or measurements to attempt to give precision to a set of observations. Consequently, the most fundamental classification has been between quantitative and qualitative approaches.

Denzin and Lincoln (1994) argue that both qualitative and quantitative approaches can be used appropriately with any research philosophy (e.g. positivist or interpretivist).

They provided evidence using the same data-gathering technique for both positivists and interpretivists. In theory, the choice of methods depends on the nature of the research problem. In practice, there are certain constraints, such as time, setting and funding, that influence the researcher's choice.

Positivism uses a quantitative approach to investigations, whereas post-positivist approaches use a qualitative perspective. Often, quantitative and qualitative research methods are often seen as opposing views; however they are frequently used together. In addition, according to some academics, the distinction between the philosophies is overstated (Webb, 1989) and triangulation of methods in current research is common (Polit, 2001).

Both quantitative and qualitative research methods share the purpose of cultivating knowledge (Field and Morse, 1990), but each has its special way of reaching that knowledge. The choice among these methods has to be made with careful assessment because they produce different kinds of data that serve different research issues and deciding whether to choose quantitative or qualitative research methods is a difficult task because there have been strong debates about the advantages and disadvantages of each. De Vaus (2001) and Nachmias and Nachmias (1996) suggest that the decision to choose the method depends on the questions being asked.

5.3.2.1 Quantitative research

Research methods are chosen because of different viewpoints and are dependent on finding the best way to answer the problem under investigation. Positivism is the traditional science school, and aims to discover laws by the use of quantitative approaches (Silverman, 1997). The positivist paradigm demands quantitative evidence and methods for testing of hypotheses that are derived from prior general theories (Black, 1999), and observed measurable phenomena that it is possible to generalise or to model, especially in the mathematical sense (Remenyi, 1998). In other words, it assumes the existence of an objective truth, and quantifiable measurements of variables are used in order to reveal the truth. Quantitative methodology is usually used where the aim of the research is to find out how many, what and where. Therefore, a quantitative approach relies on the use of standardised data collection and statistical techniques are used to help in the interpretation of data. The standardised measurement

and sampling procedures are intended to enhance the reliability of observation, facilitate replication studies, and allow generalisation to a larger population (McClintock et al., 1983). According to Bryman (2001), quantitative research usually emphasises quantification in the collection and analysis of data. The main focus on the content of evidence is on reliability, validity, generalisation of the measurements, and the prediction of causes and effects (Cassell and Symon, 1994).

Types of quantitative methods include experimental design. This has two forms: true experiment and quasi-experiment. Other types are survey designs, which include descriptive surveys or analytical surveys, as well as regular and ad hoc sample surveys. Another type of quantitative research study is the correlation study, which includes studies that attempt to discover or clarify relationships through the use of correlation coefficients.

This present study utilised an experimental approach this will now be discussed in more detail. Experimental research design is a design where the researcher manipulates aspects of a setting, either in the laboratory or in a field situation, and observes the effects of that manipulation on experimental subjects (Cohen and Manion, 1994), either in the continued artificial setting or in their natural setting. Experimental studies are carried out in controlled and structured environments and allow the causal relationships of phenomena to be identified and analysed. The variables can be manipulated or controlled to observe the effects on the subjects studied. Laboratory studies allow the best opportunities for controlling the variables in a rigorous way, although field studies can be done in the 'real world', as in this case. Whereas, with the laboratory studies, the artificiality of the situation can affect the responses of the people studied, and with the field studies, the researcher has less control over the variables affecting the situation under observation. The purpose behind the experiment is to ascertain cause and effect through manipulation and control. To manipulate a variable is to do something to it through treatment or intervention. This variable is called the independent variable. The outcome of the research is usually observed in the dependent variable or factor, which is affected by the independent variable. To control the experiment means the researcher controls the treatment of the study group while comparing and contrasting against the control group where there was no treatment or intervention (Aaker et al., 1995).

Experimental research design, as in this study, can be used as a powerful tool for discovering the true relationships between variables. However, this type of research requires certain means, which include, cost, control, time, and implementation. These means can be difficult for some researchers. The present research was conducted in a field situation and the interventions used were sound therapy and a movement programme. Since this study was conducted in a school it is important to consider the issues related to experimental research in education. In the National Research Council report on scientific research in education (Feuer et al., NRC, 2002) the need for different types of research in education was emphasised . The panel concluded by the panel that randomized trials were underused in educational research. Campbell and Stanley (2001) advocated experimental research in education and stated experiments verified improvements in a scientific way.

Campbell and Stanley (1966) argued for moving away from matching designs and highly controlled studies to studies of particular relevance to education. They advocated that researchers should conduct research that was relevant and appropriate in education, even though this may mean giving up some of the tight control possible in laboratory research. In other words, they should consider conducting 'quasi-experiments.' In addition, Campbell and Stanley (1966) argued that the social and educational programmes at that time, needed evaluation using rigorous research methodologies.

5.3.2.2 Qualitative Research

Qualitative research is an approach rooted in the phenomenological paradigm that involves some kind of interaction between the researcher and the people or the situation being researched (Hussey and Hussey, 2003). Qualitative research can be classified in different ways and different emphases can be placed on their definitions. The qualitative research approach allows the researcher to gain insight into subjective aspects of complex social and to find answers to questions such as 'What?', 'Why?', or 'How', which means data is gathered in the form of words rather than quantified numbers. Therefore, the qualitative research method is most appropriate for the humanistic (or hermeneutic) researcher, in order to gain a deeper understanding of a particular research question (Cassell and Symon, 1994). The concept of context in organisational research is one of the most important reasons for choosing a qualitative approach.

Qualitative methodology, in contrast to the quantitative, statistical, positivist perspective, is 'phenomenological' (Remenyi et al., 2000) in approach. The main reason for a researcher choosing to take this approach is to discover every aspect of the research scope, from individuals' experiences and perspective. This means that qualitative research methods focus on exploring in depth the significance of individual experience within the research context. Thus, the people under study behave in a certain way within the group or the organisation being studied and have a form of working life or a culture that is their own. The researcher, also, uses inductive reasoning and this allows the researcher to generate theories. The researcher poses questions rather than hypotheses. The objective is to discover meaning and interpretation of the social world. Concepts and theories are generated from the respondents and emerge as the study progresses rather than the other way around (Clifford and Gough, 1990).

Methods of qualitative design include case studies, either single-case or multiple-case designs, which provide descriptive data of the subject under study; meta-analysis, which can be designed to use statistical results from previous research; research analysis of administrative records, which has the feature of access to knowledge which is not normally found elsewhere; focus group discussion, which allows the researcher to bring together a number of informants who serve the issue of investigation; and in-depth interviews in the form of structured or unstructured questioning design (Silverman, 2000; Kruger 2001).

5.3.2.3 Comparison of Quantitative and Qualitative Research

Neuman (1997) compares quantitative research style against qualitative research style by using a number of sources including Creswell (1994), Denzin and Lincoln (1994), Guba and Lincoln (1994), and Mostyn (1985). The comparison is illustrated in Table 5.2.

Figure 5-2: Comparison between quantitative and qualitative methods

Quantitative Style	Qualitative Style
Measures objective facts	Constructs social reality, cultural meaning
Focus on variables	Focus on interactive processes, events
Reliability is key	Authenticity is key
Value free	Values are present and explicit
Independent of context	Situationally constrained
Many cases, subjects	Less cases, subjects
Statistical analysis	Thematic analysis
Researcher is detached	Researcher is involved

Source: Neuman (1997 p 46)

The main feature of quantitative evidence is the manipulation of numbers in the data, while in qualitative research it is the analysis, development and manipulation of concepts. The majority of quantitative analysis is based on coding groups of words in surveys, meaning giving numbers to concepts. Thus, quantitative methods deal with the counting of concepts, which eventually must be interpreted into meaningful words. On the other hand, qualitative research has been summarised as having a concern with a certain experience as it is 'felt' or 'lived' or 'undergone' (Sherman and Webb, 1988). Qualitative techniques develop theories inductively from the data, but only test theories in a limited way, while quantitative methods are intended to test and explore existing theories through new data.

One major difference between these methods is the way in which they deal with analytical categories. The qualitative methods approach the research more openly, and only categorise and define data during the research process. The quantitative technique isolates and defines categories before the study, and then determines with more precision the relationship between the categories from the data collected. Another difference is the sample size. In qualitative studies, the sample could be as few as four or six; while in quantitative studies the sample is much larger. In quantitative research a study requires a sample containing the appropriate number of subjects, so the results can

be generalised (McCraken, 1988). There are some researchers that believe that the two methods are opposed to each other. Levine (1993) calls quantitative social science, 'real social science'. He believes that it 'won the battle' against other methods. Denzin and Lincoln (1994) argue that qualitative research has expanded greatly and it is rapidly displacing outdated quantitative research.

5.3.2.4 Triangulation

Although qualitative and quantitative are two different approaches to research and though they can be viewed as competing methodologies, they can be combined; this is called triangulation. The concept of triangulation was based on the assumption that any bias inherent in particular data sources, investigator and method would be neutralised when used in conjunction with other data sources, investigators, and methods (Jick, 1979). Jick (1979) stressed that, 'triangulation purports to exploit the strengths and, neutralise, rather than compound, the weaknesses of each single method'.

There are four main types of triangulation according to Burgess (1984); Chadwick et al., (1984); Patton (1990). These are as follows, data triangulation, Investigation triangulation, methodological triangulation and theoretical triangulation. Data triangulation includes collecting data at different times, in different places or from different levels (individuals, groups etc). Investigation triangulation uses different observers, who may operate either as a team or as individuals, to collect data. Methodological triangulation involves using different study methods, as well as manipulating different patterns of the same method. The final type, theoretical triangulation, assesses data from different theoretical viewpoints.

Triangulation allows a more complete and contextual portrayal of the topic under study. It is often used to strengthen the validity of the study (Baker, 1999). One major benefit when combining these methods is that the knowledge has more validity. This validity comes from double testing. This means one method emphasises another method. Some researchers argue that more than one method should be used in the validation process to ensure that the variance reflected is that of the trait and not of the method. In the pilot study of the present study there was some qualitative data gathered as well as the quantitative data but it was in a very limited form due to time constraints. With this in mind it was decided to obtain only quantitative data for the main experiment.

5.3.3 Deductive and Inductive research

Nachmias and Nachmias (1996) and Trochim (2001) argue that there are two types of research strategy: theory-then-research and research-then-theory. Theory-then-research strategy starts with a hypothesis-testing approach to research, and then collects data that will lead to accepting or rejecting the hypothesis. Trochim (2001) called deductive top-down and inductive bottom-up thinking.

5.3.3.1 Deductive research

Deductive research moves from general ideas and theories to specific situations. According to Saunders et al., (2003), the process of deductive research is the development of a theory that is subjected to a rigorous test. Research then produces empirical evidence to test or refute theories. This approach is hypothesis-testing research. This strategy starts with a hypothesis about the nature of a social problem, and then seeks data that will confirm or reject that hypothesis. Deductive reasoning calls for a universal generalisation, a statement of the conditions under which the generalisation holds true, an event to be explained, and the rules of formal logic (Nachmias and Nachmias, 1996). In addition a deductive explanation explains a phenomenon showing that it can be deduced from an established universal law.

5.3.3.2 Inductive research

On the other hand, a particular aspect of social life might be examined and theories derived from the resultant data; this is known as induction. Inductive research moves from particular situations to make or infer broad general ideas or theories. Research comes before theory, and theoretical propositions are generated from the data. In contrast to theory-then-research, Merton (1968) argues that empirical research goes far beyond just verifying and testing theory; it does more than confirm or reject hypotheses. Reynolds (1971) believes that empirical research suggests new problems for theory. It calls for new theoretical formulations, leads to the refinement of existing theories, and serves the function of verification.

The research-then-theory strategy uses inductive reasoning. Inductive reasoning is the first step in knowledge development. Gilbert (1995) defines inductive reasoning as a basic technique for moving from a set of observations to a theory. This means that it is the process of finding a single case and observing a relationship, then observing the

same relationship in several more cases, and finally constructing a general theory to cover all the cases.

5.3.4 Applied and Basic research

The primary aim of basic research is to improve knowledge generally, without any particular applied purpose from the start. Applied research by contrast, is designed to apply the findings to a particular situation. Instead of focusing on finding the solutions, basic research aims at gaining insight into the problems and how they can be solved. This type of research supplies more knowledge and understanding, and builds theories based on research results. When some understandings are found, this can help others to develop further, new research (Gummesson 2000). Therefore the main motivation is to add to existing knowledge, not to create or invent something.

Applied research, on the other hand, is designed to solve practical problems, rather than to acquire knowledge for knowledge's sake. It is often used in order to understand and solve a highly specific problem of concern and to search for solutions.

5.4 ETHICAL CONSIDERATIONS IN RESEARCH

The terms ethics and morals are very closely linked but are different. According to Francis (1999), morals generally refer to an unwritten set of values that provide a frame of reference that we use to help our decision-making and regulate our behaviour whereas ethics generally refer to a written code of value principles that we use in a particular context. It can be said that ethics is the study of moral human conduct or the rules of conduct recognised as appropriate to a particular profession or area of life. It relates to the issue of moral principles or conscience. It regards itself as the guardian of human nature, and thereby offers some protection. There are those who hold that ethics derives from a universal natural law (Sherwin 1983; Singer 1993, 1998).

There are two different approaches to ethical issues, the deontological and the teleological approach. Teleological ethical theories focus strongly on the consequences which any action might have and are often referred to as consequentialist or utilitarianism theories. The teleological approach stresses the greatest good for the greatest number. In contrast, the deontological school of thought is heavily dominated

by Kantian ethics of duty. For Clark (2000), adherence to moral duty is the yardstick of conduct in deontological terms. The deontological approach states that duty is the basic moral category, independent of the consequences of the action whereas in the teleological approach, an action is deemed moral or immoral by examining the consequences of the action (Beu et. al. 2003). The deontologist stress, that an action is good or bad, right or wrong, by something within the action. Deontological ethical theories regard the action itself as the object of moral evaluation (Kant, 1973; Donagan, 1977; Davis, 1980) and have its foundations in the works of Immanuel Kant (1724-1804). Teleologists hold the view that the real and expected consequences or outcomes of an action determine the moral content (Singer, 1998). They also regard the nature of an action and the intentions as morally relevant (Bowie 1991; Beauchamp and Bowie 1997). They believe that an action is morally good if its consequences are desirable and bad if they are not.

The deontological approach focuses on the inherent rightness or wrongness of an action in itself and therefore, according to this approach certain features of an action make it ethical or unethical. The main disadvantage of this approach is that it easily leads to rigid application of rules and there is no room for exceptions. However the deontological approach is a powerful approach to ethics and moral intentions. The teleological approach on the other hand seeks to find the best possible result. The essential difference between the two theories is the importance attributed to the consequence of the action. For deontologists the action is more important then the consequence whilst for teleologists the consequence is more important than the action to which it attributed.

5.4.1 General ethical issues in research

The ethics of the interventions was a major consideration when conducting this study. These had to be of the highest standards, as children are classified as being 'vulnerable'. In essence, research ethics is about ways to assure that people, in this case children, taking part in research are protected from exploitation and other forms of harm. According to Trochim (2002) there are some things that researchers need to adhere to in terms of research ethics. The participation should be voluntary, participants should have given their permission, there should be no risks of harm and there should be confidentiality and anonymity which ensures privacy. In this study all of these were

strictly adhered to with permission from the local authority which could not allow any kind of research to be carried out unless this was the case.

Ethical concerns may emerge at all stages of research. Saunders et al., (2003) summarise the main issues to consider, although the ethical issues surrounding these items are not always clear-cut:

- The rights of privacy of individuals.
- Voluntary nature of participation – and the rights of individuals to withdraw partially or completely from the process.
- Consent and possible deception of participants.
- Maintenance of the confidentiality of data provided by individuals or Identifiable participants and their anonymity.
- Reactions of participants to the ways in which researchers seek to collect data.
- Effects on participants of the way in which data is analysed and reported.
- Behaviour and objectivity of the researcher.

Basically research studies have to comply with all legal requirements. This includes data protection legislation and appropriate screening of researchers working with vulnerable groups of people. Different licensing requirements apply to research involving animals or biomedical research. In addition, research is required to comply with the commonly agreed international standards for good practice. The World Medical Association (WMA) Declaration of Helsinki is regarded internationally as the pillar of ethical standards for biomedical research involving humans. Ethical standards are not universal and are influenced by cultural, linguistic, moral, religious, and social considerations; thus, many countries develop their own ethical guidelines. However internationally the guidelines in relation to the Declaration of Helsinki can be categorised as:

- Beneficence (Do positive good).
- Non-malfeasance (Do no harm).
- Informed consent.
- Confidentiality /anonymity.

Sometimes the participants in a study may be affected in one way or another. However many researchers argue for balancing the risks that studies create for subjects against the benefits to be gained for subjects, society, and science depending on the ethical stance they adopt. Possible risks include physically or psychologically harming subjects, invading their privacy, upsetting subjects, and wasting their time. Some have even suggested that habitual deception of subjects engenders distrust and suspicion and that manipulation and deception can lead to the dehumanization of research subjects (Geller, 1982; Kelman, 1982).

There does however seem to be generally agreed standards amongst researchers for example, Sieber and Stanley (1988) claim that there should balance between freedom of enquiry and harming someone. Cohen and Manion (1994) p 61 also state that, 'the principle that subjects ought not to leave the research situation with greater anxiety or lower levels of self-esteem than they came with is a good one to follow.' Ethical guidelines are of paramount importance and must be followed strictly and in good faith particularly when a vulnerable population such as children are involved. This will be discussed in the following section.

5.4.2 Research with children

When conducting research with children, important ethical and methodological considerations are raised. One kind of issue that is raised is, for example, safety issues, which is of particular importance. Discussions about research with children have mainly tended to focus on the issues of informed consent and confidentiality (e.g. Alderson 1995; France et al., 2000; Lewis and Lindsay 2000; Morrow and Richards 1996; Stanley and Sieber, 1992; Thomas and O'Kane 1998). Ethical issues are often thought to be the central difference between research with children and research with adults. For example, in order to gain children's consent and involvement in research, one has to go via adults who are able to limit researchers' access to the children.

The guidelines state that informed consent of parents, guardians or those who act in loco parents is essential. Transparency is required throughout, for example, all of the aspects of the research should be disclosed; observational research must only take place where those observed could normally expect to be observed by strangers unless consent has

been given. The appropriateness of the investigator in relation to the children is vital, as well as, the appropriateness of the available facilities.

There is an ongoing debate about whether research with children is the same as research with adults (Christensen and James, 2000; Lewis and Lindsay, 2000; Mandell, 1991; Shaw, 1996). There has been a tendency to see research with children as one of two extremes: just the same or entirely different from adults. There are researchers who consider children to be 'essentially indistinguishable from adults' (James et al., 1998) and who therefore employ the same methods as those used with adults. It is then the responsibility of the adult researcher not to draw attention to any adult–child distinctions by treating them in any way other than as mature, competent people (Alderson, 1995). Such an approach may mean that the power imbalance between adult researchers and child subjects is not always adequately addressed (Morrow, 1999).

On the other hand there are those who perceive children as being very different from adults and use ethnography as the most appropriate way to get close to understanding the child's world and the child's views are taken at face value (James et al., 1998). However, ethnography is not only suitable for those who perceive children as different. It is necessary to spend prolonged, or repeated, periods with anyone in order to get to know them beyond a one-off interview and to gain a greater understanding of their views and experiences (Fetterman, 1989). The difficulty with using this approach is that it relies on participant observation as a research strategy often without recognizing that adults are unable to be full participants in children's social worlds because they can never truly be children again (Hill, 1997).

James et al., (1998) suggested that there is another perspective to research with children; those who perceive children to be similar to adults but to possess different competencies These researchers usually use methods which are based on children's skills and this has led to a host of innovative or adapted techniques being developed, such as pictures and diaries (Nesbitt, 2000), sentence completion and writing (Morrow, 1999), drawings (Ennew and Morrow 1994), the draw and write technique (Backett-Milburn and McKie, 1999; France et al., 2000; Pridmore and Bendelow, 1995) .

5.4.3 Research context and setting for children

It is assumed to be as important to bear in mind the context and setting of the research for children as it is for adults. However, it needs to be recognized that many research environments are adult spaces where children have less control. There are more adult spaces in society, thus it can be difficult to find child spaces in which to conduct research. For example, although the school environment is a place for children to learn, it is still organized and controlled by adults. Research conducted at school should take into account that children may feel pressure to give 'correct' answers to research questions. Adult researchers need to reassure children that there are no right or wrong answers. Observation with children in their own spaces enables them to feel more comfortable. Yet adults should not assume that children necessarily prefer their own environment; they may actually prefer an adult researcher not to invade their child space. The implications of the research setting need to be considered with particular care, awareness and sensitivity in research with children.

5.4.4 Using appropriate research methods for children

The issue of using appropriate methods is a central concern in any research but with children there seems to be a greater desire to develop fun, 'child friendly' methods, drawing on familiar sources or children's particular interests. There are two reasons for this. First, adults assume that children prefer fun methods, and are more competent at them, and that children have a shorter attention span. Second, the nature of childhood in adult society means that children tend to lack experience of adults treating them as equals. The methodological issues which have been discussed are all equally relevant to research with adults and children. However, these issues are potentially different or particularly important to the way research is conducted with children for a combination of reasons. Children, particularly younger children, may have different characteristics from adults. For example, their use of language and their understanding of the world are different.

The implications of using different methods with children have begun to be examined by Backett-Milburn and McKie (1999), Christensen and James (2000), Hill (1997) and Morrow (1999). These include the need to facilitate children's ability to communicate Hill (1997) to prevent biases arising from over reliance on one method (Ennew and

Morrow, 1994, Morrow and Richards, 1960) to triangulate and cross-check data (Lucchini 1996, Morrow, 1999); to evaluate the usefulness of different methods (Hazel 1996, Morrow, 1999) and to strike a balance between traditional and innovative methods.

Finally, it has to be noted that the by comparing research with children to that with adults, there is a danger of bracketing all children together as a group in opposition to adults, and overlooking diversity among children. Qvortrup (1994) stated that we should be careful since it should be recognized that not all the research issues mentioned will be problematic with all children as a plurality of childhoods exists.

Ethical issues, by their very nature, in research and in particular in any research with children offer no easy solution. As mentioned earlier, Baumrind (1964), for example, takes an absolutist position in arguing that deception violates fundamental moral principles. The American Psychological Association (1992) code of ethics, in contrast, takes a risk-benefit approach. Ethics vary from one situation to another and can vary from one country to another depending on cultural differences etc. In addition, researchers have had to deal with the ethical issue of a person's right to service. Good research practice often requires the use of a no-treatment control group, as in this research, a group of participants who do not get the treatment or program that is being studied. When that treatment or programme may have beneficial effects, persons assigned to the no-treatment control may feel their rights to equal access to services are denied. This factor had to be considered very carefully in this study. Ethical research helps to obtain valid results, the necessary cooperation of research participants, and the societal support needed to sustain science.

5.5 SAMPLING

The process of sampling involves any procedure using a small number of items or parts of the whole population to make conclusions regarding the whole. The purpose of sampling is to enable researchers to estimate some unknown characteristic of the population. Sampling is of great importance as it can affect the reliability and generalisability of a study. Gy (1998) argues that if a sample is properly selected, it may be accurate and representative. Only a small sample is needed if the number of population is similar. This means that generalisations are always based on partial

information. Most of the time it is impossible to gather data, test, or examine every element in terms of time, costs and other human resources (Tucker 1998). Thus, we have to rely on samples to generalise the findings on the whole population.

There are two categories of sampling techniques, namely probability and non-probability sampling. Probability sampling provides a statistical basis that enables the sample to be representative of the defined population. Non-probability or purposive sampling is chosen based on researcher's judgement regarding the characteristics of the defined population and the needs of the study (Cooper and Schindle, 1996). Probability samples are those that are based on the principle of randomness, and non-probability samplings are those that are not (Neuman 1997). Below (Figure 5.3) are some different forms of sampling.

Figure 5-3: Different forms of sampling

Simple random sampling	Here each person (element) has equal chance of being selected from a population. (Fink and Kosecoff 1998)
Stratified random sampling	Subdivision of the population into subgroups and selecting a given number or proportion from each to get a sample (Fink and Kosecoff 1998).
Systematic random sampling	The starting point is selected by a random process, and then every nth number on the list is selected (Zikmund, 1994).
Cluster sampling	Clusters (larger groupings) are selected first, and then smaller samples are chosen from the clusters Usually used in large-scale studies because it is the least expensive sample design (Nachmias and Nachmias, 1996)
Convenience sampling (Haphazard)	People who are willing to complete the survey are conveniently available when you need them (Fink and Kosecoff 1998).
Purposive/judgement Sampling	This is dependant on the subjective judgment of the researcher. (Nachmias and Nachmias, 1996)
Quota sampling	The chief aim of a quota sample is to select a sample that is as similar as possible to the sampling population (Nachmias and Nachmias, 1996).
Snowball sampling	In this technique, the first element is selected, and then the second element is selected based on information from the first, and the third from the second, etc. (Schutt, 1996).

5.5.1 SAMPLE SIZE

Unless the sample size is adequate for the desired level of precision and confidence, no sampling design can be useful to the researcher in meeting the objective of the study (Sekaran 1992). Thus, neither too large nor too small sample sizes help research projects. According to Roscoe (1975), sample sizes larger than 30 and less than 500 are appropriate for most research. Another principle that helps in getting an accurate and good sample size is the smaller the population, the bigger the sampling ratio has to be and the larger the population, the smaller the sampling ratio has to be (Neuman, 1997).

5.6 DATA ANALYSIS

The field of statistics involves methods for describing and analysing data, and for making decisions or inferences the data. Methods in the first category are referred to as descriptive statistics; methods in the second category are called inferential statistics (Huck and Cormier, 1996). Descriptive statistics allow the researcher to summarise and organise data in an effective and meaningful way. They provide tools for describing collections of statistical observations and reducing information to an understandable form. Inferential statistics allow the researcher to make decisions or inferences by interpreting data patterns. Researchers use inferential statistics to determine whether an expected pattern designated by the theory and hypotheses is actually found in the observations. Inferential statistics can be categorised as parametric or non-parametric. Tests that require the assumption of normality, or any other specific distribution, are called parametric tests (Iman and Conover, 1989). Parametric statistics can be used when data are collected on an interval, ratio, or even ordinal scale. On the other hand, non-parametric statistics make no explicit assumption regarding the normality of distribution in the population, and are used when the data are collected on a nominal or ordinal scale (Sekaran, 1992). Frequencies, cross tabulation, and factor analysis are some of the terms and tests that are commonly used in statistics.

There are many numeric data analysis techniques that can be used (e.g. descriptive measures, correlation, regression, factor analysis, validity and reliability analysis, and chi-square). The following are some available techniques shown in Figure 5.4.

Figure 5-4: Different types of data analysis

Bivariate Correlations	This method computes Pearson's correlation coefficient, Spearman's rho, and Kendall's tau-b, with their significance levels. Correlations measure how variables or rank orders are related.
Linear Regression.	This estimates the coefficients of the linear equation, involving one or more independent variables that best predict the value of the dependent variable.
Chi-Square Test	This procedure tabulates a variable into categories and computes a chi-square statistic.
Mann-Whitney U Test	A non-parametric equivalent to the t test, and tests whether two independent samples are from the same population.
Wald-Wolfowitz Runs Test.	A non-parametric test of the hypothesis that two samples come from the same population and require at least an ordinal scale of measurement.
Moses Extreme Reactions	A non-parametric test designed to test hypotheses in which it is expected that the experimental variable will affect some subjects in one direction and other subjects in the opposite direction.
Kolmogorov-Smirnov Z	A non-parametric test of whether two samples (groups) come from the same distribution.
The Kruskal- Wallis test	A non –parametric test to compare three or more independent groups of sampled data.
The T-test	Is an example for explaining statistical hypothesis testing and statistical inference. It is probably the most commonly used statistical test

5.7 RELIABILITY AND VALIDITY

Reliability and validity of data gathered are of paramount importance to all researchers. Reliability is defined as the agreement between two efforts to measure the same trait through similar methods. The question of reliability in a social research context is important because it shows whether the research can be replicated by other researchers, which then achieve similar findings (Trochim, 2001).

In this present study reliability was very important since it was exploratory research and the replication of the study is highly desirable with different samples and perhaps different time scales. Saunders et al., (1997) highlight the four main threats to reliability. They are subject error, subject bias, observer error, and observer bias. Therefore, a reliability of a measure or research element is established by testing both

consistency and stability (Sekaran, 2003), and helps to assess the 'goodness' of a measure. Consistency indicates how well the items measuring a concept hang together as a set of research constructs. Consistency of measures that are free from random error means it is replicable and therefore reliable. Two tests that are useful to examine consistency are inter-item consistency and split-half reliability testing. Stability indicates the ability of a measure to remain the same over time despite uncontrollable testing conditions, and low vulnerability to changes in situation. Two tests appropriate for stability are test-retest reliability and parallel-form reliability. The larger the measurement error, the lower the reliability of the measure. Reliability test is shown by high correlation between measures underlying the construct (Shepheard and Helms, 1995).

Validity, on the other measures the same trait through different methods. In other words, one is concerned with difference whilst the other is concerned with consistency (Oppenheim, 1992). It is possible to establish high validity, but lack high reliability. If the measurement is valid, it is usually reliable; however, the reliability of a measurement may not guarantee its validity. Researchers use validity to show how well the tests used measured the particular concept it is supposed to measure. In other words, validity is concerned with measuring the concept.

In this present study the question of validity would refer to whether the sound therapy and the movement program did in fact make the claimed difference or was it some other plausible explanation. In most causal hypothesis tests, the central inferential question is whether any observed outcome differences between groups are attributable to the intervention or instead to some other factor. Validity concerns whether the instrument measures what it claims to measures or it is also to do with careful sampling, appropriate instrumentation and appropriate statistical treatments of the data. There are different kinds of validity: internal validity, external validity, content validity, criteria validity, construct validity, face validity, jury validity predictive validity, consequential validity, systematic validity, catalytic validity, ecological validity, cultural validity, descriptive validity, interpretive validity and theoretical validity. In this research the concentration is on the initial five and these will be expanded further in the following section.

5.7.1 Internal validity

Internal validity concerns the question as to whether the experimental treatments, in fact make a difference in the specific experiments under security (Cohen et al., 2000). An experiment can be said to be internally valid to the extent that within its own confines its results are credible (Pilliner, 1973) but if these results are to be useful they need to be externally valid; that is they need to be generalisable. Without internal validity one cannot have external validity. To ensure internal validity there has to be awareness of threats to internal validity. These are all alternative causes other than the programme or treatment that are responsible for the difference in the post test. According to Trochim (1999), threats to internal validity can mask the real causal relationship in a programme. Threats to internal validity are categorized into three groups depending on the nature of the research, and how it is designed. These include a single group threat, multiple group threat and social threat to internal validity.

a) A single group threat to internal validity occurs when an experiment or treatment involves a single group. That is when a control group is not used to establish a causal relationship study. A single group threat includes history, maturation, testing, instrumentation, mortality and regression to mean threats. In this study this did not apply.

b) A multiple group threat can occur to a research design that involves two groups in an experiment or in a treatment, in which one group receives a treatment and other does not. The multiple group threat to internal validity can occur when the conditions in the two groups are not comparable before the study. These multiple group threats are called a selection bias or selection threat. These include selection history, selection maturation, selection testing, selection instrumentation, selection mortality and selection regression threats (Trochim, 1999). It was extremely important, prior to the experiment, that the classes were examined closely in terms of mix of abilities to establish whether the groups were comparable. This was proved to be satisfactory in the case in this study.

c) Social threat is a final type of threat to internal validity. Social threats to internal validity include imitation of treatment, compensatory, resentful demoralization, and

compensatory equalization. To avoid such threats the children who were taking part in this present study was kept as low key as possible.

Validity and reliability are keys to experimental research in particular to quasi experimental research, which is conducted more frequently in educational research. According to Campbell and Stanley (1963), Braccht and Glass (1968) and Lewis- Beck (1993) the following are the likeiest threats to internal and to external validity:

i) History sometimes in educational research, events other then the intervention occur that could be mistakenly attributed to the differences in treatment. This was kept in mind during the course of the intervention and vigilance ensured that no other programmes or interventions occurred during the course of the research.

ii) Maturation; Children mature from pre-test to post test and this can produce a difference. This was taken into account with particular reference to the comparison group.

iii) Statistical regression; just as maturation effects can occur, so can regression effects increase with the time interval Statistical regression can occur due to the unreliability of the measuring instrument .This effect was minimised by choosing well established, standardised tests.

iv) Testing practice effects due to pre testing can occur, so in this present study there were two separate tests at the pre-test and at the post- test stage.

v) Selection; bias may occur because of the way the classes were selected in terms of the intervention group and comparison group. This was considered carefully and negated by the fact the classes were chosen randomly.

5.7.2 Threats to external validity

Threats to external validity on the other hand are likely to limit the extent to which generalizations can be made. According to Campbell and Stanley (1963) and Bracht and Glass (1968) these are the kind of issues that jeopardise external validity:

1) Failure to describe independent variables explicitly: this can affect future research and therefore replication is impossible. This was taken into consideration and attempts were made to be as explicit as possible.

2) Lack of representativeness of available population i.e. the sample was very specific of a certain area of West Yorkshire; however it represented a group of primary school children of mixed abilities.

3) Hawthorne effect; the fact that this was a research study was kept as low key as possible and all the interventions were treated as part of the normal school curriculum in order to eradicate this kind of effect.

4) Dependent variables must have validity in non experimental settings to which the findings have to be generalised. Published tests were used, in this study, which are commonly used in schools.

5) Sensitization /reactivity to experimental conditions i.e. pre-tests and post- tests This was not an issue as the children were accustomed to being tested at the end of the school year and viewed this as a normal part of school life. Standardised tests were similar to those normally used in order to be stress free although they were different to ensure lack of sensitisation to the tests.

6) Invalidity or unreliability of test; to counter this published standardised tests were used.

7) Ecological validity, i.e. the extent to which behaviour observed in one context, can be generalised to another. Although there were cultural and socio economic differences, the fact that the primitive reflexes which the movement programme aimed to address are the same the world over means that there is ecological validity.

5.7.3 Content validity

This ensures that the measure includes an adequate and representative set of items that would tap the research subject (Sekaran, 1992). The researcher can determine content validity through careful definition of the research topic, the items to be scaled, and the

scale to be used. This logical process is somewhat intuitive and is unique to each research designer (Emory, 1985). The question is ensures that the test is measuring what it says it is measuring. In this research published tests were used.

5.7.4 Criterion-related validity

'This is established when the measure differentiates individuals on a criterion it is expected to predict' (Cooper and Emory, 1995). This can be done by establishing concurrent validity or predictive validity. It is concerned with the relationship between a measuring instrument and the measurement outcomes. Concurrent validity is established when the scale discriminates against individuals who are known to be different; that is, they should score differently on the test. Predictive validity is the ability of the test or measure to differentiate among individuals as to a future criterion. This was taken into account as published tests were used.

5.7.5 Construct validity

This is established by relating a measuring instrument to a general theoretical framework in order to determine whether the instrument is tied to the concepts and the theoretical assumptions which the researcher is employing (Nachmias and Nachmias 1996). Since a construct is an abstract in this type of validity it is important to clarify what is meant by the construct. In this study the measurements aimed to establish whether the interventions had an effect on the children's learning and therefore it was important to look at established literature and research and see how other studies have construed this.

5.8 SUMMARY

This chapter has provided a detailed discussion of the research methodology issues and other issues that a researcher needs to deal with. The choice of methodology is the most important choice in the research design. There is no set methodology, but the researcher needs to carefully consider the most suitable method available. In theory, the choice of methods depends on the nature the of research problem. Both quantitative and qualitative research methods share the purpose of cultivating knowledge (Field and Morse, 1990), but each has its special way of reaching that knowledge. The choice

among these methods should be made with careful assessment, because they produce different kinds of data that serve different research purposes.

This chapter discussed inductive and deductive research as well as applied and basic research. There was a section on general ethical considerations as well as a more specific section on research ethics in relation to children. Various aspects of sampling were also discussed, as well as data analysis and aspects of validity and reliability with particular reference to this present research.

The following chapter goes on to present the research design used in this study, discussion of the pilot study, as well as a detailed description of the Integrated Therapy Experiment Design Model.

CHAPTER SIX: RESEARCH DESIGN

6.1 INTRODUCTION

This chapter outlines the development of the research methodology used in this study. It includes the research design and the relevant approaches adopted in order to assess the impact of sound therapy and the movement programme on children's learning and performance. To achieve its objective this quasi-experimental, exploratory study (as explained below) used quantitative methods of data collection. In education, most experiments are of a quasi-experimental design, due to the nature of educational settings. The data collection method, for this study was selected on the basis of the outcomes of the pilot study and the rationale for the choice of methods of data collection will be discussed. There will also be discussion on issues related to research design, to the pilot study and its outcomes, to reliability and validity, to sampling, the ethics of the research and finally a detailed description of the Integrated Therapy Experiment Design Model.

6.2 RESEARCH DESIGN STRATEGY

Research design is the blueprint which allows the researcher to come up with the research framework, offers solutions to possible problems and acts as guidance in various stages of the research process (Nachmias and Nachmias, 1996). According to Cohen et al., (2000) p 73 it is 'governed by the notion of fitness for purpose.'

The research design developed in this study was guided by many of the issues raised in the literature review. The main research question in this study was whether the two interventions used in this study, the sound programme (The Listening Program) and the movement programme (SIMPLE) had an effect on enhancing the learning and performance of the children. The fundamental research concern was with establishing causal connections between the independent variables and the dependent variables. The independent variables are those which have a causal impact on the dependent variables (Bryman 2001), whereas, the dependent variable is normally the one of primary interest to the researcher (Nachmias and Nachmias, 1996), or the variables that the researcher wishes to explain (Cooper and Schindler, 1998). The independent variables identified

for this research were the two interventions, movement and sound. While the dependent variable were the three tests used, the Suffolk Group Reading Test (Nfer Nelson, Suffolk County Council and Hagley 2002), the NFER Non- verbal (Nfer Nelson, Smith and Hagues 1993 and TAPS-R (Gardner 1996) Digit span test, both forward and backward digit span.

There are three primary types of research designs; the first randomized or true experimental designs, which are the strongest design for establishing a cause and effect relationship, as random assignment is used - and the groups involved are considered equivalent. Secondly, non-experimental designs which do not employ multiple measures and do not use a control group or use any random assignment in its design. Finally, quasi-experimental designs, as Cook and Campbell (1979) state which compromises some of the rigour of controlled experiment but maintains the argument and logic of experimental research. In this present study there are limitations in application due to a predetermined set up. For example in this study the children were already assigned to specific classes. Quasi–experimental designs usually have multiple measures or a control group without randomly assigning participants to group. The ability of these designs to establish a cause effect relationship depends on how equivalent the two groups were to start with. In the present study, all the children had been initially randomly selected and allocated to classes at age seven. The selection of which group would have the interventions and which groups would be the comparison group was random.

6.3 RESEARCH DESIGN

The next section will discuss in detail the research design strategy used for this research. Figures 6.1 and Figures 6.2 show this in a diagrammatical form. Figure 6.1 illustrates how the research was designed including the various stages of the process of implementation until the main outcomes. Figure 6.2 on the other hand details various aspects associated with how the design was implemented. The design aspects covered the following distinct stages:

6.3.1 Literature review

The study started with a comprehensive scrutiny of the relevant literature on school effectiveness and improvement, on movement programme interventions and sound therapy interventions on children's performance. The purpose of the literature review was to examine the results of other studies related to the current study, identify the gaps to be filled, and investigate ways of extending prior study. It was also a framework for establishing the importance of the study. The literature review was divided into three parts. The first part discusses the relevant literature related to school effectiveness and improvement (chapter 2), the second to movement interventions (chapter 3) and the third to sound interventions (chapter 4).

Stage 1 was concerned with scrutinising the wider body of literature on the role of movement in enhancing children's learning and performance and a pilot study which sought to verify the first set of hypotheses. The first set of hypotheses was concerned with the effects of the movement programme (Ansua Developmental Programme) and whether an integrated approach was required in order to raise children's performance. The pilot study was designed as a quasi experiment that involved two classes with one class being the comparison group. Quantitative data was collected and analysed (see section on pilot study). In addition to looking at the impact of the intervention the pilot study was also concerned with the feasibility of running the movement programme in the school situation as well as the response of the parents and the teachers. The pilot study also helped to inform the next stage of the study which was the main experiment.

Stage 2 involved the formulation of a new set of hypotheses to observe the effect of a new therapy based on sound (The Listening Program) and the impact of an enhanced movement programme (SIMPLE) and of an integrated approach combining the two.

Stage 3 was concerned with the development of an effective learning strategy derived from the key findings of the research, which formed the foundations of the suggested strategy that can support the positive performance of children.

The implementation of the current research design is depicted in Figure 6.1 and is discussed in the following sections:

Figure 6-1: Stages of the research design

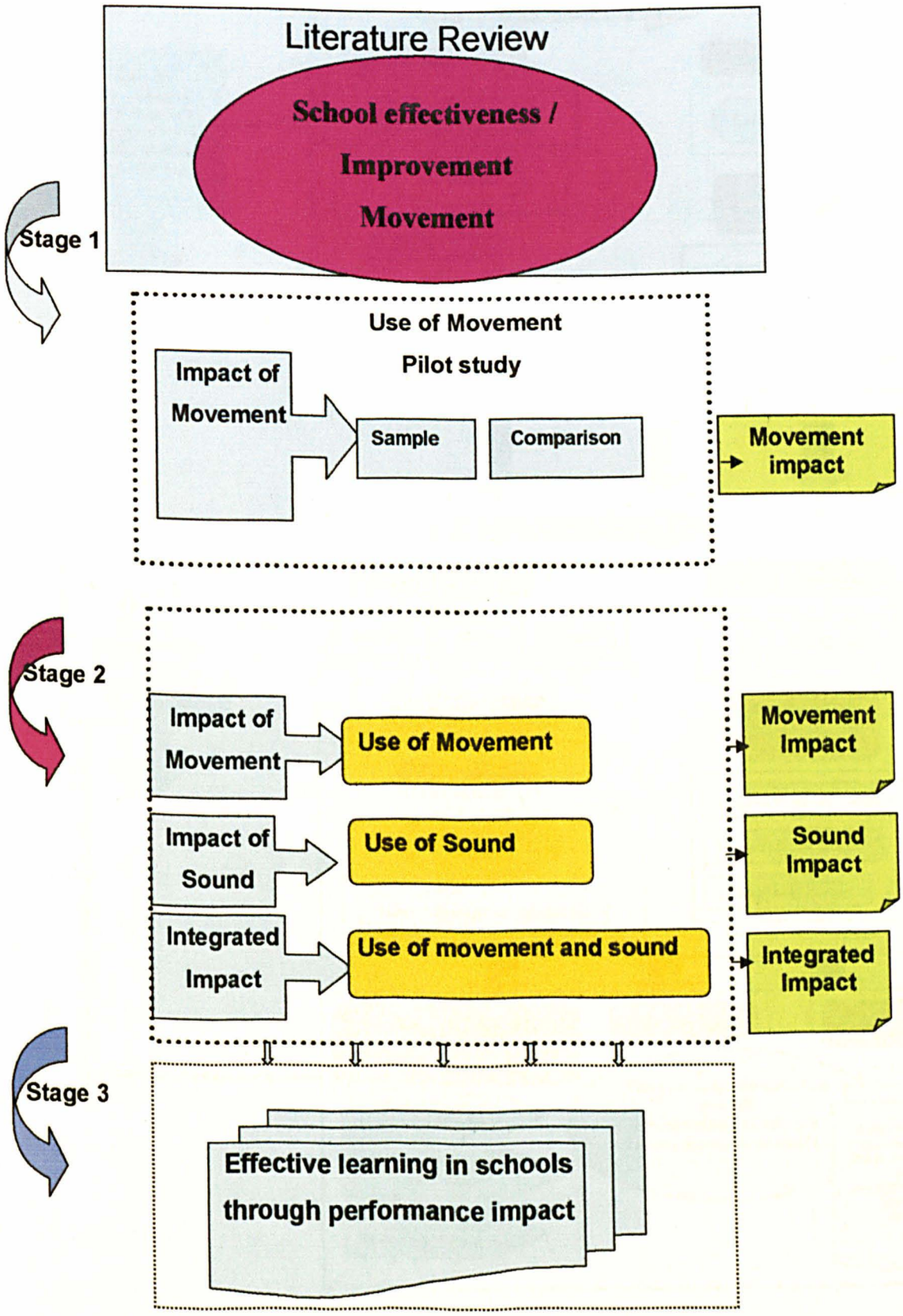
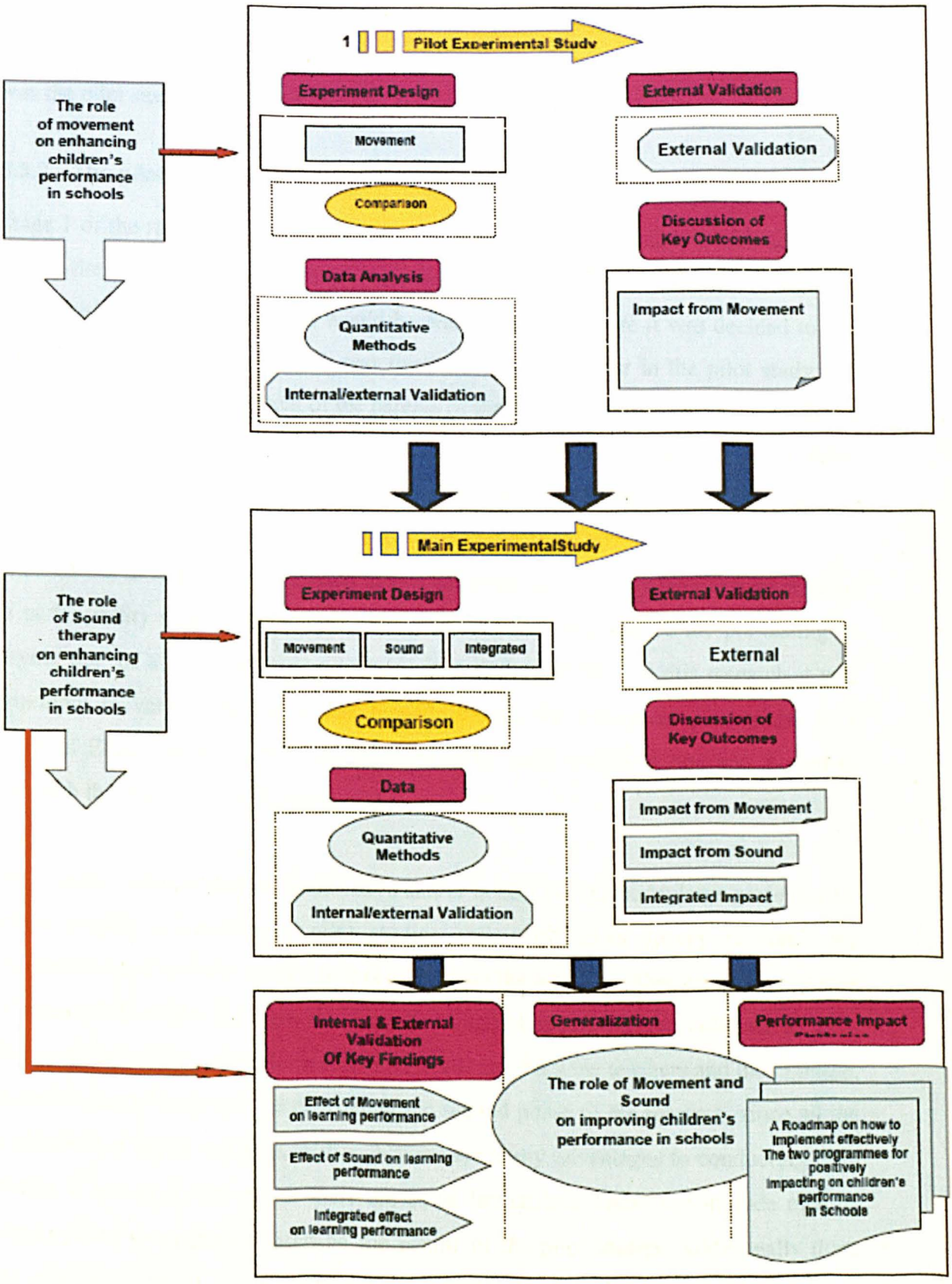


Figure 6-2: Implementation of the research design



Research design 6.1 depicts the design of the pilot study, the design of the main experimental study and the outcomes. One of the most important elements of the design was the pilot study and this will now be discussed in detail.

6.3.2 The pilot study

Stage 1 of the research design (figure 6.1) consisted of the pilot study which helped to inform the main research. In this present study, one of the aims was to find out whether the second stage of the research would be feasible and therefore it was decided to use the movement intervention which was fairly easy to administer in the pilot study and also did not require the consent of the parents or the local authority, the governors or the Director of Education. However, despite this, as a precautionary measure all of these bodies were consulted and the parents were informed of the intervention.

Pilot studies in research can be used in two different ways. Firstly they can be referred to as feasibility studies (Polit et al., 2001) or secondly they can be the pre-testing or 'trying out' of a particular research instrument (Baker, 1994). In this research it was important to verify whether it was feasible to run the movement programme as a Physical Education lesson and therefore the pilot study was a 'trying out' period to establish the feasibility of the main study.

Pilot studies can be based on quantitative and/or qualitative methods; large-scale studies might employ a number of pilot studies before the main survey is conducted (Tashakkori and Teddlie, 1998). In this pilot study the main data that was collected was of a quantitative form but there was a small amount of qualitative data collected as well. This qualitative data, in the form of written feedback from the teachers and the children, helped to support the case for continuing the second phase of the research, since all the feedback was highly positive. Although there are many advantages to conducting pilot studies it has to be noted that there are some limitations. These can include making inappropriate assumptions based on the results of the pilot studies. Additionally there can also be problems due to contamination and funding. In addition contamination can occur where the data from the pilot study is included in the main study.

Contamination is less of a problem in qualitative research, where researchers often use some or all of their pilot data as part of the main study, since qualitative data collection

is often progressive. Holloway (1997) argued that in qualitative approaches separate pilot studies are not necessary. Conversely, Frankland and Bloor (1999) argue that piloting provides the qualitative researcher with 'the focus of the study', which in turn helps the researcher to concentrate data collection on a narrow spectrum of projected analytical topics. In this study the data collected in the main study was based on the outcomes of the pilot study. In addition pilot studies can also help the confidence of the researcher in setting up and conducting the main experiment, particularly if it is conducted in 'a real setting' such as in this case.

One of the reasons for a pilot study is to assess whether there are problems with the research tool which if this was the case the data could be flawed. When an established and validated tool is used used, as in this pilot study the data may be of value. Sometimes, the pilot study sample has to be included in the main study due to numbers being too small. Here it could be argued that the pilot study sample has already been subjected to the intervention and that this would have a bearing on the outcome. The pilot study therefore constituted a different sample from the main study.

Another problem with pilot studies is if funding is not available. It can also be the case that the funding body decides to halt the research if they feel that enough evidence has been collected from the pilot study. In the case of this research, as neither the school nor the local authority was providing the funding, this was not a problem. However, due to the results of the pilot study, and the positive feedback from parents, teachers and children, the local authority agreed to grant one year's unpaid leave to the researcher to conduct the research.

According to Prescott and Soeken (1989), pilot studies are likely to be 'under underused'. Full reports of pilot studies are rare in the research literature (Lindquist 1991; Muoio et al., 1995, Van Teijlingen et al., 2001). Well conducted pilot studies can informative about the best research processes and occasionally about likely outcomes. Researchers often only write a short summary of the pilot study and the full pilot study is rarely reported, instead they may simply justify the research methods or particular research tool used. Sometimes only one element of the pilot study, for example, to the 'pre-testing' or 'pilot testing' of a questionnaire (De Vaus, 1993), is mentioned. It has to be noted that the outcomes from both successful and failed pilot studies might be very

useful to other researchers starting on projects using similar methods and instruments. This is important because in informing the full study (Mason and Zuercher, 1995). For this reason a detailed report of the pilot study is given here.

6.3.2.1 Design of the pilot study

In this present study, one of the aims was to find out whether the second stage of the research was feasible. The main method of data collection, in the pilot study, was of a crystallised form of intelligence. According to Belsky (1990) p32 crystallised intelligence can be defined as 'the extent to which a person has absorbed the content of culture.' It is the store of knowledge or information that a given society has accumulated over time. It relies on knowledge and experience or the amount of stored factual knowledge (Murphy and Davidshofer, 1994). Crystallized intelligence seems to be the amount of information obtained and the verbal skills developed over time. Together, these elements form a person's crystallized intelligence. Fluid intelligence, on the other hand is tied to biology and can be defined as our 'on-the-spot reasoning ability, a skill not basically dependant on our experience' (Belsky, 1990).

Two mixed ability classes were used to conduct the pilot. One of the classes completed the Ansua Movement Programme (Learning Connections Centre 1976) as part of their PE lesson and the other class did a normal PE lesson. Both ran for eight months twice a week for thirty minutes. The sample comprised of two Year 6 classes (for eleven year olds). The chronological ages of the children ranged from ten to eleven years. The study compared forward digit span – a measure of short-term memory; backward digit span – a measure of visual short-term memory; the Neale Analysis for reading accuracy, reading rate and reading comprehension; and Year 5 and Year 6 SATs (the national tests used to measure the progress of children in schools in England).

The movement programme was conducted twice weekly for a period of 30 minutes for eight months. This was the only time that the programme could be fitted in to the Year 6 timetable. (Studies in Australia had shown good improvement if the programme was done five days per week. Two days a week was the absolute minimum.) The class was divided into five groups of six. The first three minutes of each session were spent as a warm-up, with activities designed to extend speed of movement, loosen and mobilise joints and generally strengthen the body and improve co-ordination. The children

worked in five groups for each session, for three minutes at each activity. The main strength of the pilot study was that the samples were matched on the basis of the same year and same age and the same group of teachers teaching the children. The main drawbacks of the study were the time restrictions and lack of hall space

6.3.2.2 Tests used in the pilot study

There were three different types of tests used in the pilot study. These are discussed briefly below.

i) The Neale Analysis of Reading Ability

The Neale analysis of reading ability consists of a set of graded passages for testing reading rate, accuracy and comprehension of oral reading, as well as a diagnostic test. The test can be used with children from age six to twelve years. (The norms cover the ages from six to 12.11).It has been used in a substantial body of research to measure reading performance.

ii) The TAPS-R (Gardner 1996) digit span test

The forward digit span involves recall of a sequence of numbers given orally forwards and the backward digit span involves recall in the reverse order. Reynolds (1997) suggests the clinical interpretation of performance on the Digit Span subtest be divided based on performance on the digits forward and digits backward tasks due to the different abilities measured by the separate tasks. According to Steele et al., (1997) right hemisphere dysfunction reduces backward digits, while left hemisphere dysfunction reduces forward digits performance. Both hemispheres seem to have a role in digit repetition with different neuropsychological functions associated with forward and backward digit. (Searls, 1975). In this present study both forms of the digit span tests were used. Two processes are involved in digit span: the identification of the items, and the retention of order information. Children who are slow in identification have a shorter memory span.

The span or number of digits that can be accurately recalled varies with age, from three forwards and zero backwards for a typical four year old to six forwards and four backwards for an average adult. Atkinson and Schifrin (1968) propose that it is seven items of information (give or take two). Deficit digit span is when the subject recalls

fewer digits than is average for his or her age (Horn, 1985; Reynolds and Kaufman, 1985). Studies have also shown that 50 per cent of the population is functioning with digit span deficit.

There is support in the literature for the use of the digit span test as a measure for visual and auditory short-term memory (Vance and Singer, 1979). It has been found to be, in part, a reliable tool for assessing short-term memory with younger children (Gathercole and Adam, 1993). Also in part, the digit span has been found to be a reliable predictor for reading and maths achievement (Arcia et al., 1991). Searls (1995) stated that high scores (on digit span tests) may indicate good rote memory and immediate recall, with ability to attend well in a testing situation.

The ability to learn is reflected in how well a child receives processes and utilises sequential pieces of information. According to Doman (1986) and Jacquith (1996) a child's ability to do this constitutes short-term memory. Another possibility is that the short-term memory does not have a small storage capacity, but it is the processing capacity that is limiting (Gross, 1990). Digit spans relating to specific problems and achievement have also been noted. The ability to repeat a digit backward is not only dependent on attention and concentration, general cognitive, and short-term memory functioning, but also requires verbal and visual (nonverbal visualization) mediation. Improvement demonstrated in recall of reverse digit span tasks also shows progress in areas of organization (Baddeley, 1990)

In a study by Rumsey and Hamburger (1990), a two-digit difference was found between a 'normal" group of students and a dyslexic group, with the latter having the lower average. In addition a link has been found between poor readers and low digit spans (Spafford, 1989; Koppitz, 1975). Further a low digit span has been correlated with specific spelling disability (Newman et al., 1993).

Powell and Hiatt (1996) and Searls (1975) suggested that low scores indicate either high anxiety or hearing deficits such as disability in auditory sequencing. This is significant since both the interventions in this present study are aimed at raising the digit span of the children. Although, Spafford (1989) suggested that speed and accuracy of decoding

contribute to reading speed and comprehension, Standing and Curtis (1989) found no correlation between speed of encoding and memory span.

iii) Standard Achievement Tests (SATs)

Standard Achievement Tests for eleven year olds (Year 6) are set by the British Government and provide a summative assessment of English, maths and science. They are the 'performance gold standard' for schools and therefore inclusion of these in the data provided valuable indicator for educational professionals. All eleven-year-old children sit the Year 6 SATs in May of each year. Results of the Year 5 SATs (held at the discretion of individual schools) were compared to the year 6 SATs (mandatory).

6.3.2.3 Results of the pilot study

The results of the pilot study will be discussed below starting with the two digit span tests as well as the reading the three reading tests (reading accuracy, comprehension and rate). This will be followed by the SATs results.

Table 6-1: All tests

	Forward digit span	Backward digit span	Neale Reading accuracy	Neale Reading comprehension	Neale Reading rate
Comparison class	p= 0.017	p= 0.029	p= 0.001	p= 0.542	p=0.684
Movement class	P= 0.001	p=0.001	p= 0.007	p=0.169	p=0.005

a) Forward Digit Span

The forward digit span showed a significant difference in both groups; in the comparison class p = .017 and in the movement intervention class p = .001 (Table 6.1) which indicated an increase in short term memory. However, digit span increase is also dependent on neurological maturation and so there may have been some natural increase, as illustrated in the results of the comparison class. This increase in digit span should have been reflected in the reading age. Searls (1975) and Spafford (1985) as well as Koppitz (1975) have all linked low digit span scores to poor reading. The reason that this was not reflected in the scores of this study could be that the post- tests were

completed too quickly after the increase, without time for assimilation and remediation. The feedback from the movement intervention class teacher:

> 'I have seen a general improvement in attention and behaviour within my class. The perennially (in its horticultural sense of "year upon year") troublesome group of boys now appears to be less subject to both formal and informal disciplinary action and appears to have more concentration and willingness to work. Sceptics would ascribe this to simple maturity but there have been no signs of this in previous years'.

The aim of the movement programme was to try to enhance the potential of learning and raise the performance of the children. The results showed an increase in memory, although this was not reflected in crystallised intelligence, since crystallised intelligence relies on knowledge and experience or the amount of stored factual knowledge (Murphy and Davidshofer 1994). It seems more probable that the transfer would be seen after the intervention has finished, and time has elapsed.

b) Backward Digit Span

The backward digit spans (Table 6.1) were similar to those of the forward digit span and there was significant difference in both the comparison group $p = .029$ and the movement group $p < 0.001$. Pheloung (1997) found that auditory short-term memory improved significantly after children took part in a movement programme. Overall, the results of the forward and backward digit span indicated that the movement programme improved the children's performance on a standardised test of memory and that such interventions may raise children's learning, but also that maturation increased the scores, as shown in the results of the comparison class.

c) The Neale Analysis of Reading

The Neale Analysis of Reading rate measures the number of words read per minute. In June 2002 there were eight children at and above 90 for the comparison group, while for the movement group there were seven children. It therefore seems that overall the progress made by the top scoring children was at a par in both groups at the end of the intervention and thereby it leads to the assumption that the results reflected raised levels of the other children. The comparison class did not show a significant difference ($p = .684$) whilst the movement class showed a significant difference ($p = .005$)

Whilst reading is an extremely complex mental process requiring the integrated function of many parts of the brain simultaneously, the goal of reading is comprehension. It requires a number of perceptual and cognitive functions. In fact reading is such a demanding process that skilled performance – extracting meaning from words while moving with fluidity down the printed page – requires the highly automated application of many separate skills. If one or more of these skills are insufficiently developed, they will compete for attentional resources in our limited working memories, and performance on the composite task will decline (McLoughlin and Lewis, 1994). The literacy strategy is the area of the curriculum that is addressing the needs of children as far as reading is concerned. Therefore, if nothing else, the literacy strategy should in theory improve reading. However neither groups showed significant difference for comprehension. Results for the comparison group were (p=.542) and for the movement group (p=.169). However as far as accuracy is concerned there was significant improvement for both groups the comparison class (p=.001) and the movement intervention class (p=.007). Overall there was not a great deal of difference between the two classes except in the area of reading rate.

d) Standard Achievement Tests (SATs)

The SATs results are shown in Table 6.2 below. Level 5 was the highest level, 4 after that the scores descended from 3 to 2 to 1. Children at age 11 are expected to score level 4.

Table 6-2: SATs results

Comparison class	Year 5 average level 4c	Year 6 average level 4
Movement class	Year 5 average level 3a/ 2b	Year 6 average level 4

As can be seen from the above results the movement intervention group started off at the lowest average and the control group had the highest average. However at the post - test, the average for both groups was four .The SATs results showed that the movement

intervention class improved more then the comparison class, since they started at a lower base line. The overall average for the movement group was 2b, 3a; and for the comparison group, 4c for the pre-test. For the post- test the overall average was 4 for both groups. Since the group with the intervention started at a lower base line and since the average for both groups was 4, the movement group made the greatest gain.

6.3.2.4 General issues related to the pilot study

The pilot study in this research was an important learning process about the best way of progressing with the research, about the most effective ways of testing the children and about managing the experiment. The findings of the results from the pilot study, helped to inform the setting up of the rest of the research. Some of the learning from the pilot study was that there was advance warning about where there might be difficulties in the second phase of the research , where research protocols may not be followed, and also whether proposed methods of data collecting where useful or not. Additionally, due to the findings of the pilot study it was decided to change aspects of the data collection since the method used in the pilot study did not take sufficiently into account cultural differences and the fact that most of the children were second language learners.

Due to the knowledge accumulated from the pilot study the non verbal reasoning test was added to the data collection for the main experiment as this was designed to be more of a measure of fluid intelligence. According to Cattell-Horn Fluid-Crystallized (Gf-Gc) theory, there are two related but distinct components of intelligence, fluid and crystallised intelligence. Fluid Intelligence is ability to see relationships, as in analogies and letter and number series. This is more primary reasoning ability to solve new problems. This kind of intelligence is influenced by neurological development and is free from the influences of education and culture. Crystallized Intelligence is about acquired knowledge and skills and therefore more factual knowledge i.e. the ability to use information that has been learned.

The results of the pilot study by the researcher and other teachers that the Neale's Analysis test was influenced by culture and education; in contrast the Nfer Non –Verbal Test was not culturally biased and was not affected by the fact that the children tested were second language learners and also was more of a measure of fluid intelligence. In

changing the tests a better profile of the children would emerge and give a better insight into the changes that occurred.

This highlighted the benefit of a pilot study being conducted prior to the main study. Another aspect that was changed was that the Ansua movement programme (used in this pilot study) was replaced with a new movement programme which was developed after the pilot study. This was based on the original programme but with further additions which made it a more complete and a more appropriate programme for schools.

6.4 MAIN EXPERIMENT STUDY

The main study was concerned with looking at the role of movement individually as well as the role of sound therapy individually and looking at an integrated approach i.e. Sound therapy and movement together in enhancing children's learning. Data collection was of a quantitative nature although two aspects of the data collection were changed due to the outcomes and learning from the pilot study.

The (TAPS-R) test of Auditory –Perception Skills, auditory number memory was still used in both the pilot study and the main study. However, instead of the Neale Analysis Reading test which measured rate, comprehension and accuracy two different tests were used. One was the Suffolk Reading Test which measured the improvement in reading added to this was the Nfer Non –verbal reasoning test. The two new tests gave a better profile, and all classes were still able to be tested in a day.

Since an emerging body of new literature seems to suggest that sound therapy is effective for enhancing auditory processing and thereby improving children's performance (Jeyes 2001 and Treharne 2004, amongst others) the results of the analysis of the pilot (using the movement programme) were promising in that they showed a boost in the performance of the children. Following an adjustment to the movement programme and since the movement programme showed promising results, this intervention was kept as part of the main experiment and design. The movement programme was adjusted and redesigned to fit in with the national curriculum standards and the format for current Physical Education lessons in primary schools in England.

All elements of the original movement programme were retained based on the pilot study and further findings during the course of the pilot study, the movement programme was enhanced. The original programme was developed for schools in Australia (at the time of the pilot study there was no specific programme devised in England to be used in a classroom situation which covered both the therapy intervention required and the demands of the national curriculum) which omitted certain elements such as the use of beams and ropes.

The research was designed so that four, parallel, classes took part. Class A had no interventions (completed normal PE and music lessons), class B implemented the movement programme only (as part of PE lessons) and did normal music lessons, class C implemented The Listening Program only (as part of music lesson) and did normal PE lessons , class D implemented the integrated approach i.e. the movement programme and The Listening Program .

The data collected was in the form of quantitative data since it had the advantage of 'statistical and numerical measurements' (Gordon and Langmaud, 1988) and this form is easily understood and accepted in education. Since this was exploratory research a quantitative research approach allowed the possibility of the research being replicated in different context and circumstances and would facilitate the comparison of results easily. Nettleton and Taylor (1990) emphasise the goal of quantitative research as providing accurate measurements for social actions by explaining the causal relationships related to specific events measuring events by objective criteria.

6.4.1 The main experiment (intervention delivery)

The research was carried out in West Yorkshire, England. The school was one of the largest junior schools in England at the time and had five parallel classes in each year group. The classes were mixed ability classes taught by different teachers according to the sets they were in and in the afternoon taught by the class teacher. This allowed for an exceptional situation for conducting experimental research, since the children were not heavily influenced by one teacher as is the case in most Junior or Primary schools. This was useful for the experiment as it removed the variable quality of the main teacher. Much school research when each class has the same teacher is affected by this to some degree.

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According to Gersten, Baker et al., (2000) one of the least glamorous and most neglected aspects of research is describing and assessing the nature of the instruction in the comparison group. Yet, to understand what an obtained effect means, one must understand what happened in the comparison classrooms. In this study the conditions were kept as similar as possible and both groups thought that they were carrying out a normal PE lesson. Since the movement programme was based on the National Curriculum the lessons were similar except for the therapy part of the intervention in the experimental class lesson. However, the learning objective in both the groups was for the children to learn the necessary skills required as set out by the national curriculum requirements for gymnastics, games and athletics by the end of the year.

In relation to the sound therapy the comparison group completed their normal music lessons as set in the school timetable. The sound therapy was in the form of listening to the Listening Program (TLP) through a set of headphones. The programme contained music such as Mozart and Beethoven, with higher frequencies added and the music was gated and filtered. TLP was designed to help balance and restore ability to listen to and process sounds across the full auditory spectrum, from 20 to 20,000 Hz.

6.4.2 Data collection

The aim of the data collection phase is to collect data in a methodological manner to ensure the validity of the fieldwork (Sinclair, 1994). For some studies, it may be appropriate to collect data at only pre- and post-test. In many cases, however, researchers consider collecting data at multiple points across the course of the study, including follow-up measures. Multiple data points allow researchers to apply more complex statistical procedures such as Hierarchical Linear Modelling or Growth Curve Analyses. This data can provide researchers with a more nuanced, complex picture of student growth as well as information about immediate and long-term intervention effects. These analyses allow for an examination of individual student trajectories as well as overall group effects. In this study it was considered that it was appropriate, due to time constraints, teachers' wishes and funding constraints to collect the data at the start of the study and at the conclusion of the study.

6.4.2.1 Credibility of research findings

This section discusses the validity and reliability of the tests used in this study. According to Linn (1993), when a test is used in collecting data it must ensure that it is appropriate. Wolf (1994) suggests four factors that might affect reliability: the range of the group that is being tested, the group's level of proficiency, the length of the measures (the longer the test the greater the chance of errors) and the way in which reliability is calculated. Feldt and Brennan (1993) suggest four types of threats to reliability: individual, situational factors, test marker factors and instrument variables. In this research all of these were taken into account.

Two different types of tests can be used in research, parametric and non parametric. In this study parametric tests were used. Parametric tests are tests published as standardised tests and were commercially available. They have already been piloted on a wide representative sample and published as standardised tests that can compare with the norm and are valid and reliable. Non parametric tests are usually individually designed tests. Parametric tests are normally norm referenced in that they compare to other children of the same age. They can also be criteria referenced tests; in that a set of criteria has to be fulfilled or domain referenced so there can be specific and detailed specification of content and details to be examined.

Commercially produced tests were used in this study because they where objective, piloted, refined and standardised so that reliability and validity were already ascertained. Multiple measures were used to ensure an appropriate balance between measures. The issue of the credibility of research findings underpins the above-mentioned approaches and methods, about the various design components.

These reliable and valid tests were used in this study.

1) Suffolk Reading scale 2 test (nferNelson).

2) Non Verbal –Reasoning test (nferNelson).

3) The digit span subtest of TAPS-R, (Test of Auditory –perceptual skills).

4) The SCAN C test for Auditory Processing Disorders in Children- Revised (The Psychological Corporation 2000). This was used only as a screening tool to ensure that the children did not have hearing problems

Each of the tests used in this study will now be discussed individually.

1 Suffolk Reading scale 2 test (nferNelson).

The Suffolk Reading scale 2 test (Suffolk County Council and Hagley, 2002) is a school based test for reading ability. The results estimate the reading ability of individuals to nationally representative standards. Each level has two parallel forms A and B which allows pupils to be seated next to each other without being able to copy and also to be given a different form for the post test to minimise practice effects.

Content validity of the test was established by examining the content of the tests with and comparing to the national curriculum documents produced in England and Wales about their pupils National Curriculum teacher assessment (TA) levels in English (reading). There was a high correlation between the raw scores and the TA levels which provided a measure of concurrent validity and indicated that the test was measuring reading ability. (See appendix C). Reliability figures were high and were derived using the Cronbach's alpha formula for each level and form. These are presented in table 2 (appendix C). The internal consistency was further examined within each year group and these figures are shown in Table 3 (Appendix C). Parallel form reliability results showed correlations between form A and B showed that there was parallel form reliability

2 Non -Verbal Reasoning test (nferNelson)

The Non–Verbal Reasoning test (Smith and Hagues, 1993) measures reasoning processes which are widely accepted as being fundamental to understanding and assimilating new information and ideas. It assesses the overall reasoning of the children. Designs are used rather than words which allow these processes to be independently assessed of language skills- making it a good tool for evaluating children for whom English is a second language (as was the case with most children in this school) as well as those who struggle to think verbally. The designs used are not culturally specific and

the test involves very little mathematical knowledge, therefore only reasoning skills are assessed. Furthermore, the test uses designs in which the need to create, maintain and manipulate precise mental images of shapes, known as spatial visualation, is at a very low level.

Concurrent validity was assessed by comparing scores from Non–Verbal Reasoning 10 and 11 with scores from older Non–Verbal Reasoning test. A sample 318 pupils took these two tests with half taking the old tests and half taking the new tests. The correlation between the raw scores was 0.18 and between the standardised score was 0.81 (table 4 appendix C). The correlations were high.

3 The TAPS-R (Test of Auditory- Perceptual Skills)

The TAPS-R digit span test used in this present research was developed so that it was not biased according to ethnicity, gender, education, language and culture. The reliability of the TAPS-R was established by examining the internal consistency of the subtests and the test as a whole. Reliability was calculated using the Kuder-Richardson formula 21 values. Although this provides a lower bound on the reliability the reliability was in the accepted range.

Content validity was built into the instrument through design specifications Items that could be regionally, ethnically culturally or gender biased was eliminated. The validity of the TAPS-R was examined by determining its relationship to chronological age and to other tests (Gardener, 1996).

4 The SCAN C test for Auditory Processing Disorders in Children- Revised

This was used as a screening test and is an individually administered test for children aged 5 years to 11 years and 11months. It is an imitative test. It attempts to assess the 'primary reception' (or perception) stage of auditory processing which is pre-cognitive (Butler 1981) and has been designed to be administered in schools. There are four subtests but in this study, due to time limitations; only Subset 3, competing words was used. This is a dichotic listening test in which different words are presented simultaneously in each ear. This subtest assesses a child's ability to understand competing speech (Binaural separation). The test is used to assess function of neurological pathways of the auditory system. Poor overall performance may indicate a

developmental delay in maturation, underlying neurological disorganisation or damage to auditory pathways. Abnormalities shown by dichotic word tests results are related to a wide range of specific difficulties, including Central Auditory Processing Disorders (CAPD), language disabilities, and learning disabilities and reading disorders (Keith 1984; Musiek and Pinheiro, 1985). The competing word test reflects the development of the auditory system, auditory maturation, hemisphere specialization and short term memory.

The reliability of the SCAN C (Keith, 1986) test has been estimated using internal consistency and test retest reliability coefficients. In addition, the standard errors of measurement were examined. Internal consistency was calculated using Cronbach's Alpha (Cronbach 1951). The reliability of the test has also been evaluated by retesting a sample of children. The reliability coefficients were calculated using the Pearson correlation coefficients between the test and the retest scores and the mean differences. The stability coefficients were calculated using the Pearson Correlation Coefficients between the test and the retest scores (Guilford and Fruchter, 1978). These correlations were corrected for variability differences between the sample and the population. SCAN C subtest test retest reliabilities ranged (corrected r) from .67 to .68 for the 8 to 11year old children.

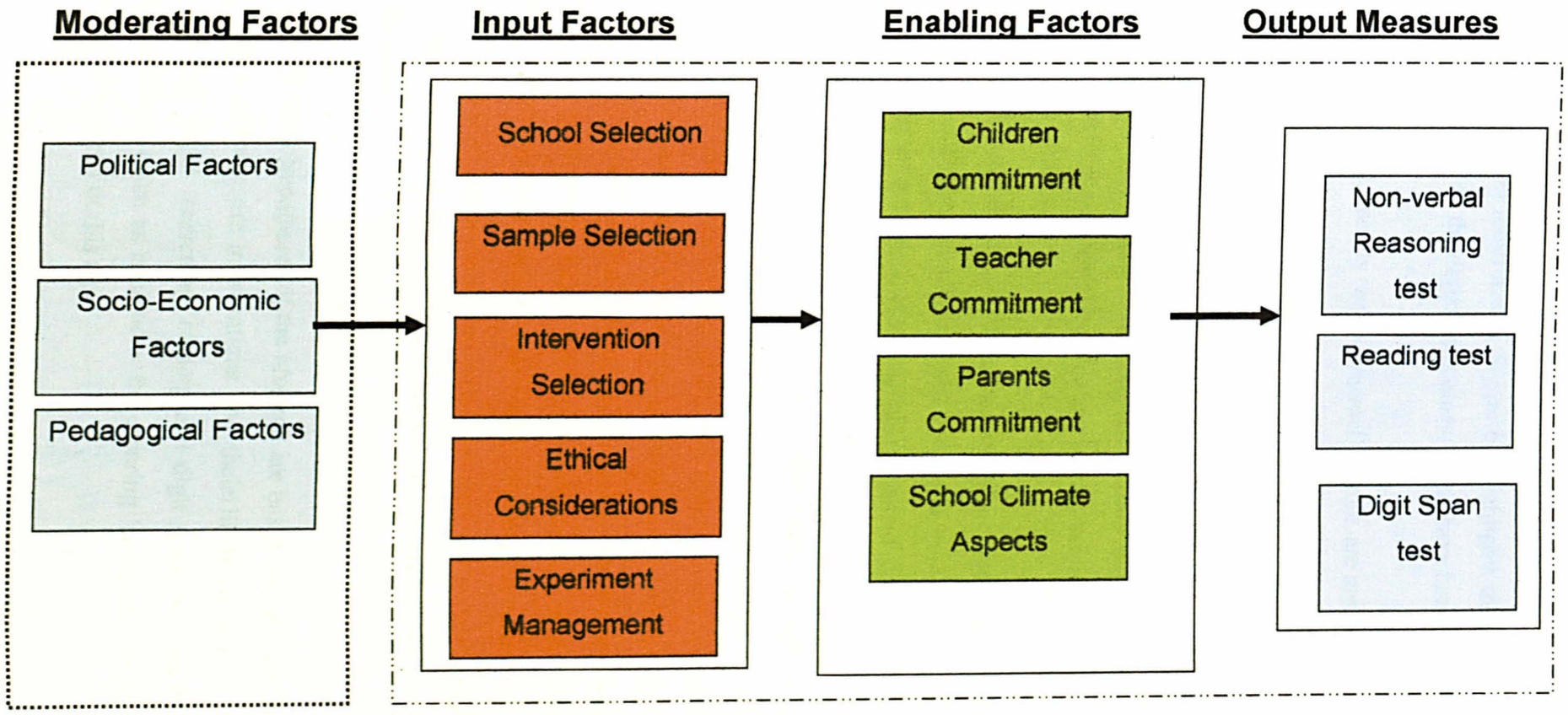
The content validity was established by determining that the test contains items that sample performance essential to or representative of, the subtest for which interpretations were to be made. The subset was constructed to assess key skills related to auditory processing.

The criterion validity was established by demonstrating the extent to which scores were in agreement with concurrent validity. The concurrent validity of SCAN C has been evaluated by comparing the scores obtained on SCAN C with the scores obtained on the original. Construct validity has been established by comparing the SCAN C results of individuals with normal auditory processing abilities and those clinicians have identified as having impaired auditory processing abilities (Keith, 1986).

6.5 INTEGRATED THERAPY EXPERIMENT DESIGN MODEL

The process for designing the current research study was based on a certain logic which was designed to yield to the best outcomes and to ensure the integrity of the experimental work thus helping ensure aspects of reliability and replicability in different contexts. The pilot study provided useful insights into how critical several aspects are and how essential their consideration was in ensuring that the experiments were conducted smoothly with effective outcomes.

Figure 6-3: Research Construct Model



Condition Statement 1

The study of causal relationships between experiments of 'subject groups' and the impact on their behaviour must be based on considering all of the environmental factors that may constrain or support the design and implementation of such experimental studies.

Condition Statement 2

The study of causal relationships between specific variables in the context of experimental research which involves 'subject groups' must take into consideration other input factors that can support the study of such causal relationships.

Condition Statement 3

The relationship between dependent and independent variables and the causal links that may exist between them in the context of 'subject groups' and the impact on their behaviour has to take into account all of the enabling factors that can affect directly the results of such experiments.

Condition Statement 4

Determination of the causal relationships between dependent and independent variables in the context of experimental research that involves 'subject groups' must be based on the ability to directly influence reliability and validity aspects and thus to guarantee the consistency of outcomes and the replicability aspects. In this context, the measures that are under consideration have to be 'controllable ones' which can be isolated from 'outcome measures' that we can refer to as 'lagging measures' or consequential measures.

Condition Statement 5

Experimental research design based on studying the causal relationships between 'subject groups' and the impact on their behaviours must be based on the development of robust research construct models which depict a clearly defined logic, highlighting inter-connectivity between sets of factors and variables and demonstrating a sound approach that can be tested and relied upon for replicating future studies.

In the following section these factors will be discussed in more detail.

6.6 RESEARCH CONSTRUCT MODEL

In the next section the research construct model will be discussed in detail. Firstly the discussion will be related to moderating factors i.e. political factors, socio-economic factors and pedagogical factors. Next input factors will be discussed i.e. school selection, sample selection, therapy selection, ethical consideration and experimental management. In addition, enabling factors will be discussed i.e. children commitment, teachers commitment, parents commitment, longitudinal considerations and school climate aspects. Finally output measures will be discussed i.e. non verbal reasoning test, reading test and digit span test. All of these are shown in figure 6.3.

6.6.1 Political factors

In theory the government is keen to support new and innovative initiatives as in their statement, for example, in the Education White Paper, 'Schools: achieving success' (September 2001) chapter 5;

> '...we want to be able to encourage and respond to innovative approaches to teaching and learning and school management from across the school system. To make sure we can do this, we intend to establish a schools innovation unit with the task of initiating and supporting new ways for schools to do their jobs more effectively.'

The reality of the situation is, however, somewhat different, in that there are many pressures and constraints on the teachers, the schools and the Educational Authorities. An example of this is that schools have to conform to the Ofsted (Inspectorate for children and learners in England) inspection and target setting, both by the local authority and the school. The Department of Education agrees Literacy and Numeracy targets for each LEA and the local education authorities are keen to ensure that individual targets collectively add up to the targets set for the LEA overall. Hence, each school is under pressure to comply and achieve the targets required. Schools and LEAs are sent by the DfEE, OCA and Ofsted national pupil performance information. This data includes National Curriculum assessment and public examination results, comparative benchmarks and value added analyses. The schools have to comply with external standards which mean they are constrained.

In turn, this puts pressure on the teachers to conform to 'the tried and tested' and to stick to teaching the requirements of the National Curriculum. The curriculum is heavily loaded so that time is limited. This does not lead to a climate for innovation or experimentation. An example of this is that since 1997 school governing bodies have been responsible for setting and publishing targets by 31 December each year, for the achievement of pupils at the end of Key Stage 2 and Key Stage 4 in the following school year. In addition schools have been required to set statutory targets at Key Stage 2 based on the same measures as the National Literacy and Numeracy targets for previous year i.e. the percentage of pupils achieving level 4 or above in English and Mathematics at the end of Key Stage 2. This reflected the priority attached to raising standards in Literacy and Numeracy, and achieving the national targets.

In this study, the initial agreement was for three days to be allocated to the interventions but in reality only two days were actually allocated. This was because the morning sessions were taken up by Literacy and Numeracy and this meant that that the hall was only available for the afternoon sessions. Since the rest of the classes in the school needed to be timetabled for the hall, this caused limitations for the study. In addition, most of the morning was taken up by Literacy and Numeracy and all other subjects had to be fitted in, teachers felt very reluctant to use any of the afternoon time for other initiatives.

It has to be acknowledged that that when research is conducted in real life settings all sorts of other priorities and issues have to be taken into account in any school there would have been other issues which would have to constrained the research . It is impossible to find real life setting where all the elements are ideal for research and if researches went around looking for an ideal situation then it is highly unlikely that much research would take place. Although the findings of the pilot study suggested that three days was required and this was the initial agreement for the main study, due to a change of heads and of the differing priorities of the new head meant that the study was compromised and took place over two days per week rather than to abandon it altogether.

6.6.2 Socio-economic factors

At the time of the study there were 529 boys and girls on roll and the majority of pupils came from the local area. The attainment on entry to the school is well below average. Although the school was situated on an exposed site, vandalism was low and the local community respected the school. Employment in the area was low. The number of pupils who were eligible for free school meals was 32 per cent although this did not accurately reflect the level of social disadvantage in the area. The combined percentage of free school meals and clothing grant of 65 per cent was a more accurate indicator.

The number of pupils from minority ethnic groups and the number who spoke English as an additional language were very high at 84 per cent and 83 per cent respectively. The percentage of pupils who had special educational needs, 16 per cent, was below the national average, but the 4 per cent who had statements of special educational needs was above average. The proportion of children with learning difficulties and/or disabilities was broadly average. Most difficulties were related to speech and communication problems. The 'Townsend score' which is most commonly used to construct a deprivation score is based on four census variables: unemployment, overcrowding, lack of car and non-owner occupation, identified the ward, where the school was based, with a score of 4.52. A score, higher than 3.00, is considered to denote an area of high deprivation. The number of children claiming free school meals was above average.

Pupils, socio-economic backgrounds are of importance since it is maintained that pupil attitudes to education are derived from pupils' socio-cultural backgrounds and that pupil attitudes predispose pupils to learning. A Canadian study of thirty one participating countries found that it was, students from high socio-economic backgrounds performed better than students from low socio-economic backgrounds (OECD Study 2000). It seems that pupils interpret both what and how they learn through the medium of the culture to which they belong. It is argued that pupil understanding of such educational values such as authority and educational goals and how to achieve them are related to their culture and have an effect on pupil motivation. This suggests that cultural values are more critical for learning than pedagogical styles and that underlying educational values give meaning to styles of pedagogy.

In terms of this research, the background of the children had to be taken into account since it was important that all the children came from similar groups if results were to be comparable.

6.6.3 Pedagogical factors

As discussed earlier, constraints are put upon the teachers by political factors and by the government and the local education authority. The National Literacy and Numeracy strategies have a huge influence on teachers', schools and Local Education Authorities and govern how and what children are taught. There is a central curriculum that teachers have to adhere to and time is of the utmost importance. The teachers are under pressure to raise standards. This was seen in the introduction of the Literacy and Numeracy strategies which reflect an increasingly centralist direction of classroom pedagogy.

The politics of pedagogy is, therefore, about the use of power in decision-making about teaching and, by implication, learning. It seems that the politics of classroom pedagogy in England has been shaped by the politics of the State since 1988. This, of course, has an implication for the effectiveness of some important pedagogical practices and teachers' professional confidence. There has been much centralised power which has generated a pedagogy in both teacher training and in schools, which seems to be damping creativity, diversity and innovation. It is also leading to convergence of training methods, for example, in the literacy hour training and to increased levels of rigid and prescribed teaching in classrooms. It is also leading to constraints and stresses on the teacher's time and to teachers sticking to 'the tried and tested', rather then innovation. This study was affected by the limited time allowed by the teachers and the head teacher to the experiment. One of the initial plans was to conduct the bilateral sequences aspect of the movement programme, every morning, in the classroom for 10 minutes a day. In all, the intervention had to be pared down in order for it to continue.

The political, socio-economic and the pedagogical factors were all moderating factors which were not under the direct control of the researcher but which could affect the process of conducing the experiment and its likely outcomes.

6.6.4 Input factors

There was however a little more control in terms of the study of the input factors since they can also be termed as supporting factors.

6.6.5 School selection

The selection of the school is important since this also affects the selection of the sample. The way that the school was set up and the size of the school lent itself extremely well to research. Firstly because there were five parallel class all of mixed ability children and secondly because the children came from a very similar socio-economic background and thirdly because the researcher was already teaching at the school and was familiar with the set up and the staff.

The school population included children whose families originated in the Indian sub-continent – from Gujerat, India, and from the Punjab. With few exceptions, the children's family and social lives were conducted in Punjabi, Gujerati or Urdu, while their developing bilingualism, their experience and use of English, were supported mainly through school provision. Language development surveys showed that few children achieved Stage 4 competence in English during their time at Junior school and many achieved only Stage 2. Access to the curriculum and educational achievement potential was restricted by lack of fluency in, or comprehension of, English.

Parents were interested in education but often had low expectations of their children and seemed to have little confidence in their own ability to help. The mainly Muslim children all went to mosque in the evening from 5.00pm - 7.30pm and completed mosque homework and revision until 9.00pm which left little time for play. There was no evidence that boys performed better than girls. Families suffered from poverty, unemployment and the attendant problems, including poor health and overcrowded housing. Many of the English children, who were a minority in the school, came from disadvantaged backgrounds.

All Year 3 pupils were assessed on entry to school and were placed into ability sets for Literacy and Numeracy only. There were five ability sets in each year group. The children were then 'setted' and worked in English and Maths sets in the morning and reverted to the classroom situation in the afternoon. In the morning, the children were

taught by different teachers according to the sets that they were in and the afternoon they were taught by their class teacher. The classes were mixed ability and care was taken to ensure that this was the case.

6.6.6 Sample selection

Convenience sampling was used in this study and this is commonly used in exploratory research to generate hypotheses (Zikmund 1994). However, this type of sampling is rarely generalisable, because more important elements are not available or included (Schutt1996). It was essential and prudent to try to increase the probability that participants were comparable across conditions.

The optimal method for assigning participants to study conditions is through random assignment, although in some situations as in schools, this is impossible. The design is better with random assignment of participants and intervention providers. In working with schools procedures do not allow for random assignment of children but will allow random assignment of classrooms, as in this study. Obviously this situation is preferable to no random assignment. However, this method of random assignment has implications on design and analyses.

6.6.7 Intervention selection

The rationale for the proposed intervention, sound therapy, was based, in part, on facts and concepts presented in the review of the literature. Ideally, if the intervention is applied to new participants, settings, or context, there should be clear links based on argument and/or research for this new use. The three main innovative interventions that private institutions and private therapists have been using as an alternative and innovative ways to help children raise their performance have been, movement programmes, sound therapy and nutrition. Movement programmes and sound therapies have been used individually for some time by private therapists. The literature review both for sound therapy and movement, in chapters 3 and 4, highlighted some of the studies conducted in this area.

The link between nutrition and cognition has been recognised for sometime, for example there has been controlled research to verify this link. According to the Scientific American, (February 1996) nutrition can have an effect on mental

achievement that can last a lifetime. Ten studies which were carried out on the topic as to whether vitamin-mineral supplementation will increase intelligence scores showed that seven had reported that taking supplements was associated with improved performance on intelligence tests, or measures of attention, for at least some children (Benton and Cook, 1988; Schoenthaler et al, 1991; Nelson et al., 1990; Crombie et al., 1990; Benton and Buts, 1990; Southon et al., 1994; Kerlmova and Aleskerova 1990; Nidich et al., 1993, Sands and Shama, 1993; Benton and Cook, 1991). A trial looking at the effect of essential fatty acids and learning conditions were completed By Portwood (2002). This trial involved more than 100 children at 12 primary schools in the county. The trial looked at dyspraxia and motor skills, but also assessed for dyslexia and Attention Deficit Disorder. More than 12,000 assessments were undertaken in the course of this full double-blind, randomised, placebo-controlled trial. This study showed that there were positive effects from taking the supplements. There have been other numerous trials and studies to support these kinds of findings, for example by Puri (2002) and Parker (1989). There have been many other studies to support the link between nutrition and learning.

The choice of interventions to use, for the children, between lay between these three main therapies. Ultimately, the two therapies chosen were a movement programme called the SIMPLE programme (see appendix A) which was specifically designed for the main experiment due to the outcomes of the pilot study and sound therapy called The Listening program (Advanced Brain Technologies). There were several reasons why this movement programme and sound therapy were finally chosen. One of the reasons is that it was very difficult to control the intake of nutrition by children and control toxins that children may also take in which can have a detrimental affect on children's learning (Echobichon and Stevens 1973). The neuro-toxicity hypothesis is strongly grounded in findings from a number of laboratory studies and observations of human behaviour. For example, in seven different studies of groups of prison inmates, violent criminals had substantially higher levels of lead in their hair than the non-violent criminals or law-abiding controls (Hone and Dashi 1998). Alongside the vitamin/mineral debate, and the fatty acid debate, there is also the issue of iron deficiency. Iron deficiency is one of the most prevalent nutritional problems of children in the US. Iron deficiency in infancy may cause a permanent loss of IQ later in life and can cause anaemia and lead to shortened attention span, irritability, fatigue and

difficulty with concentration. Consequently, anaemic children tend to do poorly on vocabulary, reading and other tests (Parker 1989).

Since there were so many tracks that could be followed when trying to take the nutritional road and so many elements that would need to be researched separately (fatty acids deficiency, iron deficiency, vitamins and minerals deficiency, the effects of neurotransmitters, the effects of toxicity) within the nutrition debate it was felt that it would be easier to establish a causal relation between the outcomes and the interventions if the nutrition element was excluded.

Ultimately, the two interventions that were chosen, the sound therapy and the movement programme presented a wide variety of choice within themselves; however, this choice was narrowed down since there was only one suitable type of sound therapy that was suitable for a school and this was The Listening Program. In terms of the movement programme there were several programmes that could have been used but the emphasise was on finding a programme that was most suitable to replicate a PE lesson and that was easy to implement and required minimum training for teachers. The only such programme that was available that was suitable and which was used in the pilot study was the Ansua Movement programme. However, this was designed for schools in Australia, where the equipment was different and the curriculum was different. The SIMPLE programme was designed, following the pilot study.

Included in the SIMPLE programme was Bilateral Integration, as devised by Sheila Dobie (2000). This was an important element which addressed minor neuro–developmental problems in children. Most importantly and what made this programme unique was that it incorporated all the requirements of the national curriculum for PE and thereby could be used as part of the PE curriculum thus addressing constraints felt by the teachers in including new initiatives in the classroom. It also planned the PE timetable for the teachers for the whole school year. In order to replicate this study it would be easier to convince teachers to take part if the programme offered both the intervention and the requirements of the curriculum.

The two programmes were chosen, because these are the two main therapies being used in private institutions to help children with learning difficulties and because movement

programmes were already being used in schools in Australia, and by private therapist and some schools, in England and Northern Ireland (McPhillips 2000) with seemingly good results.

6.7 ETHICAL CONSIDERATIONS IN RELATION TO PRESENT STUDY

A major consideration when conducting this study was the ethics of the interventions and thereby the study. The general issues related to the ethics of research were covered in chapter 5. These issues are more specific to the present study.

Discussions about research with children have mainly tended to focus to the issues of informed consent and confidentiality (e.g. Alderson, 1995; France et al., 2000; Lewis and Lindsay, 2000; Morrow and Richards 1996; Stanley and Sieber 1992; Thomas and O'Kane, 1998). The guidelines state that informed consent of parents, guardians or those who act in loco parentis is absolutely necessary. Everything should be transparent for example all of the aspects of the research should be disclosed. Observational research must only take place where those observed could normally expect to be observed by strangers unless consent has been given. The appropriateness of the investigator and of the available facilities is vital as is the inclusion of a sufficient number of children to contribute to a meaningful analysis relative to the purpose of the study.

When conducting research one of the dilemmas is to strike a balance between finding out something scientifically in pursuit of truth and the subjects (under research) rights and values potentially threatened by the research. This is known as the cost /benefit ratio. Nachmias and Nachmias (1992) summarised this by saying that social scientists have to consider the likely social benefits of their endeavours against the personal cost to individuals taking part. Another fundamental concept along with costs/benefits ratio is informed consent. This involves four elements competence, voluntarism, full information and comprehension. All of these were taken into account. The issue of competence was covered, because the parents had to give permission for their children to take part; the issue of voluntarism was covered again because the parents volunteered their children (except for one child who was allowed to opt out of the sound therapy). Additionally, the parents were given full information about the interventions in a form that was easily understandable to them and finally they were sent a letter and also had

the option of talking to the researcher and the head teacher in case they did not fully understand what was involved.

The issue of consent is of paramount importance in research with children since most research in education concerns children consent has to be obtained from various adults who are representing the children and who have the children's best interests at heart. Most importantly and legally, consent had to be obtained from the parents. Additionally, the consent of the local authority had to be obtained, the input of the school psychologist was obtained, and consent was given by the Director of Education. Consent had to be obtained from school governors. Naturally, the permission of the head teacher had to be obtained to do the research and of course the teachers had to agree to take part in the research. The following procedures were followed:

- The head teacher gave permission for the research to take part.
- The teachers were consulted and agreement was gained.
- Formal permission was obtained from the School Governors
- Formal permission was obtained from the Local Education Authority
- Formal permission was obtained from the Director of Lifelong learning.
- The parents were informed in writing and permission was sought by filling in a consent form.

At this point the head teacher left the school and a new head teacher was appointed. The new head teacher gave his go ahead to all the conditions originally agreed for the research. However, when the experiment was about to start certain elements had to be changed because the head teacher reneged on his original promise. In addition, prior to the start of the sound therapy, one of the teachers left and a new teacher replaced her. Permission was then obtained from this new teacher to continue the experiment.

Another fundamental in the field of ethics is the "right of privacy" which can be easily violated during research. In order to make sure that this was not the case in this research the data collected was the standard type of data that is normally collected during the course of the school year therefore it was no more personal or sensitive than usual. In addition once the data was collected numbers were allocated instead of names

to protect privacy. Confidentiality is a second way of protecting a person's right to privacy and again this was upheld.

Anonymity is another very important issue in ethics (Frankfort-Nachmias and Nachmias 1992). This was upheld, as outlined earlier. The data was collected in a non-threatening and was not stressful for the children. The researcher compiled with the commonly agreed international standards of good practice as agreed by the World Medical Association (WMA) Declaration of Helsinki. Safety issues were stringently adhered to.

It is very important to consider very closely the ethics of research since ethical research helps to obtain valid results, the necessary cooperation of research participants, and the societal support needed to sustain science.

6.8 EXPERIMENT MANAGEMENT

Smith (1991) claims that the only way causality can be established is through the experimental approach, although many researchers would contest this. Since part of the study was concerned with causality and if rival causes or explanations can be eliminated then it could be argued that clear causality is established; therefore, when managing the experiment this was of great importance. An essential feature of experimental study is that the researcher deliberately controls and manipulates the conditions. This however can be difficult when the study is carried out in the context of this study, where the teachers have their own agenda and have both internal and external constraints and pressures.

One important aspect of managing an experimental study is fidelity of implementation. This is described and assessed in terms of surface and quality features. Fidelity of implementation (also known as treatment fidelity or treatment integrity) refers to the extent to which an intervention is implemented as intended (Gresham et al., 2000). Information about treatment fidelity is essential in understanding the relationship between an intervention (i.e., independent variable) and outcome measures (i.e., dependent variables). The goal of experimental research is to demonstrate that any changes in a dependent variable are the direct result of implementing a specified intervention in this case the sound therapy or the movement programme either separately or together as an integrated therapy. Without evidence about whether the

intervention was actually implemented as planned, it is impossible to establish this relationship unequivocally. This indicator is concerned with both whether treatment fidelity was measured and how it was measured. One of the factors to be noted is the number of days/sessions that the intervention was conducted and whether this was in accordance with the number of days that was required for it to be implemented. A record was kept as to how many days the intervention occurred and whether it was cancelled for any reason. This was crucial because the initial plan had already been changed and a more limited time was allocated for the study.

Another very important issue is whether the central aspects of the interventions occurred, particularly when different people were involved in conducting the intervention. Since the researcher along with other staff, led the movement programme it had to be established clearly that the most critical aspects of the intervention occurred so that the movement programme was delivered with the same integrity and consistency for both classes. To make sure that the way the sound therapy was conducted was consistency across the two classes, both teachers were trained on implementation of the therapy.

Other aspects that were taken into account when conducting the experiment are listed below:

- Reducing the Hawthorne effect.
- Avoiding having too long or too short breaks between tests.
- Matching comparison groups and experiment group as well as possible.
- Ensuring standardised procedure for gathering data and for administrating test.
- Making sure that the tests chosen were tailored tests to the concentration span of the children and appropriate and non -threatening to the children.
- Addressing other situational factors such as health, environment, noise and distraction whilst taking the tests.
- As far as possible avoiding inaccurate reporting.
- Using two equivalent tests A and B for the reading tests to reduce practice effects.

- Making sure that the tests and data collected were controllable, predictable, consistent and replicable. This is particularly in keeping with the positivists' paradigm.
- Achieving goodwill and cooperation since the research required a period of time and some extra work in conducting the sound therapy and in both cases for doing the pre-testing and the post-testing.
- Avoiding the effect of just one teacher input as various teachers taught the children in the morning and the children were with their own class teachers in the afternoon.
- Ensuring that conditions when the interventions took place were similar as all the interventions were carried out in the afternoon.
- Checking to see whether there were any undetected hearing problems through the use of Scan C.

6.9 ENABLING FACTORS

These are factors that are directly associated with the experimental work itself and have a significant impact on the results and expected outcomes. These can also be termed 'core factors'.

6.9.1 Children's commitment

The children's commitment was not a significant issue in this study because permission was not required for the movement programme as this was perceived to be part of their Physical Education lesson and this was in fact how it was run. This was done deliberately so that issues such as the Hawthorne effect did not play a part in the study. In terms of the sound intervention, the children were told they were listening to music as part of their lesson. Since this had occurred in the past, this did not cause undue stress. The interventions were chosen carefully and deliberately for ease of management and for familiarity for the children so that it was felt to be a normal part of school life, for both the children and the teachers. Since the interventions were in the form of familiar activities, it was felt that they would not cause undue stress to the children, but be enjoyable for the children. All the interventions were kept low key, so that the comparison group did not feel deprived .The lessons were treated as PE lessons to limit the effect of novelty that can occur with a new intervention

6.9.2 Teacher commitment

The cooperation of the teachers was of paramount importance in this study and they all had to agree, since the intervention of the sound therapy had to be timetabled into the school day. They also had to take part in the movement lessons led by the researcher. In addition, they had to treat the interventions as normal school life to avoid the Hawthorne effect, Staff had to allow for pre -testing and post -testing of the children which necessitated time out for the children from their lessons and some minor disruption. However, children at this school were used to being tested in this way. More commitment was needed from the two teachers conducting the sound therapy, since they had to learn how to conduct it and set it up daily. Prior to the start of the sound therapy one of the teachers who had agreed to conduct the sound therapy, left the school suddenly. Since permission had been obtained from the class to take part in this intervention, it was vital that the new teacher agreed to do the sound therapy. This agreement was reached.

6.9.3 Parental commitment

For ethical reasons it was vital that the parents agreed to the interventions. This was discussed earlier in this chapter. Written consent was given by all the parents except for those of one child who did not do the sound therapy. Once consent was obtained, parents did not have to get involved. In private practice parents have to do the therapies with their children which place a burden on them.

6.9.4 School climate aspects

One of the most important aspects of the research was to conduct it in such a way as to make sure that it did not disrupt the school day and in fact the school life and that it did not place undue stress either on the teachers or the children. Throughout the study , this aspect of undue stress was essential to consider to since teachers were already under a great deal of stress to comply with the National Curriculum requirements to try and raise the standards set both by the school and the LEA as well as general stress from an overloaded curriculum. Both of the interventions chosen complied with the needs of the national curriculum and so some of the issues of time taken by used up by the interventions was minimised.

It was also essential that the school governors felt that they were informed and included in the research, as were the parents. Furthermore, it was important that all parties felt that they had all the necessary information and that the research was transparent. the pilot study laid the ground for the main experiment and had established trust.

The school had taken part in research before and was keen to adopt and try out new ideas. Sport was a big part of the school life and it was deemed that if nothing else, at least the movement programme would have a positive impact on the school sporting programme as all the necessary elements of gymnastics and athletics were covered. It was noted by the teachers, following the pilot study, how skilful the children who had taken part in the study had become subsequently and also what a positive effect it had on their general behaviour. In addition, some parents whose children had taken part in the pilot study wanted the movement programme offered to their younger children, as they had noted the general improvements in concentration and attention span and behaviour.

6.10 OUTPUT MEASURES

In previous rigorous scientific studies that have been completed on movement programmes such as the studies by McPhillips et al., (2000) and Jordan –Black (2005) several tests were used to give an overall profile of the children. McPhillips et al., (2000) all used the Neale analysis reading test and this was one of the reasons why it was used in the pilot study. However, from the outcomes of the pilot study it was decided to change the tests because of the unsuitability of the tests. This was discussed earlier, in the section on the pilot study. Again, in the aforementioned studies, three measures were used and so in this case it was decided to use three measures to gain an overall profile.

6.11 SUMMARY

This chapter discussed the fundamental issues pertaining to the way that the research was conducted in this study. Specifically, it discussed the research design and the relevant approaches adopted. To achieve the research objective the quasi experimental study used quantitative methods of data collection. The discussion examined the rationale used for choosing the methods of data collection, issues related to research

design, to the pilot study and its outcomes, to reliability and validity, to sampling, and the ethics of the research were discussed. Finally a detailed description was given of the Integrated Therapy Experiment Design Model and all the various issues pertaining to it.

CHAPTER SEVEN: QUANTITATIVE DATA ANALYSIS

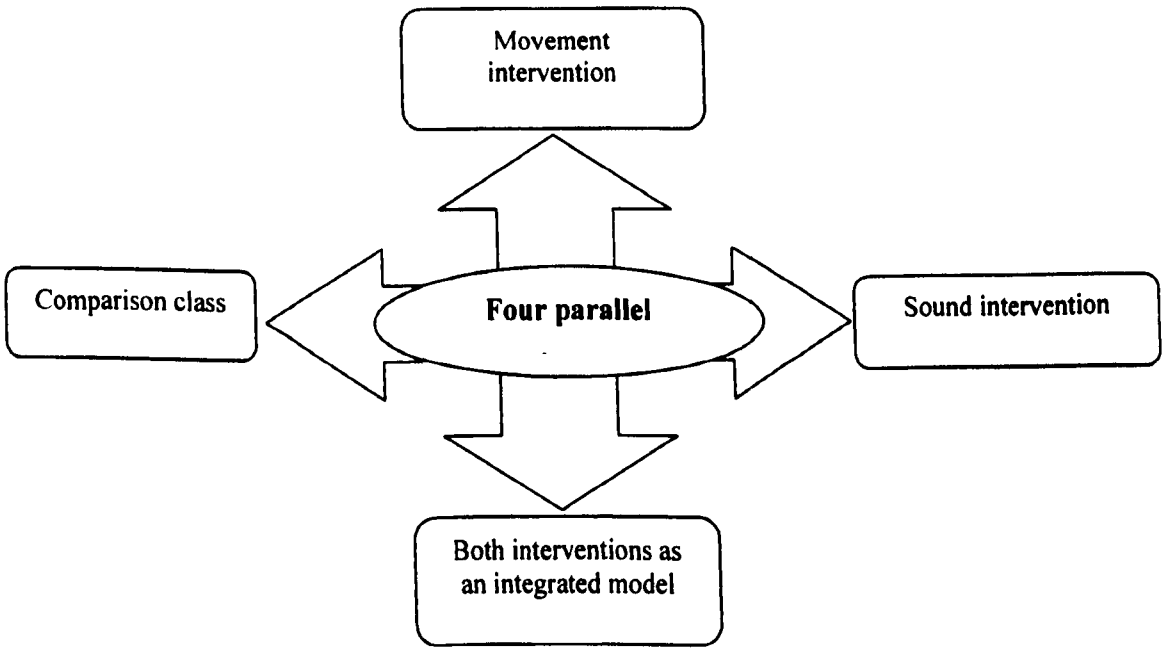
7.1 INTRODUCTION

This chapter describes the results from the quantitative data collected from four parallel classes and 117 children in a school used in this study. Fundamentally this chapter reports on the results of the tests to try to ascertain which of the interventions, movement or the sound, if at all, raised the children's academic performance and whether the two together as an integrated model were more successful at raising the children's learning and performance than as individual interventions. The performance was measured using the following tests:

- Suffolk reading test
- NFER non –verbal reasoning test
- TAPS forward digit test
- TAPS backward digit test

These tests, discussed in detail in chapter 6, were administered at the start of the intervention and at the end of the intervention to all four classes. This is depicted in the figure below.

Figure 7-1 Classes and interventions used



These specific tests were used because they measured different elements of children's performance and helped to gain a more complete picture as to whether the interventions had an effect. The choice of these tests was based on the literature review. The classes involved were as follows:

- Class A: comparison class- no intervention
- Class B: movement intervention- movement programme only
- Class C: Sound intervention – sound programme only
- Class D: movement and sound intervention - integrated group (combined therapies).

7.2 HYPOTHESES

In order to ascertain whether the individual interventions or the combined interventions had an effect on the children's performance the following hypotheses were stated:

Table 7-1 Research hypotheses

H1	Class B (movement intervention class) will perform better than class A (comparison class)
H2	Class C (sound intervention class) will perform better than class A (comparison class
H3	Class D (integrated intervention class) will perform better than class A (comparison class)
H4	Class D (integrated intervention class) will perform better than class A , class B and class C

7.3 TESTS USED FOR ANALYSIS

To test the hypothesis a comparison was made on the mean of the raw data collected and this data was analysed using the SPSS package. The following tests were used for the analysis:

1. The Kruskal-Wallis one- way analysis of variance test which is a non-parametric equivalent to ANOVA and can be used when there are two or more groups. The formula for Kruskal–Wallis is based on the ranks of the scores, rather than the scores

themselves. The test looks for a significant difference between the mean ranks of some or all of the conditions. In this case the test looked for the differences in test scores between the classes.

2. The Mann-Whitney test was used to compare the overall performance (all four tests together) of the children as there are no post- hoc tests that follow naturally from Kruskal –Wallis. The Mann Whitney test analysed the data of the overall performance (all four tests) of the comparison class in relation to the movement intervention (B), than in relation to the sound intervention class (C) and finally in relation to the class receiving the integrated therapy (D)

3. An evaluation was made of the (pre and post test) linear relationship between the different tests (the reading test, the non -verbal test, the forward digit span test and the backward digit span test) using Spearman's rho which is a test that looks at correlation coefficients. Spearman's rho transforms the original scores into ranks before performing further calculations.

The above tests, which are non-parametric tests, were used after testing the data for normality. According to Cramer (1994) to use parametric tests the data has to be distributed normally and if the assumptions are violated than non parametric tests should be used.

There are two dimensions of normality the first being 'Skew' or 'Skewness' and the second 'Kurtosis'. A variable that is positively skewed has large outliers to the right of the mean and a variable that is negatively skewed has outliers to the left. Whereas Skewness examines the horizontal deviation of a distribution from a perfect norm, Kurtosis examines the vertical displacement. A perfectly normal Skewness will have a Skewness statistic of zero and a Kurtois of zero. SPSS provides tests of normality incorporating both Skewness and Kurtosis. The first is the Kolmogorov-Smirnov test for normality, sometimes called the KS Lillefors test for normality. The second is the Shapiro-test for normality. The latter is used when the samples are smaller than 50.

In order to test the data for normality, the Shapiro-Wilks's statistic for normality was used of the KS Lilliefors test. It is generally believed that nonparametric tests are

immune to data assumption violations and the presence of outliers. While nonparametric methods require no assumptions about the population probability distribution functions, they are based on some of the same assumptions as parametric methods, such as randomness and independence of the samples. In addition, many non parametric tests are sensitive to the shape of the populations from which the samples are drawn. This was taken into consideration.

7.4 DATA ANALYSIS USING THE KRUSKAL-WALLIS TEST

The Kruskal-Wallis test is a test to compare two or more independent groups of sampled data. The test statistic for the Kruskal-Wallis test is H. This value is compared to a table of critical values for U based on the sample size of each group. If H exceeds the critical value at some significance level, it means that there is evidence to reject the null hypothesis in favour of the alternative hypothesis.

The analysis of the Kruskal –Wallis was conducted to evaluate how each of the classes did in relation to the comparison class A in terms of the individual tests and in terms of the overall performance (all four tests together). Each of the tests was designed to measure a different aspect of performance although the hypotheses were intended to see the effect of the independent variables on all the combined dependent variables as a whole.

In order to conduct the Kruskal-Wallis test, the samples must be from populations with similar shapes and equal variances. The Kruskal-Wallis test does not make assumptions about normality and homoscedasticity (assumption that the variability in scores for one variable is roughly the same at all values of the other variable, which is related to normality, as when normality is not met, variables do not display homoscedasticity).

Like most non-parametric tests, the test is performed on ranked data, so data is ranked by ordering it from lowest to highest: the smallest value gets a rank of 1, the next smallest gets a rank of 2, and so on.

The following table displays the mean of the raw scores of the individual tests as well as the combined score for overall performance (dependent variable) in relation to Class B (movement intervention) in comparison to Class A (comparison -no intervention)

Table 7-2 Results of Class B in comparison to Class A

	Classes Involved in the Tests	N	Mean Rank
Reading differences between Classes	Class A	28	30.45
	Class B	32	30.55
	Total	60	
Non Verbal differences between Classes	Class A	28	31.43
	Class B	32	29.69
	Total	60	
BDS differences between Classes	Class A	28	24.75
	Class B	32	35.53
	Total	60	
FDS differences between Classes	Class A	28	23.34
	Class B	32	36.77
	Total	60	
Overall Performance	Class A	28	23.55
	Class B	32	36.58
	Total	60	

The above table displays the results of the four tests as well as the overall performance between class B and class A.

Table 7-3 Results of Kruskal-Wallis test (Class B in comparison to Class A)

	Reading Differences between Classes	Non Verbal Differences between Classes	BDS Differences between Classes	FDS Differences between Classes	Overall Performance
Chi-Square	.000	.149	5.732	8.975	8.316
df	1	1	1	1	1
Asymp. Sig.	.982	.699	.017	.003	.004

A Kruskal Wallis Test

B Grouping Variable: Classes Involved in the Tests

Analysis of the reading test results indicated that there was no significant difference between the classes at 5% (chi square =.000 df = 1, p =.982). Likewise, the non- verbal test results showed there was no significant difference 5% (chi square =.149 df = 1, p =.699). However, the backward digit span showed there was a significant difference at 5% (chi square =5.732 000 df = 1, p =.017) and this was echoed in the forward digit span test results 0.05% (chi square =8.975 df = 1, p =.003). Finally, in terms of overall

performance there was a significant difference at 5% (chi square =8.361 df = 1, p =.004).

The following Table 7.4 shows the analysis of the mean of the raw scores of the individual tests as well as the combined score for overall performance (dependent variable) in relation to Class C (sound Class) to Class A (comparison Class).

Table 7-4 Results of Class C in comparison to Class A

	Classes Involved in the Tests	N	Mean Rank
Reading differences between Classes	Class A	28	24.55
	Class C	29	33.29
	Total	57	
Non Verbal differences between Classes	Class A	28	31.41
	Class C	29	26.67
	Total	57	
BDS differences between Classes	Class A	28	25.29
	Class C	29	32.59
	Total	57	
FDS differences between Classes	Class A	28	25.00
	Class C	29	32.86
	Total	57	
Overall Performance	Class A	28	26.45
	Class C	29	31.47
	Total	57	

Table 7-5 Results of Kruskal-Wallis test (Class C in comparison to Class A)

	Reading Differences between Classes	Non Verbal Differences between Classes	BDS Differences between Classes	FDS Differences between Classes	Overall Performance
Chi-Square	3.972	1.167	2.795	3.247	1.305
df	1	1	1	1	1
Asymp. Sig.	.046	.280	.095	.072	.253

A Kruskal Wallis Test

B Grouping Variable: Classes Involved in the Tests

This analysis indicated that the reading test revealed that there was a significant difference at 5% (chi square =3.972 df = 1, p = .046). The non- verbal test results showed there was no significant difference at 5% or 10% (chi square =1.167 df = 1, p =.280). The backward digit span showed that although there was no significant

difference at 5% there was a difference at 10% (chi square =3.247 000 df = 1, p =.095). The forward digit span test showed that there was no significant difference at 5% but again there was a difference at 10% (chi square =3.247 df = 1, p = .072). Finally, for overall performance there was no significant difference at 5% or 10%.

The following table 7.6 shows the analysis of the mean of the raw scores of the individual tests as well as the combined score for overall performance (dependent variable) in relation to Class D (integrated class) compared to Class A (comparison class).

Table 7-6 Results of Class D in comparison to Class A

	Classes Involved in the Tests	N	Mean Rank
Reading Differences between Classes	Class A	28	27.21
	Class D	30	31.63
	Total	58	
Non Verbal Differences between Classes	Class A	28	28.45
	Class D	30	30.48
	Total	58	
BDS Differences between Classes	Class A	28	26.54
	Class D	30	32.27
	Total	58	
FDS Differences between Classes	Class A	28	25.41
	Class D	30	33.32
	Total	58	
Overall Performance	Class A	28	23.11
	Class D	30	35.47
	Total	58	

Table 7-7 Results of Class D in comparison to Class A

	Reading Differences between Classes	Non Verbal Differences between Classes	BDS Differences between Classes	FDS Differences between Classes	Overall Performance
Chi-Square	.997	.212	2.264	3.395	7.768
df	1	1	1	1	1
Asymp. Sig.	.318	.646	.132	.065	.005

A Kruskal Wallis Test

B Grouping Variable: Classes Involved in the Tests

This analysis indicated that the reading test scores were not significantly different at 5% or at 10%. The non -verbal test and the backward digit span test replicated this finding and showed no significant difference 5% or 10%. However, the analysis of the forward digit span test showed there was no significant difference at 5% but there was a difference at 10% (chi square =3.395 df = 1, p =.065). Finally, in terms of overall performance there was a significant difference at 5% (chi square =7.768 df = 1, p =.005).

The analysis of these tests leads to the following conclusions in relation to the hypotheses:

1. We can accept hypothesis H1 that class B (movement programme class) will perform better than class A (comparison class).

2. We can reject hypothesis H 2 that that class C (sound programme) will perform better than class A (comparison class).

3. We can accept hypothesis H3 that class D (integrated class) will perform better than class A (comparison class).

As regards Hypothesis H4, that Class D (integrated intervention class) will perform better than class A, class B and class C, this will be discussed in relation to the analysis of the Mann- Whitney tests in the following section.

7.5 DATA ANALYSIS USING MANN- WHITNEY TESTS

The Mann- Whitney test is an alternative to the independent group t-test, when the assumption of normality or equality of variance is not met. This, like many non-parametric tests, uses the ranks of the data rather than their raw values to calculate the statistic. The test involves the calculations of a statistic usually called 'u', whose distribution under the null hypothesis is known. In the cases of small samples under 20 the distribution is tabulated but for samples above 20 there is a good approximation using the normal distribution. 'U' is given by $U_1 = R_1 - \frac{n_1(n_1+1)}{2}$ where nI is the two sample size for sample 1 and RI is the sum of the ranks in sample size.

The only assumptions of the Mann-Whitney test are that the two samples are randomly and independently drawn and the dependent variable is continuous and capable in principle, if not in practice, of producing measures carried out to the nth decimal place. Finally, that the measures within the two samples have the properties of at least an ordinal scale of measurement, so that it is meaningful to speak of "greater than", "less than", and "equal to".

Results of Mann-Witney tests – Overall Performance (comparison and movement intervention class)

Table 7-8 Overall Performance of Class B in comparison to Class A

	Classes Involved in the Tests	N	Mean Rank	Sum of Ranks
Overall Performance	Class A	28	24.07	674.00
	Class B	32	36.13	1156.00
	Total	60		

Table 7-9 Results of Mann-Whitney test Overall Performance

Overall Performance	
Mann-Whitney U	268.000
Wilcoxon W	674.000
Z	-2.669
Asymp. Sig. (2-tailed)	.008

A Grouping Variable: Classes Involved in the Tests.

The analysis of overall performance i.e. all four tests put together of the comparison class and the movement intervention class showed a significant difference at 5% (Chi square =8.359 df = 3, p = .039).

Results of Mann-Whitney Test – Overall Performance (comparison and sound intervention class)

Table 7-10 Overall Performance of Class C in comparison to Class A

	Classes Involved in the Tests	N	Mean Rank	Sum of Ranks
Overall Performance	Class A	28	26.45	740.50
	Class C	29	31.47	912.50
	Total	57		

Table 7-11 Results of Mann-Whitney test

Overall Performance	
Mann-Whitney U	334.500
Wilcoxon W	740.500
Z	-1.142
Asymp. Sig. (2-tailed)	.253

A Grouping Variable: Classes Involved in the Tests

The analysis of the overall performance (all four tests together) of the comparison class A, and the sound intervention class C, did not show a significant difference at 5% (p = 0.253). However the sound class 31.47 (mean rank) performed better than comparison class.

Results of Mann-Whitney Test – Overall Performance (comparison and integrated intervention class)

Table 7-12 Overall performance of Class D in comparison to Class A

	Classes Involved in the Tests	N	Mean Rank	Sum of Ranks
Overall Performance	Class A	28	23.11	647.00
	Class D	30	35.47	1064.00
	Total	58		

Table 7-13 Results of Mann-Whitney test

Overall Performance	
Mann-Whitney U	241.000
Wilcoxon W	647.000
Z	-2.787
Asymp. Sig. (2-tailed)	.005

A Grouping Variable: Classes Involved in the Tests

The results of overall performance (all four tests together) of the comparison class and the integrated intervention class put together showed a significant difference at 5% (p = .005).

Results of the Mann-Whitney Test – Overall Performance (movement and integrated intervention class)

Table 7-14 Overall performance of Class D in comparison to Class B

	Classes Involved in the Tests	N	Mean Rank	Sum of Ranks
Overall Performance	Class B	32	31.84	1019.00
	Class D	30	31.13	934.00
	Total	62		

Table 7-15 Results of Mann-Whitney test

Overall Performance	
Mann-Whitney U	469.000
Wilcoxon W	934.000
Z	-.155
Asymp. Sig. (2-tailed)	.877

A Grouping Variable: Classes Involved in the Tests

The analysis of the overall performance for the movement intervention class A and the integrated intervention class D did not show a significant difference at 5% (p = 0.877). Both classes were identical in their scores.

Results of the Mann-Witney Test – Overall Performance (sound and integrated intervention class)

Table 7-16 Overall performance of Class D in comparison to Class C

	Classes Involved in the Tests	N	Mean Rank	Sum of Ranks
Overall Performance	Class C	29	28.40	823.50
	Class D	30	31.55	946.50
	Total	59		

Table 7-17 Results of the Mann-Whitney test

Overall Performance	
Mann-Whitney U	388.500
Wilcoxon W	823.500
Z	-.705
Asymp. Sig. (2-tailed)	.481

A Grouping Variable: Classes Involved in the Tests

The results of overall performance of the sound intervention class and the integrated intervention class did not show a significant difference at 5% (p = .481). The analysis revealed that the results were nearly identical.

On the basis of the Mann Whitney analysis on the overall impact of the programme above it would be reasonable to reject Hypothesis H4: Class D (integrated intervention class) will perform better than class A, class B and class C and we have to accept the null hypothesis that there will be no difference.

In summary of this section the movement intervention class B and the integrated intervention D class preformed better than the comparison class A, however the integrated intervention class D did not perform better than the sound intervention class C and or the movement intervention B class as originally hypothesised.

7.6 DATA ANALYSIS USING SPEARMAN'S RHO

An evaluation was made of the linear relationship between the different rests (reading, non–verbal, forward digit span, backward digit span) using Spearman's Rho correlation. The Spearman Rho correlation indicates the magnitude and direction of the association between two variables that are on an interval or ratio scale. The p value or significance level for the rank order is calculated using the F test. The correlation coefficient is a number between +1 and -1. This number indicates the magnitude (strength of correlation) and direction (positive or negative relation) of the association between the two variables. If the correlation is positive, the two variables have a positive relationship (as one increases, the other also increases). If the correlation is negative, the two variables have a negative relationship (as one increase, the other decreases). The closer the correlation is to either +1 or -1, the stronger the correlation. If the correlation is 0 or very close to 0, there is no association between the two variables. Since Spearman's rho it is a non-parametric test , it does not require the assumption that the relationship between the variables is linear, or measured on interval scales; it can be used for variables measured at the ordinal level. The formula for Spearman's rho is: rho = 1 - [(6*SUM (d2)/n (n2 - 1)] where d is the difference in ranks. This correlation is calculated by applying the Pearson correlation formula to the ranks of the data rather than to the actual data values themselves. In so doing, many of the distortions that plague the Pearson correlation are reduced considerably.

The following table shows the results of the pre-test for the Spearman's rho, for the comparison class.

Table 7-18 Spearman's rho comparison class pre-test

Pre-test		Reading	Non verbal	BDS	FDS
Reading	Correlation Coefficient	1.000	.218	-.202	.105
	Sig. (2-tailed)	.	.266	.302	.595**
	N	28	28	28	28
Non Verbal	Correlation Coefficient	.218	1.000	.182	.138
	Sig. (2-tailed)	.266	.	.353	.482**
	N	28	28	28	28
BDS	Correlation Coefficient	-.202	.182	1.000	.417*
	Sig. (2-tailed)	.302	.353	.	.027
	N	28	28	28	28
FDS	Correlation Coefficient	.105	.138	.417*	1.000
	Sig. (2-tailed)	.595**	.482**	.027	.
	N	28	28	28	28

Correlation is significant at the .05 level (2-tailed).

The following table shows the results of the post-test for Spearman's rho, for the comparison class.

Table 7-19 Spearman's rho, comparison class, post-tests

Post-test		Reading	Non Verbal	BDS	FDS
Reading	Correlation Coefficient	1.000	.492**	.045	.181
	Sig. (2-tailed)	.	.008	.819	.357
	N	28	28	28	28
Non Verbal	Correlation Coefficient	.492	1.000	.193	.274
	Sig. (2-tailed)	.008	.	.326	.159
	N	28	28	28	28
BDS	Correlation Coefficient	.045	.193	1.000	.345
	Sig. (2-tailed)	.819	.326	.	.072
	N	28	28	28	28
FDS	Correlation Coefficient	.181	.274	.345	1.000
	Sig. (2-tailed)	.357	.159	.072	.
	N	28	28	28	28

** Correlation is significant at the .01 level (2-tailed).

* Correlation is significant at the .05 level (2-tailed).

Analysis for the comparison class for the pre tests demonstrated that there was a moderate relationship between the reading test and non verbal reasoning (r= .417) and was it was statistically significant (p= .027) at 5%. The post tests demonstrated that there was a moderate relationship between the reading test and non- verbal reasoning test (r= .492) and it was statistically significant (p= .008) at 1%.

The next table shows the results of the pre-test for the Spearman's rho, for the movement intervention class.

Table 7-20 Spearman's rho results movement intervention pre-tests

Pre-test		Reading	Non Verbal	BDS	FDS
Reading	Correlation Coefficient	1.000	.517**	.160	.333
	Sig. (2-tailed)	.	.002	.382	.062
	N	32	32	32	32
Non Verbal	Correlation Coefficient	.517**	1.000	.223	.329
	Sig. (2-tailed)	.002	.	.219	.066
	N	32	32	32	32
BDS	Correlation Coefficient	.160	.223	1.000	.644**
	Sig. (2-tailed)	.382	.219	.	.000
	N	32	32	32	32
FDS	Correlation Coefficient	.333	.329	.644**	1.000
	Sig. (2-tailed)	.062	.066	.000	.
	N	32	32	32	32

** Correlation is significant at the .01 level (2-tailed).

Correlation is significant at the .05 level (2-tailed).

The following table shows the results of the post-test for the Spearman's rho, for the movement intervention class.

Table 7-21 Spearman's rho, movement intervention, post-tests

Post-test		Reading	Non Verbal	BDS	FDS
Reading	Correlation Coefficient	1.000	.710**	.187	.382
	Sig. (2-tailed)	.	.000	.304	.031
	N	32	32	32	32
Non Verbal	Correlation Coefficient	.710	1.000	.326	.493**
	Sig. (2-tailed)	.000	.	.069	.004
	N	32	32	32	32
BDS	Correlation Coefficient	.187	.326	1.000	.752
	Sig. (2-tailed)	.304	.069	.	.000
	N	32	32	32	32
FDS	Correlation Coefficient	.382	.493**	.752**	1.000
	Sig. (2-tailed)	.031	.004	.000	.
	N	32	32	32	32

** Correlation is significant at the .01 level (2-tailed).

* Correlation is significant at the .05 level (2-tailed).

Analysis of the pre tests of the movement intervention class revealed that there was a moderate relationship between the reading test and non verbal reasoning (r= .517) and was statistically significant (p= .002) at 1%. In addition there was a moderate relationship between BDS and FDS (r= .644) and it was statistically significant (p= <001) at 1%.

The post tests demonstrated that there was a strong relationship between the reading test and non- verbal reasoning test (r= .710) and it was statistically significant (p=< .001) at 1%. There was moderate relationship between reading and FDS (r=.382) and it was statistically significant (p=.383) at 5% Similarly, there was a moderate relationship

between the non –verbal reasoning test and FDS (r= .4930 and it was statistically significant at (p= .004) at 1%. Finally, there was a strong relationship between BDS and FDS (r= .752) and it was statistically significant (p= <.001) at 1%.

The following table shows the results of the pre-test for the Spearman's rho, for the sound intervention class.

Table 7-22 Spearman's rho sound intervention pre-tests

Pre-test		Reading	Non Verbal	BDS	FDS
Reading	Pearson Correlation	1.000	.546**	.258	.070
	Sig. (2-tailed)	.	.002	.176	.719
	N	29	29	29	29
Non Verbal	Pearson Correlation	.546	1.000	.326	.190
	Sig. (2-tailed)	.002	.	.085	.325
	N	29	29	29	29
BDS	Pearson Correlation	.258	.326	1.000	.808**
	Sig. (2-tailed)	.176	.085	.	.000
	N	29	29	29	29
FDS	Pearson Correlation	.070	.190	.808**	1.000
	Sig. (2-tailed)	.719	.325	.000	.
	N	29	29	29	29

** Correlation is significant at the .01 level (2-tailed).

Correlation is significant at the .05 level (2-tailed).

The following table shows the results of the post- test for the Spearman's rho, for the sound intervention class.

Table 7-23 Spearman's rho sound intervention post-tests

Post-test		Reading Test	Non Verbal	BDS	FDS
Reading Test	Pearson Correlation	1.000	.669**	.543**	.527**
	Sig. (2-tailed)	.	.000	.002	.003
	N	29	29	29	29
Non Verbal	Pearson Correlation	.669**	1.000	.546**	.543**
	Sig. (2-tailed)	.000	.	.002	.002
	N	29	29	29	29
BDS	Pearson Correlation	.543**	.546**	1.000	.750
	Sig. (2-tailed)	.002	.002	.	.000
	N	29	29	29	29
FDS After	Pearson Correlation	.527**	.543**	.750**	1.000
	Sig. (2-tailed)	.003	.002	.000	.
	N	29	29	29	29

** Correlation is significant at the .01 level (2-tailed).

* Correlation is significant at the .05 level (2-tailed).

Analysis of the pre- tests of the sound intervention class indicated that there was a moderate relationship between the reading test and non verbal reasoning (r= .546) and was statistically it was statistically significant (p= .002) at 1%. In addition there was a very strong relationship between BDS and FDS (r= .808) which was statistically it was statistically significant (p= <.001) at 1%.

The post tests revealed that there was a relationship between all the tests. There was a strong relation between reading test and non- verbal reasoning test (r= .669), and it was statistically significant (p= .002) at 1%; between the reading test and BDS (re .543) statistically significant (p= .002) at 1% and between the reading test and FDS (r=.527)

statistically significant at (p=.003) at 1%. Similarly, there was a moderate relationship between the non –verbal reasoning test and BDS (r= .546) which was statistically significant (p= .002) at 1%. There was a moderate relationship between the non –verbal reasoning test and FDS (r= .543) and it was statistically significant at (p= .002) at 1%. Finally, there was a strong relationship between BDS and FDS (r= .750) which was statistically significant (p= < .001) at 1%.

The following table shows the results of the pre-test for the Spearman's rho, for the integrated intervention class.

Table 7-24 Spearman's rho integrated intervention pre-tests

Pre-test		Reading Test	Non Verbal	BDS	FDS
Reading Test	Correlation Coefficient	1.000	.466	.056	.143
	Sig. (2-tailed)	.	.010	.769	.450
	N	30	30	30	30
Non Verbal	Correlation Coefficient	.466	1.000	.176	.434*
	Sig. (2-tailed)	.010	.	.354	.017
	N	30	30	30	30
BDS	Correlation Coefficient	.056	.176	1.000	.236
	Sig. (2-tailed)	.769**	.354	.	.209
	N	30	30	30	30
FDS	Correlation Coefficient	.143	.434*	.236	1.000
	Sig. (2-tailed)	.450**	.017	.209	.
	N	30	30	30	30

** Correlation is significant at the .01 level (2-tailed).

* Correlation is significant at the .05 level (2-tailed).

The following table shows the results of the post- test for the Spearman's rho, for the integrated intervention class.

Table 7-25 Spearman's rho integrated intervention post-test

Post-test		Reading Test	Non Verbal	BDS	FDS
Reading Test	Correlation Coefficient	1.000	.625**	.093	.320
	Sig. (2-tailed)	.	.000	.626	.084
	N	30	30	30	30
Non Verbal	Correlation Coefficient	.625**	1.000	-.019	.416*
	Sig. (2-tailed)	.000	.	.919	.022
	N	30	30	30	30
BDS	Correlation Coefficient	.093	-.019	1.000	.204
	Sig. (2-tailed)	.626**	.919**	.	.280
	N	30	30	30	30
FDS	Correlation Coefficient	.320	.416*	.204	1.000
	Sig. (2-tailed)	.084	.022	.280	.
	N	30	30	30	30

** Correlation is significant at the .01 level (2-tailed).

* Correlation is significant at the .05 level (2-tailed).

Analysis of the pre-tests of the integrated intervention class indicated that there was a moderate relationship between the reading test and non verbal reasoning (r= .466) which was statistically significant (p= .010) at 1%. In addition there was a moderate relationship between non verbal reasoning and FDS (r= .434) which was statistically it was statistically significant (p= <.017) at 5%.

The post tests demonstrated that there was a moderate relationship between the reading test and non- verbal reasoning test (r= .625) and it was statistically significant (p= <.001) at 1%. Similarly there was a moderate relationship between non –verbal reasoning test and FDS (r= .416) and it was statistically significant at (p= .022) at 5%.

7.7 SUMMARY

In this chapter the data was analysed using the Kruskal-Wallis test to compare class performance on the Mann-Whitney test to compare for overall performance and to compare the impact of the integrated interventions with the individual interventions, and Spearman's rho for correlations between the tests. The analysis for Kruskal-Wallis was presented first, followed by the analysis for the Mann-Whitney and finally the analysis for Spearman's rho.

The objective was to try and ascertain whether the classes that completed the individual interventions exhibited improved performance and whether the class that received the integrated approach together showed more of an improvement in relation to the classes that received the individual interventions and the class that had no interventions.

The analysis of the Kruskal-Wallis test showed that both the movement intervention class and the integrated intervention significantly raised the overall performance of the children in relation to the comparison class but that this was not the case with the sound intervention. However, the sound intervention class displayed improved performance in their reading tests.

The analysis of the Mann-Whitney test, which just looked at the overall performance, showed that the movement intervention class and the integrated intervention class overall preformed better than the comparison class. This was reflected in the Kruskal-Wallis test analysis. However, the integrated intervention class did not perform better than those receiving the sound or the movement intervention alone as originally hypothesised. This too, was echoed in the findings of the Kruskal-Wallis tests.

Spearman's rho analysis demonstrated a relationship between the forward digit span and the backward digit span in the intervention classes. Secondly a relationship was demonstrated between all the tests in the sound intervention class (post-test) which was the only class that displayed enhanced reading performance.

The next chapter will go on to discuss the findings in depth and discuss why the initial hypothesis that the combined therapies would raise the children's performance the most was not supported.

CHAPTER EIGHT: DISCUSSION AND MODEL PROPOSAL

8.1 INTRODUCTION

This chapter provides a comprehensive discussion on the analysis of the results and findings of the quantitative data presented in chapter seven. This study was conducted with the following objectives:

- To study the impact of a movement programme (SIMPLE) on raising children's overall academic performance.
- To study the impact of sound therapy (The Listening Programme) on raising children's overall academic performance.
- To study the impact of both programmes together in order to see if they made more of an impact than the individual programmes on raising children's overall performance.

In order to ascertain whether there was an impact on children's performance and learning, several tests were used to obtain an overall profile.

- The Suffolk reading scale 2 test (nferNelson) is a school based test for reading ability and the results estimate the reading ability of individuals to nationally representative standards.

- Non-verbal reasoning test (nferNelson) is a measure of reasoning processes which are widely accepted as being fundamental to understanding and assimilating new information and ideas. It assesses the overall reasoning of the children.

- Digit span subtests can be 'used as a measure of short-term memory, retrieval and distractibility '(Peterson and Peterson, 1959). Both the forward and the backward digit span test were used.

There were thus four dependent variables, which were combined to give an overall profile of the child's performance, since the different tests measured different elements of a child's performance. An attempt was made to take into account measures of fluid intelligence and crystallised intelligence, as well to counter effect factors such as ethnic background (Dollaghan et al., 1997) and maternal education level (Gathercole et al., 2002) and various other influences. Components of working memory tests (forward digit span and backward digit span) were used to measure cognitive processing skills that could have an impact on the child's abilities to learn (Baddeley and Gathercole, 1999) since the interventions were intended to improve child learning in the long term.

The results, in relation to the two interventions, as well as the integrated intervention will be discussed in this chapter. The different aspects that may have been affected, such as coordination, primitive reflexes, and the cerebellum and vestibular system in relation to the movement programme, as well brain plasticity, auditory processing, and reducing hypersensitivity in relation to sound therapy. These will be discussed in relation to the individual tests as well as the overall scores of all tests put together.

Following from that, a proposed generic model for enhancing learning for children is suggested, based on an integrated perspective. Furthermore, this chapter provides comparisons and external validation in relation to previous empirical studies regarding the enhancement and improvement of child learning.

8.2 RESEARCH FINDINGS

Several findings emerged from the data collected and these will now be discussed more fully. In general, as indicated in Table 8.1, the study indicated that the class who completed the movement only programme (class B) showed significantly improved overall performance compared to the comparison class (chi square 8.361.df1, p=.004). This overall improvement was not replicated with the class that completed the sound therapy, class C, although there was significant improvement in

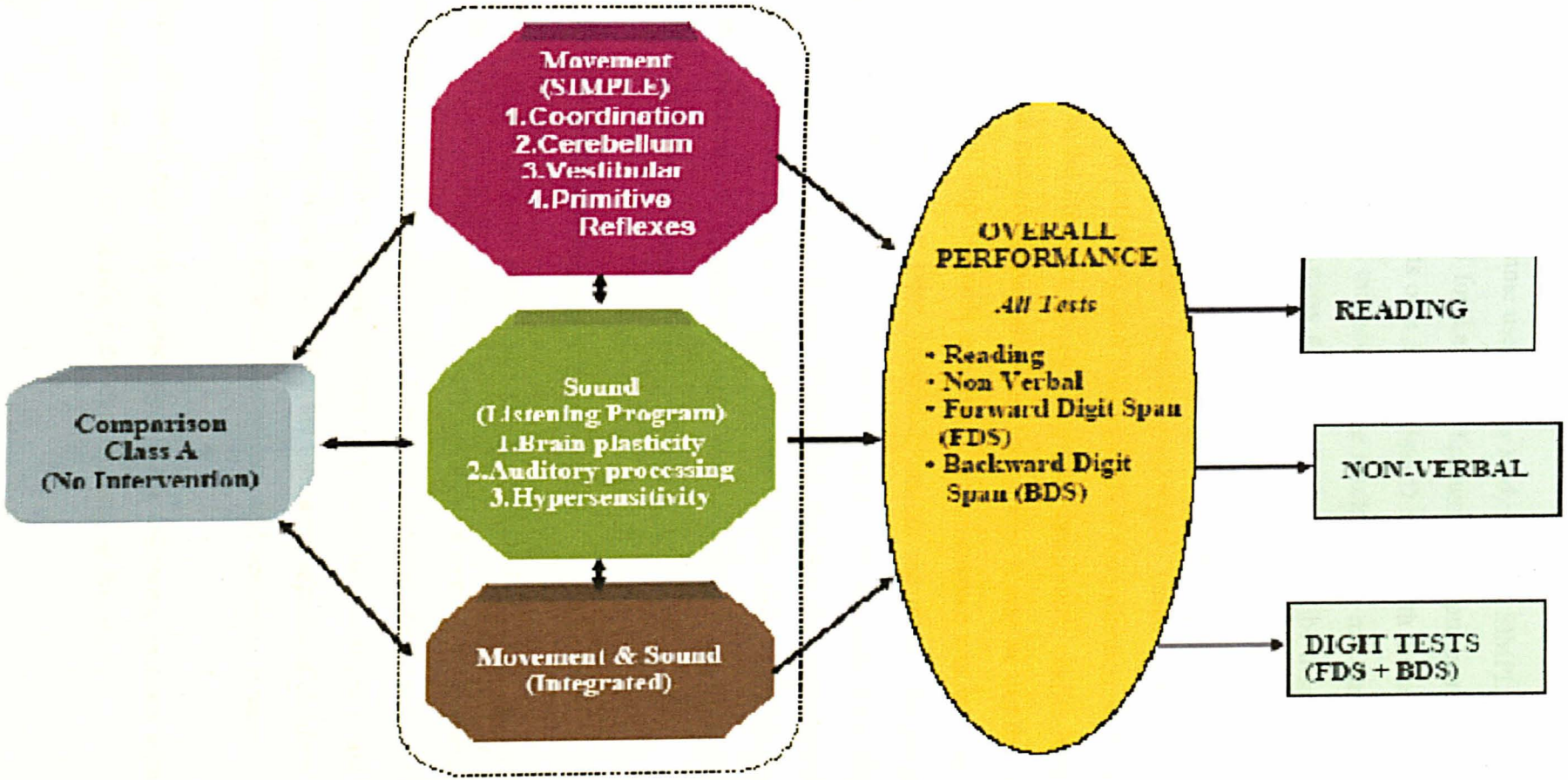
the reading scores (chi square 3.972.df1, p=.046). The class that completed the integrated intervention (class D) also showed a significant improvement (chi square 7.768.df1, p=.005) in overall performance compared to class A (no interventions) but not in comparison to class B (movement intervention) or class C (sound intervention), refuting the hypothesis that the two programmes integrated together would have even more of an impact than the programmes carried out individually. An attempt to explain why this may have occurred will be offered in the following sections as each of the findings is discussed.

Table 8-1 Kruskal-Wallis analysis

Classes	Class A	Class B	Class C	Class D
Intervention		Movement	Sound	(Integrated)
Overall performance	Comparison	p=.004	p =.253	p =.005
Reading test		P=.982	P=.046	P=.318
Non-verbal reasoning		P=.699	P=.280	P=.646
Forward digit span		P=.003	P=.072	P=.065
backward digit span		P=.017	P=.095	P=.132

In the following sections, each of the interventions will be discussed in relation to the comparison class A. In the first instance the overall results will be discussed followed by a discussion of the reading analysis, the non-verbal reasoning analysis and finally the digit span analysis (forward and backward). In addition there will be discussion on the relationship of the integrated programme to the movement and sound interventions individually in order to answer one of the original hypotheses put forward; that the integrated programme will have more of an impact than the individual programmes. The diagram below, Figure 8.1, illustrates this sequence.

Figure 8-1 Sequence of discussion



8.3 MOVEMENT INTERVENTION

The movement programme used in this study was the SIMPLE (Sensory Integration Movement Programme for Learning Enhancement) programme. This intervention was run in class B on its own and in class D along with the sound intervention (The Listening Program). In this section the results of the movement programme on its own, but in relation to class A (no intervention) will be discussed. The movement programme as part of an integrated approach will be discussed in a separate section below. The principles behind the SIMPLE programme involved activities that tried to affect the vestibular system (vestibular based activities), the reflexes (developmental activities), and the cerebellum (coordination activities). As already discussed in the literature review in chapter three, other studies have supported the premise that movement has an impact upon these. It may be that the reason that there was an overall improvement in children's performance was because some or all of these areas may have been addressed through the movement programme. In the following section the overall performance will be discussed followed by the individual test results (reading, non-verbal, forward and backward digit span test). The forward and backward digit span test will be discussed in the same section as they measured very similar elements. The discussion of the sound intervention and the integrated intervention will follow this format.

8.3.1 Overall performance and movement

Based on the present study analysis the results showed a significant (chi square 8.361.df1, p= 0.004) improvement in children's overall performance i.e. in all four components: reading, non-verbal reasoning, forward digit span and backward digit span in combination. An explanation as to why this occurred could be because the movement programme impacted on the following aspects of children's development: coordination, primitive reflexes, cerebellum, and vestibular system.

Each of these areas will be discussed in the following sections with relation to the overall improvement shown in the data analysis of this study.

8.3.1.1 Coordination

The findings in this study are consistent with several other studies which looked at the link between reading difficulties and motor coordination (e.g. Dewey et al., 2002; Fawcett and Nicolson, 1992; Kadesjo and Gillberg, 1998; Kaplan et al., 1998; Theberge, and Zvi, 1995; Maeland 1993; Nicolson and Fawcett, 1990, 1994, 1999; Ramus, Pidgeon, and Frith, 2003). A positive impact on child performance was established through the various interventions used by these other authors.

One of the aspects that the SIMPLE movement programme aimed to improve was coordination which has been seen to have an impact on children's development. Dewey et al., (2002) investigated problems of attention, learning and psychosocial problems with a group of children with developmental disorders. Results showed that children with Developmental Coordination Disorder (DCD) and suspected DCD obtained significantly poorer scores on measures of attention and learning (reading, writing and spelling). Since coordination is part of developmental disorder there seems to be a link here. O'Hare and Khalid (2002) reported a high risk of reading and writing delay for children with Developmental Coordination Disorder. The results were similar to the findings from other studies (Dewey et al., 2002; Kaplan et al., 1998; Sugden and Wann, 1987). A similar pattern was reported for children with DCD and learning difficulties (LD) by Jongmans et al. (2003). This was also supported by Iversen et al. (2005) who investigated motor problems in two groups of poor readers compared to good readers. Their study showed a strong link between reading difficulties and motor coordination problems; more than 50% of children in poor readers showed signs of motor coordination difficulties.

Sensorimotor development may also have been affected through the SIMPLE programme leading to an improvement. This is supported by Schaefer et al. (1989) who emphasised the importance of sensorimotor foundations in learning. Kephart (1971) also considered a child's ability to integrate sensory information as decisive to learning. This is backed by Goddard (1982) who argues that sensorimotor behaviour provides the essential readiness success for learning. Palmer (1984) also found a positive link with movement and reading.

It is evident from the discussion in this section that there is a link between motor coordination and learning.

8.3.1.2 Primitive reflexes

Another aspect on which the SIMPLE programme was intended to have an effect was the reflexes; studies have linked the reflexes with child learning. This is supported by various studies such as McPhillips et al. (2000) and Houghton and Chapman (1999). Morrison (1985) linked the lack of reflex integration into the developmental/coordination/sensorimotor debate and stated that there was a link between primitive reflexes beyond the age at which they should occur and learning difficulties, including reading. McPhillips et al. (2000, p 537) supported this with their study on the persistence of reflexes and state that 'this study provides further evidence of a link between reading difficulties and control of movement'.

Houghton and Chapman (1999) also demonstrated improvements in reading. They concluded that retention of primitive reflexes may also be linked to academic difficulties. The movement intervention study by McPhillips et al., (2000) showed that it was possible to reduce the level of Asymmetrical Tonic Neck Righting reflex interference and this led to significant progress in reading and writing skills. This link with primitive reflexes and learning as assumed in the present study, was also supported by further research by McPhillips and Sheehy (2004) who investigated retained reflexes in a primary school and supported their earlier findings. McPhillips and Jordan-Black (2005, p 101), again investigating the link between the reflexes and children's performance concluded that there was a 'link between the attainment of core educational skills and the interference that may result from an underlying developmental deficit the attainment of core educational skills'.

Their study implied that persistence of the ATNR reflex was significantly predictive of attainments in reading ($t = -8.34$, $p < .001$), spelling ($t = -8.00$, $p < .001$), non-word reading ($t = -16.15$, $p < .001$), and verbal IQ ($t = -4.71$, $p < .001$).

Similarly, Goddard–Blythe (2000) found that a movement intervention had a significant impact on reducing the levels of ATNR persistence in children and that this was associated with significant improvements in reading and mathematics. The

authors concluded that the programme could be used to complement other strategies, for children's learning.

The findings in this present study, which views reflexes as a neurological function, are consistent with the work of Goddard–Blythe (2005) who found that children who had scores of more than 25% on tests for neurological dysfunction and whose reading age was less than their chronological age at the outset also showed small but significantly greater progress in reading than children who did not take part in the programme. Blythe (1992) also concluded that 85% of those children with specific learning difficulties that do not respond to various classroom intervention strategies have a cluster of aberrant reflexes. He argued that as long as these reflexes remain undetected and uncorrected, the educational problems will persist.

This has implications on the variety of strategies and interventions that were put forward by the government to raise children's learning and performance such as the High Reliability Schools Project (Reynolds et al., 2001), The National Literacy Policy (1998), the National Numeracy Policy (1999) Reading Recovery (Burroughs–Lange 2005) and The Literacy Pledge (Cuckle and Shorrocks-Taylor 1999). There were others such as the Manitoba School Improvement programme (Earl et al., 1998) which had strong but not lasting changes; the Leverhulme Numeracy Research Programme (Brown et al., 1997) where the Year 4 data showed that the average percentage of children successful rose by only 3%; and the District M study (Gallucci et al., 2003) in which positive results were not shown across all schools.

The findings in this present study may form some part of the solution to understanding and tackling the persistent problem of the failure of some and the lack of consistency and sustainability of any improvements. The theory behind 'Success For All' intervention was from a move towards early intervention and not remediation. This commitment was concerned with the aspect of the child being able to read but in some ways supported the premise of the present study; that in order to raise child learning and performance the underlying causes have to be dealt with and one of these causes could be the persistence of the reflexes. It is evident from the discussions in this section that there is some link between the primitive reflexes and learning.

8.3.1.3 Cerebellum

The SIMPLE programme may have had some impact on the cerebellum. It is well established that movement is linked to the cerebellum in the brain and therefore in completing the SIMPLE movement programme the cerebellum was utilised. In 1995, at the Annual Society of Neuroscience Conference, 80 studies were mentioned that suggested strong links between the cerebellum and memory, spatial perception, language, attention, emotion, non-verbal areas and even decision making. These findings strongly implicate the value of movement in affecting cognition. The role of the cerebellum is also implicated in several studies with dyslexic individuals, which point to motor problems and abnormalities in muscle tone as common symptoms (Fawcett and Nicolson, 1992, 1999; Nicolson and Fawcett, 1990, 1994, 1999).

One of the activities in the SIMPLE programme was movement sequences which were designed to help automisation skills. The concept of automatisation refers to the gradual reduction in the need for conscious control as a new skill is learned. Nicolson and Fawcett (1990, 1994) suggest that 'incomplete mastery' characterises many other features of dyslexic performance, such as problems learning to ride a bicycle or tie shoelaces. However, a general 'automatisation deficit' would be most evident during complex, highly demanding, multi-sensory tasks such as learning to read and write. Research findings in several studies concluded that cerebellum plays an important role in this type of deficit (Fawcett, etal., 1996; Nicolson et al., 2001 Nicolson and Fawcett 1999).

8.3.1.4 Vestibular system

The other aspect on which the SIMPLE programme may have had an impact is the vestibular system. There were activities within the SIMPLE programme to try to address the problems of balance, which are based in the vestibular system. The overall improvement findings seen in this present study may have occurred because of this. This is supported by de Quiros (1976) who noted that a number of primary school children, when tested, had learning disabilities without specific cause. He found that fifty two children out of sixty three had 'abnormal vestibular responses',

which contributed, amongst other things, to 'motor problems in reference to reading and writing, and loss of interest in school learning' (De Quiros, 1971).

Similarly, Smith et al. (2001) developed a programme based on the principles of balance training (e.g. Belgau and Belgau, 1982). Reynolds et al., (2001) who supervised the study concluded that cerebellar and vestibular signs were substantially alleviated following the programme which included repetitive coordination and vestibular activities. These were the kinds of activities that were included in the SIMPLE programme. They also found significant improvements in fundamental cognitive skills including working memory, phonological skill and semantic fluency, again these supported the findings in this present study. A component of working memory was measured by the backward digit span and the forward digit span. In the present study a significant difference was found at 0.05% (chi square 5.732 .df 1, p =.017) for the BDS and (chi square 8,975 .df 1, p =.003) for the FDS. This leads to the suggestion that the SIMPLE programme may have had an impact. McPhillips et al. (2000) provided further evidence of a link between reading difficulties and movement in children.

It is evident from the discussions in this section that there is some link between the vestibular system and learning, since the SIMPLE programme was trying to impact the vestibular system in terms of improving balance and this may have in turn led to the overall improvement in the results.

8.3.2 Reading results and movement

The analysis for the reading test indicated that there was no significant difference at 5% (chi square .000 .df 1, p = .982) in performance after the movement programme intervention. One explanation of this could be related to the fidelity of implementation that is, to the extent to which an intervention is implemented as intended (Gresham et al., 2000). The agreement when setting up the research with the school and the teachers was for the movement programme to be completed three times a week and for the bilateral integration sequences to take place everyday in class for five times a week. However due to a change in headship this original agreement was not honoured. Secondly, reading is a taught skill and the reading test was used to reflect crystallized intelligence (Murphy and Davidshofer, 1994). Since

one of the aspects of crystallized knowledge is about knowledge acquired through experience, it could be that only once underlying problems are addressed this allows for the skills required in reading to be put in place and therefore to establish whether this area has been affected the impact should be measured after a period of six months, to allow for the remediation to take place. In a nutshell, the movement programme may be able to alleviate some of the underlying problems that could affect reading, but remediation has to be allowed to take place once these underlying causes have been addressed.

8.3.3 Non-verbal reasoning tests and movement

Likewise, in terms of the non-verbal reasoning test, there was no significant difference (chi square .149 .df 1, p =.699) between class B and class A. Once again, this could have been because of the divergence from the original plan and agreement, as explained in section 8.3.2. In addition, none of the interventions showed an improvement in this test which was used to measure a form of fluid intelligence.

8.3.4 Digit span test and movement

The analysis of the backward digit span and the forward digit span were both statistically significant. Since these two measures are components of working memory (Gathercole and Pickering, 2000) they will be discussed together in this section. In the backward digit span there was a significant difference at 5% (chi square 5.732.df 1, p =.017) between class B and A, and this was echoed in the forward digit span test 5% (chi square 8.975 .df 1, p =.003).

These findings are consistent with the view of Gathercole and Pickering (2000) who concluded that the intellectual operations required in mathematics and science are constrained by the general capacity of working memory. Both the forward and backward digit span was improved and these are components of working memory. This has other implications, for example in the area of numeracy skills.

It has also been shown in several studies that children with poor mathematical abilities show deficits in complex working memory span tasks (Bull and Scerif, 2001; Mayringer and Wimmer, 2000; Siegel and Ryan, 1989) and therefore this has further implications for raising children's learning abilities.

One of the premises of the SIMPLE programme was that the performance of specific movements would have an impact on cognition. Since the digit span was raised, and from various other studies, it could be concluded that this could have impacted working memory and thereby helped raise children's performance in these tests. In support of this, Smyth et al. (1988) found that participants' retention of simple movements in sequence was comparable to their retention of verbal information. Other studies have found evidence that working memory deficits are more common in children with special needs than those without (e.g. Alloway et al., 2005b; Pickering and Gathercole 2004). Also, existing literature makes links between measures of verbal working memory and reading (e.g. de Jong 1998; Swanson, 1994), mathematics (e.g. Bulland Scerif 2001; Mayringer and Wimmer 2000; Siegel and Ryan 1989) and language memory and learning in children with DCD and learning difficulties comprehension (e.g. Seigneuric, et al., 2000), as well as attainments in National Curriculum assessments of English and mathematics (Gathercole and Pickering, 2000; Gathercole, Pickering et al., 2004b; Jarvis and Gathercole 2003). It is evident from the discussions in this section that there is a link between memory as measured by the digit span test and learning.

8.4 SOUND INTERVENTION

The sound therapy (TLP) intervention was run in class C on its own and in class D as an integrated approach along with the SIMPLE programme. In this section the analysis of the results of The Listening Program (TLP) alone, will be discussed in relation to the comparison class (no intervention). The Listening Program was designed to help balance and restore ability to listen to and process sounds across the auditory spectrum, from 20 to 20,000 Hz. The programme delivered auditory stimulation to the brain, designed to stimulate the brain and to impact on the ability to process sound and reduce hypersensitivity. These three areas: brain plasticity, auditory processing and hypersensitivity will be discussed in detail in the following sections. The literature review in chapter four revealed that other studies have supported the premise that sound therapy has an impact on some or all of these areas. In the following section the overall performance will be discussed followed by the individual test results (reading, non-verbal, forward and backward digit span test).

The forward and backward digit span test will be discussed in the same section as they measure very similar elements.

8.4.1 Overall performance and sound

Based on the present study analysis the results for the overall improvement did not show a statistical difference (chi square 1.305 .df 1, p =.253) between those who received sound therapy and those who did not. This could be due to two main reasons. Firstly at the planning stages of the study the recommendation for the TLP intervention was a completion of one cycle or a minimum of twenty hours listening time. The recommended minimum listening times for the initial cycles of TLP are now set at two cycles at 40 hours, after further research and development by advanced Brain Technologies. Secondly, the effects of sound therapy have been ongoing by Beelan et al., (2005) who examined the effects of a sound therapy of Hemisphere Specific Auditory Stimulation (HSAS) by Johansen. Immediately after the therapy, results showed improved audiograms and statistically significant changes of auditory laterality and statistically significant improvements in decoding, spelling, reading aloud, phonemic analysis, rapid naming, visual memory and behaviour. Nine to ten months after completion, although the post-test results taken immediately after the therapy showed no significant improvement from the pre-test scores, the results for the long-term effects showed that for auditory memory improvement was significant p=.026. In addition the following results also showed an improvement: technical reading (decoding) p= .023; reading aloud p=.003; spelling, p=.004, sound processing, KLEPEL: non-word-test p= .002 and phonemic analysis p= .002. This was consistent with a study completed by Trehearne (2003) who found that in all processes studied, progress was evident several weeks after completion of The Listening Program and continued for up to ten months afterwards. Thus, more time may have been required to allow for the full impact of TLP to be revealed.

Although there was no significant difference in the overall performance, the idea that positive impact may have been initiated was supported by the findings in this present study in the analysis of both the digit span results. In the backward digit span analysis, although there was no significant difference at 5% (chi square 3.247 000 .df 1, p =.095) there was a difference at 10% and forward digit span analysis showed that there was no significant difference at 5% (chi square 3.247 .df 1, p =.072), but

again there was a difference at 10%. This indicated that there were positive changes taking place.

Another consideration to take into account is that the sound therapy may have affected other areas such as behaviour, which were not measured in the present study. For example, Gilmore (1999), when studying the efficacy of the Tomatis sound therapy with children with learning and communication disorders reported that positive changes occurred not only in auditory processing cognitive and linguistic aspects, but also in personal and social adjustment and psychomotor skills. Consistent with this, Beelan (2005) found an improvement in behaviour and similarly, Calhoun (2006) concluded that in her study pupils demonstrated stronger pro-social skills and better mental status.

In terms of raising children's learning, findings that link better pro-social skills with earlier reading acquisition have also been explored by Miles and Stipek (2006). Erickson et al. (2005), when investigating the relation between auditory processing and attention and memory, showed that Auditory Processing (AP) measures significantly correlated with each other as well as with some measures of attention, memory, and behaviour ratings.

Fjordbo (2006) believed that it was very difficult to define APD as there are many facets to this problem. This has been the case with the research in sound therapy to date, not only are there so many different types of therapies available, affecting different aspects, but there are so many kinds of problems which makes it difficult to pinpoint exactly where and whether improvements have occurred, such as the case with behaviour. Improvements can only be seen to have occurred if the relevant constructs have been measured in the first place. Although there was no significant improvement in overall performance in relation to the sound intervention in this study, there was an improvement in reading, which is discussed next.

8.4.2 Reading and sound

Analysis of the reading test indicated there was a significant difference between class C and class A at 0.05% (chi square 3.972 .df 1, p = .046). This is consistent with other studies in areas of communication, learning and social pragmatics (Rourke and

Russell, 1992; Kershner et al., 1986; Mould, 1984 and Gilmore, 1985). Jeyes (2004), in her study on the impact of The Listening Program in a school, showed that seventy-nine percent of the children showed progress well above average in at least one area of mathematics, language and reading.

Again, the analysis of the reading results using The Listening Program were supported by Calhoun (2006) who found with two cohorts in 2005 and 2006, significantly greater growth in phonemic awareness, reading tasks reading comprehension, prior knowledge and reading rate. In addition, in his study these improvements in reading were accompanied by improvements in auditory and motor skill tasks. Added to this the experimental group demonstrated stronger pro-social skills and better mental status. It is significant that motor skills improved in Calhoun's study and the explanation may be that that the intervention had an impact on the vestibular system; the fact that the vestibular system contains the apparatus in the body for listening, it also affects balance and which has shown to be implicated in the ability to read (de Quiros, 1996; Smith et al., 2002; McPhillips, 2000), helped to form the initial plans to run the two interventions together. The Calhoun (2006) study showed that the experimental group gained about two years of reading level, on average, while the control group gained, on average, a year or less.

The TLP findings in this present study are also consistent with Sohlman's (2000) findings with a different sound therapy HSAS. He found that there was an improvement in reading. Pre-tests showed the mean error rate before the therapy was 33.33% (SD=13.05). After the therapy the mean error rate was 14.00% (SD= 9.24). d =1.73. Also, the mean error rate for the age matched controls was 13.50% (SD=6.13). Parents and children involved in this study reported that reading and spelling had improved more than expected. This is consistent with a report published by A Chance To Grow/New Visions School (2001) where it was reported that a group of 50 students following a similar HSAS programme to that used by Sohlman (2000) programme made an average gain of 1.56 years on the Gates-MacGinitie test (measuring vocabulary understanding and reading comprehension skills), while the students who did not participate in this programme made a 0.93 year gain on this test.

One of the aims of TLP was to deliver auditory stimulation to the brain, and hence make an impact on auditory processing. Espy et al., (2004) reported improvements from such therapy believing that sounds are important in later reading ability.

The link between auditory processing and reading is supported by the fact that studies have repeatedly shown that children with reading difficulties have trouble identifying words that rhyme (e.g. Bradley and Bryant, 1978). This is supported by McGuinness (1997) who stated children needed to be trained to hear the sounds of the language.

It seems reasonable to state that to be able to do this, auditory processing should be adequate, for as Tomatis (1958) claimed, you can only reproduce what you can hear. This was more fully discussed in chapter 4. Therefore, it seems that the ability to process sound effectively is of great importance in the ability to read and this could explain the improvement made by the TLP class in this study. It could be that TLP improved dichotic listening, which Näslund, et al., (1997) reported to predict reading performance.

Just as the analysis of the reading results of TLP raised reading levels in the present study, Korpilahti et al., (2002) concluded that ADT/HSAS training could be used to reach better auditory discrimination and, by that means, help children to acquire language. Consistent with this Bertucci et al., (2003) found reading disabilities were linked only to less well-defined vowel categories than the control group.

The premise that TLP impacted on the ability to process sound effectively is stressed in a study on dyslexics by Miller-Shau., (2005) who believe dyslexics need help in improving processing to help their reading.

Even without specific sound therapy, music has been shown to have an effect on learning. Two studies conducted by Hallam and Price (1997) used music in the background. In Study 1, with children with high disruptive behaviour, music was played in the background. Results showed a significant differences at $p = .002$ level ($t = -4.7$, $df = 8$) in completing maths problems between children who listened to background music and those who did not. Results also showed less rule breaking

when the music was on at .001(t =4.89, df =8). The correlation carried out showed negative associations, r=.-47, p=.036. This negative association, according to the researchers, suggested that the improvement in the behaviour was to do with music. Study 2 revealed that the mean for those listening to the background music was 34.9 (SD 7.7) problems solved and without background music 27.3 (SD 7.8). This difference was statistically significant (p =.02). Thus it seems that it is just not in reading that sound therapy could be beneficial.

The following sections highlight some of the reasons why TLP may have raised the reading levels. Firstly, in relation to the theory of brain plasticity, secondly in relation to efficient auditory processing and thirdly in importance of reducing hypersensitivity.

8.4.2.1 Brain plasticity

The Listening Program was designed to stimulate or 'exercise' the different functions of the auditory processing system. The premise is that there will be changes through the sensory experience of listening to the sound therapy in the area of brain plasticity. Neuroscientists Elliot (1999) stated: brain hardware is not fixed, but can be changed. Johansen (1992) verifies this and links plasticity to auditory perception, and says it can be improved with auditory stimulation. Compatible with this Brown (2001) argues that music and language functions are linked in the brain. This could be an explanation as to how TLP affected the reading. Also, according to Diamond (1988), growth factors can be produced at any age so this leaves the possibility again for the intervention to be effective in the sense of the ability of the brain to receive an intervention such as TLP. This idea is supported by the work by Buonomano and Merzenich (1998) who suggest that the cortex can be reshaped by experience.

Supporting this view of brain plasticity is research reported in 2006 Society for Neuroscience which indicated that after children with reading failure completed intensive phonemic and phonics instruction, their reading skills improved. A review of many NIH-supported behavioural and brain imaging studies showed that reading strategies that teach phonemic and phonics skills, especially early in elementary school, significantly improve a child's reading skills more than instruction that does

not teach these skills (Society for Neuroscience, 2000). Thus this is of great importance to the government, as discussed earlier.

In support of this paradigm of brain plasticity and the impact of TLP are brain imaging studies and post-mortem examinations of individuals with dyslexia, learning disabilities, ADHD, and normal controls. These have revealed functional, morphologic and structural differences in the auditory areas of the brain that are activated when listening to simple tonal complexes, language and music (Galaburda and Kemper; 1978; Hynd et al., 1990, 1991); thus once again showing the link between sound therapy and language. This link is supported by MEG and PET data (Tervaniemi et al., 2000) indicating that the earliest auditory processing stages do not differ between speech and music sounds. Recanzone et al. (1993) trained owl monkeys to make fine-pitch discriminations in selected regions of the auditory frequency spectrum. Tonotopic mapping carried out showed that the cortical area tuned to the trained frequency spectrum was enlarged by a factor of 2 to 3 compared to untrained monkeys. This, and other experiments by Buonomano and Merzenich (1998), all support the theory of the plasticity of the brain and hence the rational for TLP. Merzenich et al., (1993) concurs that it has been found in an animal model that auditory discrimination abilities may progressively improve with practice.

8.4.2.2 Auditory Processing

The Listening Program was also developed to enhance auditory processing and this could have impacted upon the improvement in reading. Auditory processing problems can be seen in many ways. Some children may experience difficulty reading aloud due to an inability to associate visual and auditory symbols. There may be difficulties with auditory discrimination. There may be auditory distractibility, or hypersensitivity to loud sounds and large differences between verbal and performance IQs (Musiek and Geurkink, 1980). Some children with auditory processing weaknesses may have difficulty perceiving and discriminating sound, attending to sound, localizing sound as well as other problems (Bellis, 1996; DeConde and Gillet, 1993). Auditory discrimination is the ability to automatically notice, think about or manipulate the sounds in language according to Torgesen (1997). Therefore any problems in this area may have an effect on reading, spelling and writing skills that the government are striving to raise. The fact that in this study

scores on the digit span showed an improvement after exposure to TLP supports the view that the intervention was successful in enhancing auditory processing.

Research in the area of auditory processing has to led to the conclusion that many other types of disorders can coexist with or mimic auditory processing weaknesses, and in fact a lot of the research on sound therapy has been completed with children exhibiting such disorders which makes it difficult to identify exactly which improvements, if any, can be attributed to TLP or similar interventions. Consequently, more research is required with samples of 'normal' children and sub typing the different categories. In terms of the interventions in this study it is interesting to note that only the sound intervention improved reading test scores.

Aspects of auditory processing that could have improved due to the intervention of TLP could be follows:

a) Auditory Decoding Deficit (primary auditory cortex may be the problem) may have improved which is important for phonemic discrimination (Koch, et al., 1999) so that the information is processed quicker and more accurately.

b) Output-organisation deficit may have improved so that problems with sequencing, recalling, and/or expressing an answer were reduced for these children.

c) Integration deficits may have improved so that children had who difficulty across modalities with any task that requires efficient inter-hemispheric communication improved. Cases of integration deficits delay in responding and problems may appear in linking auditory and visual information together (Bellis, 2000). Supporting this view, Gilmor (1989) stated that the way we process sound is of vital importance and the ability to process the sounds of language may affect the ability to interpret the written form of language. Reading is a visual process but it is the sound which gives meaning to the letter. Poor integration of sounds into language is likely to cause problems with the written form and result in poor spelling and comprehension. It seems that the process of decoding letters into sound is more efficient when auditory processing skills are not affected.

d) Auditory discrimination may have improved. This is the process used to discriminate among sounds or different frequency, duration or intensity (e.g. high/low, long/short, and loud/soft). It is the ability to automatically notice, think about or manipulate the sounds in language (Torgesen, 1997). It refers generally to the awareness of words, syllables or phonemes. A problem with auditory discrimination can effect following directions, listening, understanding, reading, spelling and writing skills. It can result in poor auditory memory and auditory fatigue. Swain (2005) found that children with poor auditory discrimination or acute hearing can tune out some sound as this becomes a stress for the system. This may develop into a habit and can have an effect on hearing specific frequencies. Tuning out has an implication in the classroom situation and in the ability of children to learn effectively. Based on the results from a research project, Richardson et al. (2004) suggested that individual differences in auditory processing skills are related to individual differences in the quality of phonological representations, reading and spelling.

e) Auditory latency may have improved so that lapses or hesitation delays in response time, when presented with auditory stimuli, become more efficient. To support this, Hallam and Price (1997) in their study using Tomatis sound therapy showed that prior to the treatment, average delays in processing were present 63% of the time. Following treatment, delays were reduced by 24.23%. This was supported by Swain (2005) who found improvements in auditory latency.

Auditory processing disorder is a very complex and controversial issue. It cannot be said that all children in the study had a problem in this area but it could have been a consideration. However, this study shows that sound therapy has implications for raising children's levels of reading.

8.4.2.3 Reducing hypersensitivity

The other way that TLP could have positively affected the levels of reading scores is by reducing sound sensitivity. TLP provides sound stimulation that aids the nervous system to better modulate sensory input. When modulating ability, there is often a reduction in abnormal sensory perception, especially with sound – reducing sound sensitivity (Advanced Brain Technologies). Swain (2005) concurs that children need

to be able to separate speech from other noise, therefore, if hypersensitivity was reduced this could help better reading scores.

Classrooms can be such environments with the constant scraping of chairs, noise from children moving about both inside and outside the classroom, air ducts blowing heat in and constant buzzing from fluorescent lights and from computers all affecting the input of information. Many studies support this view of hypersensitivity.

Martin and Clark (2000) described minimal auditory deficiency syndrome, a language-learning condition associated with erratic auditory input that echoes this premise. TLP could have reduced such problems which would explain improved the reading results.

Interestingly Kujala et al., (2004) reported data showing that long-term exposure to noise can lead to a persistent effect on central auditory processing and concurrent behavioural deficits. Speech-sound discrimination was impaired in noise-exposed individuals; furthermore, irrelevant sounds increased the distractibility of the noise-exposed subjects. So hypersensitivity to sound not only affects learning, but also behaviour, which in turn affects learning, as several studies have shown.

In order to learn, a child must be able to attend to, listen to, and separate important speech from all of the other noises at school and home. When auditory skills are weak the child may experience auditory overload and the impact of poor acoustics is more greatly felt. This makes learning more challenging and suggests a beneficial role for interventions such as sound therapy. It would seem that most people with auditory processing problems have normal intelligence and normal hearing sensitivity. However, the development of phonemic awareness may be hampered by minor and unrecognized auditory processing problems and hence the use of programmes such as TLP is important and has implications for raising children's learning. Sohlman (2000) supports this view; his study would appear to show that specific auditory stimulation has an effect on auditory laterality and on hearing sensitivity.

8.4.3 Non-verbal reasoning and sound

The analysis of the non-verbal reasoning test revealed there was no significant difference at 5% or 10% (chi square 1.167 .df 1, p =.280) between children who received the sound intervention and those who did not. In fact non-verbal reasoning did not appear to be affected by any of the interventions. In the case of sound therapy this could be due to two main reasons, as more fully discussed in section 8.4.1. Firstly, it may have been due to the completion of only one cycle instead of two cycles as discussed above. Secondly, the effects of the sound therapy have been shown to be ongoing and if retests are conducted straight after the therapy; some studies have shown that the results are not always conclusive, as there can be ongoing improvement for some time afterwards. This possibility was supported by the findings by Beelan et al., (2005) and by Trehearne (2003), which were discussed in section 8.4.1 on the overall performance and sound.

8.4.4 Digit span and sound

Analysis of the forward digit span (TAPS) results showed that there was no significant difference at 5% (chi square 3.247 .df 1, p =.072) but there was a difference at 10%. Similarly the backward digit span (TAPS) test revealed that although there was no significant difference at 5% (chi square 3.247.df 1, p =0.95) there was a difference at 10%. Therefore it can be surmised that there was a positive change taking place that may have further increased had post testing been done at a later stage, as in the studies of Beelan et al., (2005) and Trehearne (2004). These and their implications were discussed more fully in section 8.4.1.

In relation to this study, this improvement is important because of the suggestion that the primary function of verbal short-term memory is to support the long-term learning of the phonological structure of the language (Baddeley et al., 1998). Consequently, children with poor short-term memory skills will experience difficulties in learning to read, using the phonics method, as the government proposes in their mandate to be rolled out in 2008. This view has been borne out in developmental research and there is substantial evidence linking poor verbal short-term memory skills during childhood with specific difficulties in acquiring language

and scholastic abilities (e.g. Bowey, 2001; Gathercole and Baddeley, 1989; Gathercole et al,, 1999; Gathercole et al., Baddeley, 1992; Michas and Henry, 1994). Such difficulties are verified by Swain (2005) whose results indicated that prior to treatment of sound therapy overall immediate memory skills for digits forward (41 children) were placed at the 9.68th percentile and that following sound therapy these skills improved to the 46th percentile, reflecting an average improvement of 36.32%. Gathercole and Pickering (2000) too, investigated the relationship between child performance in National Curriculum assessments and working memory and found evidence for a direct link between the two. It was found that children failing to reach expected levels of attainment in English and mathematics performed poorly on central executive tasks involving both processing and storage of verbal material for brief periods of time. Also, children with learning difficulties performed poorly on the same working memory measures (Gathercole and Pickering, 2001). In addition at 7 years, children with high abilities in both English and mathematics scored better on working memory measures than children of low or average ability.

This is consistent with other evidence that children with learning difficulties in the area of literacy show marked deficits in complex working memory (de Jong, 1998; Siegel and Ryan, 1989; Swanson and Alexander, 1997), and suggests that the capacity to process and store material is very important in learning to read.

Both the forward and backward digit span analysis showed an improvement and these are components of working memory. This improvement has other implications, for example in the area of numeracy skills. Other studies have found evidence that working memory deficits are more common in children with special needs than those without (e.g. Alloway et al., 2005b; Pickering and Gathercole, 2004). The findings in this present study also fit within the existing literature on the link between verbal working memory and reading (de Jong, 1998; Swanson, 1994) as well as attainments in National Curriculum assessments of English and mathematics (Gathercole and Pickering, 2000; Gathercole, et al. 2004b; Jarvis and Gathercole, 2003). The storage component of working memory tasks are seen to be positively affected in the analysis of the results obtained in this study, and is extremely important when children are acquiring and applying phonic knowledge in reading and writing (Ellis and Large 1988; Frith, 1985). Other studies verify the importance of working

memory being a good indicator of a child's capacity to perform more complex activities such as reading (Gathercole and Alloway, 2004; Gathercole, et al., 2006; Swanson and Saez 2003). Alloway and Temple (2007) concluded that working memory was significantly associated with learning. Thus, the fact that working memory, as reflected in the digit span test, showed some improvement after exposure to TLP, suggests that TLP may indeed promote improved learning, as was manifested in the reading test performance in this study.

8.5 INTEGRATED INTERVENTION

In this class the two interventions, The SIMPLE programme and The Listening Program were combined together and run as an integrated intervention concurrently. In the following sections the overall performance is discussed in relation to the integrated intervention as well as in comparison to the individual interventions in classes B and C and also the original hypotheses, followed by the individual test results (reading, non-verbal, forward and backward digit span test). The forward and backward digit span test will be discussed in the same section as they are measuring very similar elements.

8.5.1 Overall performance and integrated intervention

The analysis of the overall performance showed that there was a significant difference at 5% (chi square 7.768 .df 1, p =.005) between the class that received the integrated intervention and the comparison class A. It should be recalled here that an overall improvement related to the movement intervention this was not the case in the sound intervention class C. This could have a bearing on the findings of the integrated intervention. However, it is difficult to conclude whether the improvement in the overall performance of the class who received the integrated intervention could be attributed to the movement intervention, since the sound intervention on its own did not show a significant difference, or whether there could have been a synergistic effect when the two were used together.

The other point to be mentioned at this stage is that the third hypothesis in this present study was that class D (integrated intervention) will perform better than class A (comparison class), class B (movement intervention) and class C (sound

intervention). However this original premise was not supported. What is of interest here is that the integrated class did not perform much better than the classes that were subjected to individual interventions.

Analysis using The Mann-Whitney test looked at the improvement of class D (integrated intervention) in relation to class A (no intervention), class B (movement intervention) and class C (sound intervention). The results are summarised in Table 8.2.

Table 8-2 Mann-Whitney analysis

Intervention comparison	Overall performance using Mann Whitney test
Class A -B	p =.039
Class A -C	p=.253
Class A -D	p=.005
Class B-D	p=.877
Class C -D	p=.481

The reasoning behind running the two interventions together was based on studies such as those by Nicholson and Fawcett (1998), who revealed that children with dyslexia suffered severe deficits in skills including not only phonological skill but also picture naming speed, bead threading and balance. This suggested a link between phonological skill and balance (motor skill). The link between auditory and motor skill tasks was also noted in the study by Calhoun (2005) and by Butler and Clarke (2003) in their pilot study using TLP and primitive reflexes where results showed a significant improvement. In addition to this the connection is based on the role of the vestibular system in both balance and in auditory processing and the implications both of these have on raising child attainment.

The vestibular system is well documented as supporting basic functions such as equilibrium, balance, proprioception (body in space awareness) muscle tone audition. This final area includes hearing, filtering and focusing auditory attention, sustaining auditory attention, and auditory input and vision. The vestibular and auditory systems

are linked anatomically by the vestibulocochlear nerve. In addition to this anatomical link, the vestibular and proprioceptive systems rely on information from muscle and joint receptors, working in tandem with one another. The vestibular system has projections, linking it strongly to the cerebellum, which not only regulates movement, but also provides a direct connection to the functions of the autonomic nervous system. Several other functions can also be affected as a result of over-stimulating and overwhelming the vestibular systems such as pulse rate, breathing, etc. All of this explains the link between the two systems and why the study was planned to explore the relationship between the two.

However, it seems from the results of this present study that there is a possibility of overload; the stimulation of the two interrelated systems, may have been overlooked. This could have been the reasons not only for the discrepancy in the reading results for the sound and the integrated intervention but also for the fact that the integrated intervention did not show the expected results of a greater improvement in comparison to the other three classes.

8.5.2 Reading and integrated intervention

Analysis of the reading test indicated that there was no significant difference at 5% (chi square .997 .df 1, p =.318) or at 10% between the class receiving the integrated intervention and the comparison class. This was an interesting finding, since on its own, the class exposed to the sound intervention showed an improvement in the reading test, yet as an integrated intervention this was not the case. There could be two reasons for this: the fidelity of experiment by class teachers and the implications of the overload theory. One reason could have been that in terms of the fidelity of implementation based on the information from the teachers involved in class D it was noted that this class missed some of the sound therapy sessions or cut some sessions short whereas in class C (sound intervention) the teacher was more consistent with the implementation. This could have had a bearing on the overall result, as could have the implications of the overload theory since the two interventions were being run concurrently.

8.5.3 Non- verbal reasoning test and integrated intervention

Analysis of the non-verbal showed test there was no significant difference 5% or 10% (chi square .212.df 1, p=.646) between the class receiving the integrated intervention and the comparison class. This was consistent with the findings in relation to the other interventions. As discussed more fully in relation to the sound intervention 8.4.1, it may be that after a delay, post tests would have shown some improvement as revealed by Beelan (2005) and Treharne (2003). In addition, the lack of significant improvement could have been because of the implications of the overload theory of the interventions utilised, as previously discussed.

8.5.4 Digit span test and integrated intervention

Analysis of the forward digit span test, between the class receiving the integrated intervention and the comparison class, showed that there was no significant difference at 5% (chi square 3.395 .df 1, p =.065) but there was a difference at 10%. The backward digit span test, between the class receiving the integrated intervention and the comparison class, showed that there was no significant difference at 5% (chi square 2.264 .df 1, p =.132) or at 10%. This was again an interesting result as the movement intervention on its own showed a significant difference at 5% which once again seems to implicate the overload theory in the findings. Analysis of the movement results revealed a significant difference at 5% (chi square 5.732.df 1, p =.017) on backward digit span and this was echoed in the forward digit span test 5% (chi square 8.975 .df 1, p =.003). In contrast, in the class that received the sound intervention, there was no significant difference at 5% (chi square 3.247 000 .df 1, p =.095), but again there was a difference at 0.10% in the backward digit span. Similarly the forward digit span results showed that there was no significant difference at 5% (chi square 3.247 .df 1, p =.072) but again there was a difference at 10%. Therefore, in both cases of individual intervention, the results of the digit span tests were better for children receiving the intervention than the comparison class. The fact that this was not the case for class D, integrated intervention, once again points to the overload of the vestibular system. This has implications for further research, as it may be deemed better to run the therapies in an integrated experiment one after the other, to counter effect this overloading of the system – if this is indeed the explanation in this study. It may also be possible to test the overload theory by running one class with two interventions concurrently and two interventions simultaneously.

8.6 SPEARMAN'S RHO CORRELATION ANALYSIS

The analysis of the spearman's rho indicated important findings that revealed three main relationships as seen in Tables 8.3 to 8.5. These are described in turn below.

Table 8-3 Correlation between FDS and BDS

Comparison class A	0417 p=.027	0345 p=.072
Movement class B	0.644 p=.001	0.752 p=.001
Sound class C	0.808 p=.001	0.750 p=.001
Integrated class D	0.236 p=.209	0.204 p=.280

Firstly, as can be seen in Table 8.3 correlation results demonstrated that there was a statistically significant relationship between the forward digit span and the backward digit span for the comparison class (no intervention), the movement intervention class and the sound intervention class. However, the only increase was for the movement intervention class, from a correlation value of 0.644 p=.001 to 0.752 p=001, which indicates a strong correlation, as both of the constructs are measuring components of memory. The weak correlation for the integrated intervention class remained constant. Therefore it seems that movement intervention affected these two tests positively and these may be important in raising child learning and performance.

Table 8-4 Correlation between reading and non-verbal reasoning tests

Comparison class A	0.218 p=0.266	0.492 p=001
Movement class B	0.517 p=001	0.710 p=001
Sound class C	0.546 p=001	0.669 p=001
Integrated class D	0.466 p=001	0.625 p=001

Secondly, there was a significant relationship between reading and non-verbal memory constructs (Table 8.4) in all cases except for the pre test of the comparison

class (significant correlation values ranging from 0.492 to 0.710 p= 005). These correlations grew stronger in each case in all of the post tests indicating some significant relationship between these two tests. However, the Kruskal-Wallis analysis did not show a significant improvement with either of these tests, except in the case of the sound intervention, where reading was significantly improved.

Table 8-5 Spearman's rho correlations for sound intervention class

		Reading Test After	Non Verbal After	BDS After	FDS After
Reading Test After	Pearson Correlation	1.000	.669	.543	.527
	Sig. (2-tailed)	.	.000	.002	.003
	N	29	29	29	29
Non Verbal After	Pearson Correlation	.669	1.000	.546	.543
	Sig. (2-tailed)	.000	.	.002	.002
	N	29	29	29	29
BDS After	Pearson Correlation	.543	.546	1.000	.750
	Sig. (2-tailed)	.002	.002	.	.000
	N	29	29	29	29
FDS After	Pearson Correlation	.527	.543	.750	1.000
	Sig. (2-tailed)	.003	.002	.000	.
	N	29	29	29	29

Thirdly, as seen in Table 8.5, for the class exposed to TLP, all of the tests were statistically significantly correlated p<001 to each other (values ranging from .527 to .750). Thus it would seem to suggest that sound therapy helped all the relationship between different tests which improved reading, and since this pattern was not seen in any of the other classes, it would indicate that to raise the standards of reading all the abilities measured by all the tests need to be improved.

In summary, the analysis of the spearman's rho indicated that there was a strong relationship between the forward digit span and the backward digit span and this was understandable since they were both measuring components of memory. Therefore it seems that in raising children's levels of learning, these have to be taken into account. Secondly, there was a relationship between reading and non-verbal memory in all cases except for the pre test of the comparison class. This was interesting since reading did not improve in any of the interventions except the sound intervention. Thus it would seem to suggest that though non-verbal reasoning is an important element in learning, aspects such as memory need to be raised in order to improve reading. This has been fully discussed in the previous sections.

8.7 THE CHILD CENTRIC LEARNING EFFECTIVENESS PROPOSED MODEL

In the following section, based on the learning from this research, a model is proposed which is intended to address a variety of factors crucial to learning improvement. This model, depicted in figure 8.2, is derived from a variety of aspects both addressed in the critique of the literature and other aspects which have been investigated through this research. It transpired from this research that effective learning and development outcomes are heavily dependant on macro aspects, driven by government guidance and interventions in preparing the ground for educational models to cater for children's growth and development in a continuous and sustainable manner. Furthermore, schools have been found to have a key enabling role by preparing the right climate, developing the right models of learning and nurturing children's absorption of knowledge in the right way and with the right final outcomes.

The proposed model is described in the following sections. It is dependent on three things:

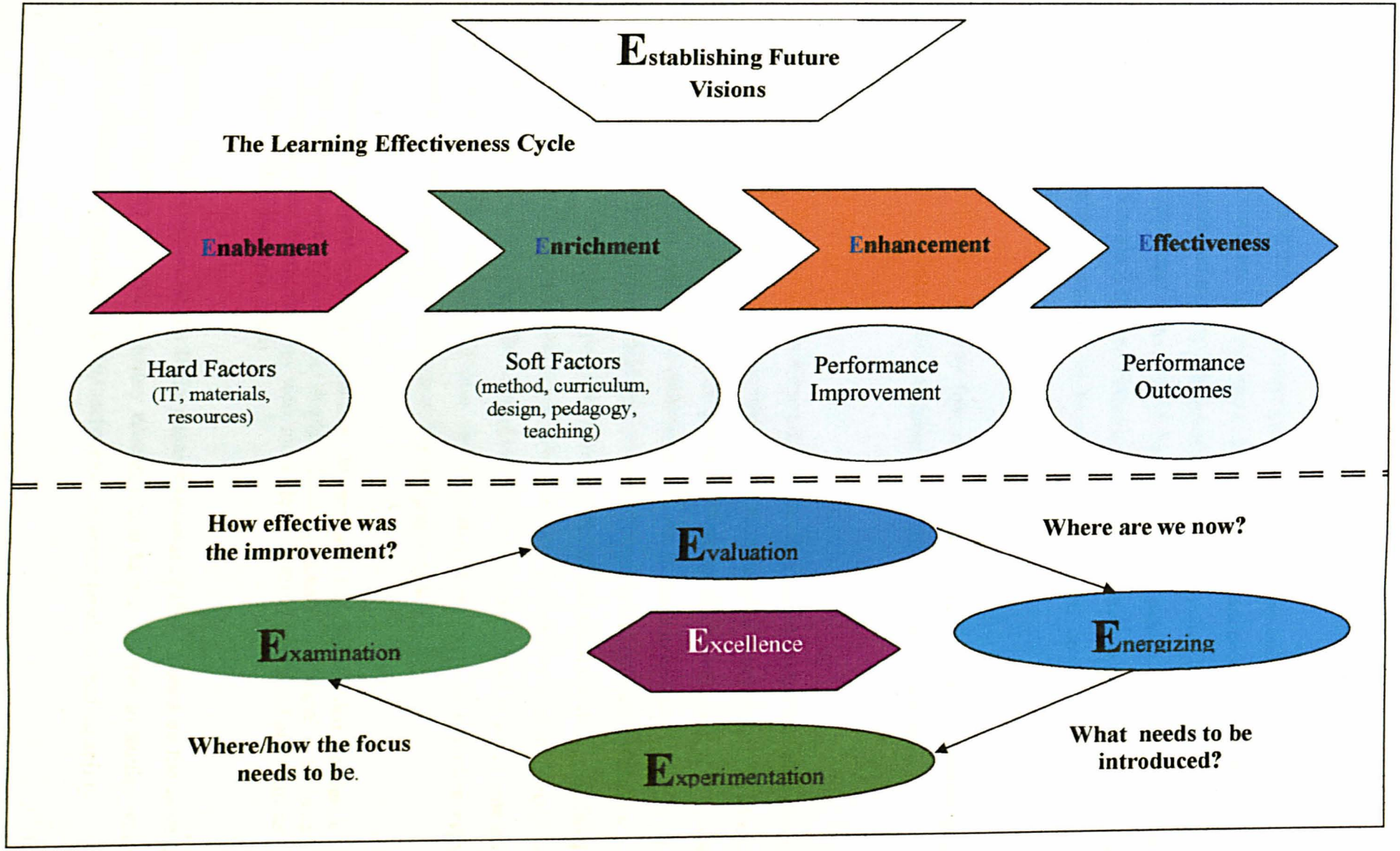
a) - Government inspiring learning growth and development for all children (top down).

b) - The child's learning experience being affected – focus on the child (linear).

c) - The schools striving to improve standards through empowerment (bottom up).

The government is concerned with improvement of standards and therefore its role is to establish the vision for learning and raising standards of children's education. The role of the government is to raise standards through guidance, research, policies and setting realistic standards based on children reaching their full potential. Learning is driven by government policy and clear vision and providing learning opportunities for all intending to raise standards and reach full potential (excellence).

Figure 8-2 The child centric learning effectiveness cycle (CCLEC)



The goal should be to create a flowing approach which focuses on high impact and high standards of effectiveness. The resources, strategies, interventions should be channelled at targeting the child and thereby enhancing the ability of the child to learn effectively – and not on the peripheral areas around the child, as has mostly been the case. The CCLEC (Child Centric Learning Effectiveness Cycle) is termed child centric which means all the endeavours have to be appropriate, holistic, developmentally sound, customised, fruitful learning experiences for the children.

The Learning Model is driven by four major elements which include: Enablement, Enrichment, Enhancement and Effectiveness. These are briefly described below:

8.7.1 Enablement

This is the role of leadership. It is about creating the right environment that can facilitate and induce an efficient learning experience, about providing the necessary resources and the materials i.e. the hard factors. The government needs to channel interventions and initiatives on sound education and child centred bases. It needs to consider carefully the developmental aspects of the child and perhaps reconsider its policies on the age at which academic subjects are appropriate to be introduced and when the child's readiness to learn is priority, and therefore, when developmental and emotional skills should be the key focus of the teachers. The compulsory starting age for school is six in nineteen European countries, including France and Germany, and seven in a further eight countries, including Sweden and Poland. The telegraph reported that:

> 'American research recently found that children who had "teacher-led, academic lessons" at the age of five did not display "lasting academic advantage" over those who began later. Moreover, they were more likely to suffer emotional problems as adults'. (The Telegraph, 2003)

Professor Brook's report on the DfES phonics seminar (2003) touched on the issue of the age of starting formal/compulsory education and he too referred to studies which implied that earlier starting ages ultimately result in lower levels of reading ability.

The environment of the school has to be conducive to learning as well. For example, there is much background noise in a classroom generated by several types of sources: heavy traffic, adjacent classrooms or corridors, uncarpeted floors, chair bottom squeaks and fans in the air conditioning system. Acoustically inadequate classrooms are one of the most insidious factors that are contributing to the countless numbers of students who have graduated from high school without the skill of being able to read and write. According to Elliot (1982) what is of major importance is the need to develop an education and learning model that allocates the school's resources in the right way and ensures that the goal is always to focus on the children and their learning experience.

8.7.2 Enrichment

These are the core aspects such as curriculum design, pedagogy and learning styles and teacher effectiveness. These should be well researched and appropriate intervention strategies, such as Reading Recovery, employed. The strategies used by the teachers should empower the teachers and enthuse the teachers and should be realistic. The child needs to be at the core. For example, teachers need to be trained as to how a child learns and aspects of the brain which are central to learning. This will bring in elements such as the importance of using a variety of learning styles in teaching, as more is understood about how the brain works with regards to learning.

Staff need to be motivated and enthused and strategies that help control and manage the behaviour of the children need to be a core part of teacher training. Striking the right balance between creative, academic and practical subjects is vital since the emphasis is on the well-being and development of the whole child. The teachers need to be helped to manage the workload which should be kept to a manageable amount, for example, eliminating unnecessary paperwork or meetings. Parents need to be involved in supporting their children. Creating the right ethos for educating children and providing the necessary requirements conducive to learning, such as healthy diet and physical exercise, should be part of the education of both the parents and the children.

A key area needs to be incorporated in the curriculum that develops and addresses emotional intelligence as well as academic intelligence, and physical literacy as well as literacy. The impact and importance of emotional intelligence is not only in being able to learn effectively but about children managing their learning and becoming responsible for their learning.

Developmentally, children need to be ready to learn and areas such as auditory processing and primitive reflexes need to be considered carefully, since they enable the child to learn efficiently and effectively. This does not mean that problems related to specific reading difficulties are not found in other areas (coordination problems, left right confusions, sequencing problems, several problems related to vision, problems with postural control and primitive reflexes to mention some) as shown in research (Zeffiro and Eden, 2000) and documented by Bein-Wierzbinski (2001), Goddard (1996), Nicolson and Fawcett (1994, 1995, 1999), Sohlman (2000), and by Stein (2001). Also by Sperling et al. (2003), Stein (2001, 2003), Talcott, et al., (2000) and Talcott et al., (2003).

The training for assessment and implementation of programmes if required needs to occur either at school level or teacher training level. All of these, teacher factors, factors with curriculum, factors with pedagogy, factors with learning styles, and factors with intervention (holistic improvements) – are of vital importance if the issue of raising child learning is to be addressed effectively and in a sustainable fashion.

8.7.3 Enhancement

The learning experience cannot be left on its own, with the underlying assumptions that because resources, policies and interventions are in place, effectiveness will ensue. This was one major criticism of previous strategies that have not worked, as well as the fact that they were not child centred. The purpose of this enhancement, as a key component of this cycle, is to ensure that interventions, approaches, methods and strategies implemented have a positive effect on learning experience and therefore, are more likely to yield the desired outcomes. Basically, specific performance improvement evaluations

have to be an integral aspect of any enrichment mix that is proposed. Enhancement of the learning experience is a key element of verifying and validating the appropriateness of the learning strategy adopted and the usefulness of any method or best practice approach that a school seems to adopt.

Child centred standards of improvement need to be established and any likely improvements noted and verified. This can be done through testing or assessments such as tests that assess the developmental stage of the child or the incidence of any aberrant reflexes which could affect learning. These might include:

i) Testing primitive reflexes.

ii) Measuring eye functions such as the ability to saccade, converge, diverge and accommodate, as well as binocular fusion, before teaching children to read.

iii) Checking auditory processing

iv) Checking fine and gross motor skills and coordination.

In Sweden, for example, children are screened for deficits in attention, motor control and perception at 6 years of age. These are factors that impact on preparedness for school and include language abilities and auditory processing skills. Therefore, children should be screened on entry to school.

All of the above tests assess whether the child is developmentally ready to learn effectively as discussed previously. In addition, emphasis must be placed on helping the child develop emotionally as well. This is more likely if the child is in control of his or her physical and can then wrestle with the emotional world and then, finally, with the academic world.

8.7.4 Effectiveness

This component reflects the final performance outcomes that schools and government seek to attain. This is how children can achieve benchmarking standards in the form of specific standards. These might not be the ones already in use. For example, the ability of the child to coordinate the body and eyes has a bearing on the child's ability to read effectively and efficiently, or on his readiness to read and ultimately literacy levels, just as the child's developmental ability to control his bladder has an impact on how quickly he can be potty trained.. Similarly if the child's short-term working memory has an impact on his overall performance as suggested in this study, or the child's auditory processing ability impacts on his ability to read, also as suggested in this study, these factors must be considered in standard-setting.

Since the CCLEM is proposed as an integrated, flowing approach, causal relationships can be established throughout the model, thus reflecting effectiveness not only as a final outcome but also through the knock on effect or causal impact that can be generated. For instance, it would be established through this model whether enablement approaches used in school are having the effect of making the learning experience better (enrichment). It would also be checked whether an enrichment strategy is actually improving the learning experience, and finally whether the learning experiences are positively managed and it could be expected therefore that the standards independently set can be easily achieved. Therefore the CCLEM depicted in fig 8.2 is based on the following:

1. A sound logic making experience through a child centred approach.

2. Integration of upstream activities that are concerned with planning, resourcing and enabling and downstream activities that are concerned with tracking improvement and measuring outcomes. It is vital to emphasise that schools should not become obsessed with outcomes. They should be driven by the needs of the child seeking to raise standards by having holistic strategies and learning methods that are most appropriate to and specific to the needs of each child, before becoming concerned with meeting aggregate standards and benchmarks set by the government. This is the only way

possible for them to validate and verify that all the strategies that a school undertakes are succeeding and having the desired effect on the development of each child.

The proposed model has an additional component which helps render the learning experience more dynamically oriented and therefore constantly subjected to innovation, change and improvement. This component is referred to on the CCLEM and at its heart is the drive to fulfil each child's potential. There are four stages to this, evaluation, energizing, experimentation and examination, in a closed loop approach.

This closed loop cycle can help schools evaluate and scrutinise each aspect of the CCLEM and modify add, enhance or introduce new ideas that will assist in making each of the key components more robust, more effective and producing higher impact throughout the cycle (like a hologram). This is done through a constant cycle of baseline evaluation (where are we now), gap identification and remedies (energizing). By having a focus on the key areas where the improvement or change might be required and under a final examination of the impact generated, the drive for achieving full potential can be continued and the overall effectiveness of the CCLEM cycle can be generated.

Current approaches used in schools, as far as learning effectiveness is concerned, tend to be missing the closed loop cycle which drives the improvement. In other words investment in raising standards, investment in new interventions and methods are done through a 'hit and miss' approach. The improvement cycle will assist schools in managing learning as a core process, in an intelligent, highly focused and common sense and controlled manner. It offers the following prompts and directional points.

1- A self assessment perspective: by asking the question 'where are we now?' and the search for likely gaps, opportunities for optimisation and improvement can be constantly identified.

2- Through a regular approach to injecting new ideas, implementing change programmes and introducing new innovations. This can help energize the drive for excellence for the end benefit of the children manifested in achieving their full potential.

3- Through a stratified approach to experimentation with new ideas and change programmes that focus on the areas of peripherals, preventing the dilution of effort that tended to occur with most change programmes to date.

4- Self-assessment is futile if there is no closed loop that gives a clear measurement that can prove whether or not innovative thinking and change programmes have brought about improvement. It is the role of school leaders to ensure that the areas subjected to improvement and change are examined (through measurement or assessment) in order to verify that 'the medication has worked'. However, the improvement cycle is never ending and has to be the engine of change, improvement and optimizing potential. In order to see where the gaps are in terms of children's development, it is necessary to have in addition, assessments at the start of a child's school life. These are developmental and not necessarily academic assessments.

By doing an experiment in a holistic way and looking at whether the interventions worked or not, the indications are that it is possible to enhance the learning experience of children, if the focus is on the child and everything that is designed and implemented is geared towards providing each child with a unique customized appropriate experience, since causal relationships can be established.

The complete experience of schools is the drive to achieve children's full potential and provide foundations for future learning effectiveness so that the government can benefit from helping to raising the achievement levels of children and the standard of education generally. The cross fertilisation and exchanges between various schools through the sharing of best practices can also be a mechanism for enhancing and raising school standards. In other words, this is an integrated perspective and a dynamic closed loop approach. It is recommended that all the key stakeholders contribute in the formulation

of learning and development for the future of all children, and that learning strategies in all schools are implicated through a generic integrated, flowing and child-centric model, incorporating internal and external influences.

The dynamic and closed loop approach of the model means that constant guidance, monitoring, measurement and an action orientated mindset is applied at all school leadership levels. Finally, the model suggests that outcomes will have relevance and significance and can provide the capabilities for moving further the innovative cycle of learning in the future.

8.8 SUMMARY

This chapter was concerned with the interpretations of the key findings emerging from the data analysis and had the main purpose of discussing the key outcomes. In relation to the various discussions, the following emerged:

(i) Results from the movement intervention revealed that there was a statistically significant improvement in the overall performance at 5% and in both the forward digit span and the backward digit span test at 5%, suggesting that both the forward and backward digit span are implicated in the overall improvement.

(ii) Results from the sound intervention revealed that there was a statistically significant improvement in reading at 5% and an improvement in both the forward and backward digit span tests at 10%.

(iii) Results from the integrated intervention showed that there was a statistically significant improvement in the overall performance at 5% and an improvement in one aspect in the forward digit span test, at 10%.

(iv) The integrated intervention did not produce a greater improvement than either of the individual interventions as originally hypothesised.

(v) Reading scores were improved by the sound intervention only and there was a relationship between all tests in the Spearman's rho correlation after the intervention which was not evident in the pre test, implying that all areas had to be improved to affect reading.

Several of the key outcomes from the study were consistent with similar research. Other authors searching for child focused interventions and researching the impact on learning capacity and improvement in performance have found similar outcomes. In particular, the following results are worthy of mention. The tests used to measure crystallised intelligence showed (apart from the class exposed to the sound intervention) that there was no improvement; this leads to the conclusion that the interventions used in this study have only a part to play and that remediation and other strategies such as the ones put in place by the government have a role to play in raising child learning. There was more of an impact on the tests that were designed to measure memory (forward and backward digit span test) and therefore the assumption is that if this is raised, learning will become more effective, as will the implementation of any strategies and teaching.

Whilst the SIMPLE programme may be able to help increase the readiness of children to learn, it should not be seen as an alternative to good sound teaching. The results of the present study suggest that the use of sound and movement may have an impact on raising children's performance particularly with regard to memory and, in the case of the sound therapy in reading, but remediation and teaching is absolutely a core part. In a nutshell the movement programme may be able to alleviate some of the underlying problems that could affect reading, but not actually teach reading.

The next chapter will attempt to put the key findings discussed in this chapter in a wider context by considering the limiting factors and their likely implications.

CHAPTER NINE: CONCLUSIONS AND RECOMENDATIONS

9.1 INTRODUCTION

The research presented in the preceding chapters represents an exploratory study to examine the effects of two interventions used in this study, the sound programme (The Listening Program) and the movement programme (SIMPLE) with regard to enhancing the learning and performance of children, when administered, as individual interventions or as an integrated intervention. The fundamental research concern was in establishing causal connections between the independent variables and the dependent variables. The initial holistic approach thus identified was then explored in the fieldwork through a complementary empirical investigation using a collection of quantitative data. The data collected was intended to provide a basis for assessing the importance of innovative and different interventions in raising children's learning and performance. It asked whether an integrated approach constituted the best means of doing this. The research design was quasi-experimental. The research design and methodology incorporated a systematic study of literature, including the review and validation of the literature findings. This was followed by data collection, analysis and interpretation.

This chapter will present an overview of the research and highlight the key findings. In addition, it will present the major contributions of the research, such as the theoretical contribution, the methodological contribution and the practical contribution. This concluding chapter summarises the study's contribution to both research and practice. The chapter will also highlight any limitations of the research and provides suggestions for further research relevant to this relatively new area of study and suggest ways of enhancing and raising children's educational performance.

9.2 OVERVIEW OF RESEARCH

After an introductory chapter, the study started with a comprehensive scrutiny of relevant literature on school effectiveness and improvement, and on the effects of movement and sound on children's performance. The literature review was divided into

three parts. The first part discussed the literature related to school effectiveness and improvement (chapter 2), the second to movement interventions (chapter 3) and the third to sound interventions (chapter 4). Based on this review, factors that constitute a holistic approach to raising children's learning and performance were identified and described. In addition, by reviewing various pools of literature related to raising children's learning and achievement, it was identified that underlying causes of learning problems, such as auditory processing and neuro development need to be examined. It could be that government initiatives in school improvement have not had the impact expected or not sustained any impact they were supposed to make, because of these underlying problems, causing an inability to access and assimilate the learning presented in schools. Chapter Five was concerned with research Methodology and Chapter Six with research design.

Stage 1 of the research was concerned with scrutinising the wider body of literature and conducting a pilot study which sought to verify a set of hypotheses concerned with the effects of a movement programme (Ansua Developmental Programme) and whether an integrated approach was required in order to raise children's performance. It was also concerned with the feasibility of running the movement programme in a school situation, as well as the responses of the parents and the teachers. The pilot study also helped to inform the next stage of the study, which was the main experiment.

Stage 2 involved the testing of a new set of hypotheses to observe the effects of a new therapy based on sound (The Listening Program), of an enhanced movement programme (SIMPLE) and of an integrated approach combining the two.

In order to ascertain whether either of the individual interventions or the combined interventions had an effect on the children's performance the following hypotheses were stated:

i) H1: Class B (movement intervention class) will perform better than class A (comparison class).

ii) H2: Class C (sound intervention class) will perform better than class A (comparison class).

iii) H3: Class D (integrated intervention class) will perform better than class A (comparison class).

iv) H4: Class D (integrated intervention class) will perform better than class A, class B and class C.

In order to investigate the effectiveness of the interventions implemented, several analyses were conducted. Firstly, the Kruskal–Wallis test was used to analyse the impact of the interventions between the classes in terms of the individual tests and the overall performance of the children. Secondly, the Mann-Whitney test was used in order to find out the overall performance of the interventions in relation to the comparison class and also of the integrated intervention in relation to both the individual interventions. Finally, Spearman's rho correlation analysis was used to analyse the relationship between the tests used in the study.

Stage 3 was concerned with the development of an effective learning strategy derived from the key findings of the research, presented in the form of a suggested model which is meant to support the positive performance of children.

The findings of the data are presented and analysed in chapter seven, of this study. These findings were then discussed, summarised and linked together, reviewed, and validated in terms of the review of literature. The findings, their interpretation and discussion of the results were addressed in chapter eight, in relation to the literature review, and in accordance with the proposed hypotheses. This chapter also formed the basis of a suggested model for use in schools aiming to raise children's learning and performance.

9.3 KEY FINDINGS

Although, as will be discussed in section 9.5, there are limitations to this study, as is the case with most empirical work, it does provide a number of significant findings, presented below. An extensive review of pertinent literature revealed that research on movement and sound interventions is very limited in general but that there is extensive

research in the area of school effectiveness and improvement. A discussion of major findings of this research is presented in Chapter Eight.

First, the study findings have shown that the movement programme had a positive effect on the overall performance of the children. This may have occurred because of the link with the primitive reflexes and learning challenges consistent with the findings of other studies. This leads to two recommendations:

Firstly, in the quest to raise children's learning and performance, any problems in this area need to be assessed and addressed just as in the case of reading and numeracy skills. Studies have shown that reflexes have been implicated in the ability to read successfully. Since these reflexes have an effect on the eyes in aspects such as sacadding (smooth pursuit of the eyes) and tracking binocular fusion, accommodation, convergence and divergence, there should also be an assessment in this areas to assess whether the eyes are functioning, mechanically, as well as they can be. Also, the vestibular system (balance) may have been affected positively. Studies have shown that this is implicated in the ability to read successfully and the recommendation again is for this area to be assessed and addressed.

Secondly, it is evident from the findings that scores on both forward and backward digit tests improved. These reflect working memory which has been implicated in raising children's learning, both in this study and in others. This has implications for the type of assessment that is carried out at the start of a child's schooling and the necessary steps taken to improve any shortfalls. Working memory affects cognition and this is involved in all complex learning situations, such as those in acquiring literacy and numeracy skills.

Thirdly, the sound intervention findings showed an improvement in reading and this may have occurred due to improved auditory processing and plasticity of the neural networks. In the report of the National Reading Panel (NICHD, 2000) it is recommended that reading programmes should cover five domains: phonological awareness, phonics in reading and writing, work on fluency, vocabulary and finally comprehension. The findings presented in this study lead to a recommendation of a sixth "domain", adequate auditory processing ability. The new Early Years Foundation

Stage that will be implemented from 2008 will require high quality phonic work so any auditory problems need to be addressed if children are to fully reap the benefit of this strategy.

The two findings above imply that the assessment and provision of proven movement programmes and sound therapy in the first year of children's schooling is highly recommended between ages five and seven as foundation skills of reading are most easily learned (Kantrowitz and Underwood, 1999) at this time. Similarly, since Kraus et al., (1999) found that auditory discrimination skills are largely developed by age six; it would seem prudent at this age to test whether they have developed and run a remedial programme if required.

Fourthly, the findings in this present research showed that the movement intervention which was conducted as a Physical Education lesson and was designed to include all the national curriculum requirements had a positive effect on the learning of the children. Although Physical Education is not regarded as a core subject, these findings suggest that it is a fundamental and vital part of children's development, which has more extensive and far-reaching effects then originally thought. It therefore needs to be included, not just for the impact that it has on the cognitive functions of the children but also because of the following:

a) Implications for running a programme such as SIMPLE are the health benefits derived from physical activity (Pate et al., 1997, Allied Dunbar Study 1992), the problem of obesity amongst children (Let's Make Scotland More Active, 2003) and finally the potential for improved social and affective development through physical activity (Parrott, 1997).

b) Implications for developing children's Physical Literacy which, Best (1978) and Arnold (1979) defined as kinaesthetic intelligence, skilful action or intelligent action. This, Whitehead (1993) argued, is essential to a complete experience of human life. It is important to enable individuals to realise a wide range of aspects of their potential and thus enhance their quality of life.

Fifthly, the findings showed that the sound therapy had a positive effect on reading. Therefore, another aspect that needs to be considered (apart from auditory processing), is that the learning environment should present listening conditions which are favourable and conducive to learning. This should be taken into account in designing the acoustics of the school environment. If auditory processing is impeded this have implications for aspects of the enablement of pupils.

Sixthly, the study findings have pointed to the child being a core aspect of raising standards and attainment. This, therefore, means that interventions need to be child centric, to enhance the capacity of the child to learn.

Finally, based on the overall findings of this study, a proposed integrated generic model as a holistic way of raising children learning and performance was developed. Detailed descriptions and illustrations were given in chapter 8 for the workings of the key elements of the model, based on the study findings and a comprehensive review of the literature.

9.4 MAJOR CONTRIBUTIONS OF STUDY

9.4.1 Theoretical contribution

The theoretical body of knowledge, as far as movement and sound interventions are concerned, is still in its early stages. Even though private therapists and clinics, as well as some schools, have attempted in various ways to implement movement and sound programmes few of them are not based on a specific theoretical foundation. This study can be considered as a step towards theory building. It has integrated a large body of relevant literature, and unified diverse schools of thought. In particular, the study has been uniquely effective in identifying and describing some components that could make up a holistic approach to raising children's learning and performance. Not only did this study provide an empirical assessment of the two interventions, but it also assessed the implications of putting them together as an integrated approach based. It also gave a comprehensive review of the concepts and theories behind the movement and sound interventions to date.

The study has also indicated that raising children's potential for learning and improving performance is complex and multidimensional. The government and schools have found this endeavour challenging in terms of sustainability, maximum impact and transferability. Efforts have swung from a top down to bottom up approach and to a combination of the two. Policy so far has disregarded the importance of the intervention being targeted at the underlying problems of the children. The findings from this study suggest that the child is crucial in raising standards and sustainable learning and performance. The way forward seems to lie in a holistic, child-centric perspective, based on the child developmental aspects which in turn affect the child's academic achievement. This calls for a new way of assessing the needs of the child and new perspectives in addressing these needs.

9.4.2 Methodological contribution

The study employed quantitative techniques to investigate the research questions in a school setting with tests that teachers could relate to. The quantitative study provided useful information for further studies and also showed that these kinds of studies can be conducted in schools with minimum disruptions. Since the study was of a quasi-experimental nature, this has an advantage over pure experiments, because it was conducted in the natural setting and since programme effects were found it can be assumed that at least we can be confident that these work in real schools and classrooms, with all their complexity, and not solely in laboratory settings. Consequently, this study has contributed to the methodology of research on raising children's learning by demonstrating that it is possible to implement movement and sound programme in schools.

9.4.3 Practical contribution

The findings of this study are important and relevant to different sized schools in different areas, and different samples of children. The research has provided an insight into new and innovative ways that can be used to raise children's learning and performance. Despite the numerous interventions that the government has put into place in the last decade, the issue of raising children's performance is complex and an on-going concern. Consequently, this study has recognised a series of critical aspects in the link between the child's development and learning that must be carefully considered to ensure raising children's educational standards. These factors culminated in the

proposed generic model. Taking into account the various dimensions of CCLEM model will help schools ensure that children's needs are being met in a holistic way.

Generally, the generic model proposed by this study could enhance the current practices of schools in trying to raise children's performance and meet the government's demands. This was in contrast to past initiatives which have not targeted the child as an integral part of the process of raising performance and have mostly been peripheral approaches around the child. In essence, the results of this research will help schools to take a more holistic and wider approach in the implementation of strategies and initiatives to achieve the children's full potential and to address the underlying problems that children may be facing, before going on to teach the children the skills required for a successful school career.

9.5 LIMITATIONS OF THE STUDY

Like every research endeavour, this study is limited in many respects. These limitations must be taken into account when interpreting the research results. In this section, the key limitations of this study are as listed.

First, movement and sound interventions are areas of research where theory is still inadequate and limited. This necessitated an exploratory approach in this study. This is particularly the case, as the research seeks to develop a holistic and integrative understanding of raising children's learning and performance, a feature which demands broadening the scope of the study by reviewing a large body of relevant literature and collecting a huge set of appropriate data. However, while it has been endeavoured to meet these requirements by reviewing various bodies of literature and seeking quantitative data, it is not possible to claim that the empirical investigation has covered every issues related to movement and sound interventions.

Second, the time frame was one of the main constraints. Given the limited time frame, a complete investigation of the phenomenon under consideration, especially with movement intervention, although initially planned for and agreed on was not honoured, and could not be undertaken. Although all possible efforts were made to secure the school's agreement for the intervention to take place three times a week as initially agreed, unfortunately each class could only complete the movement programme twice a

week because of lack of time and other constraints, as well as the school's reluctance to allow time for 'non essential' subjects which was seen as the main inhibitor to this. With more time given for the movement programme, the results may have been more conclusive. In addition, the pilot study findings pointed to the desirability of an increase from two days to three days but it was not possible to put this into practice

Third, the limitations of quasi-experimental research meant that although the intervention took place in a real setting, it was difficult to have a pure control class and instead a comparison class that was already allocated had to be utilised. Since this class was not assigned randomly, it was not possible to be certain of controlling relevant differences in quasi experiments. As large an amount of data as possible needed to be collected, however, due to the situation of the school meant that each class had only around thirty children, so numbers were limited. However, this is still a relatively large sample for studies involving primary school children.

Fourth, since this is exploratory research only replication of the findings will enable firm conclusions to be made.

Fifth, in any research where people are involved, it has to be considered that class teachers may influence children, even though the latter were taught by different teachers in the morning. Each group of children returned back to their own teachers in the afternoon and so this has to be taken into account as each teacher has different skills and strengths and weaknesses.

Sixth, this research was carried out in one school with a limited sample and therefore it difficult to generalise the findings. For example, since most of the children were second language learners it may be that this affects auditory processing more than in the case of native English speakers. Also, since most of the children were of Muslim origin, the amount of time spent in the mosque could curtail the time allowed for play. It could be possible that these children were more affected by the retention of the primitive reflexes, since one way of integrating the reflexes is through normal childhood activities. This was one of the premises on which that the SIMPLE programme was based.

Seventh, the implications of the overload theory were not expected. As a result of this the design would have been different as the interventions would have been run in sequence to avoid this effect. The initial hypothesis H4 was that the integrated approach would be more beneficial than the individual interventions. However, this was rejected. Findings showed that though the class with the integrated intervention improved significantly more than the comparison class, it did not, however, do so compared to classes receiving the individual therapies. It was therefore assumed that this was due the overload effect.

9.6 FUTURE RESEARCH DIRECTIONS

This research constitutes an initial step toward further understanding the factors that influence performance improvement and learning standards of children. A systematic programme of research is required to gain a more comprehensive understanding of the factors that affect learning effectiveness. Some areas that could influence the direction of future research include the following:

First, in this study the sampling frame was restricted. In order to increase the generalisability of the results, the study could be replicated in different schools and using different groups of children and with bigger samples.

Second, the sound therapy may have affected aspects such as behaviour, which was not measured in this study. For example, Gilmore (1999) reported that the sound therapy resulted in positive changes in not only auditory processing, cognitive, linguistic, but also personal and social adjustment and psychomotor control. Future research could focus on this aspect.

Third, the initial hypothesis H4 that the integrated approach would be more beneficial was rejected. This could have been because of the overload factor. This could be catered for by running the movement intervention first and then the sound intervention; so both would be run but in sequential order one after the next.

Fourth, it could be useful to conduct a similar study then measuring at six monthly intervals year- on- year on, in order to reflect the change in crystallised intelligence (acquired knowledge). In this context, for example, the remediation for reading could be

put in place first, before re- testing. This would allow for the intervention effects to be studied longitudinally.

Fifth, research as needed to empirically test and refine the proposed generic model in order to verify its logic, comprehensiveness and the link between enabling elements and those concerned with tracking and measuring improvement and learning outcomes;

Sixth, it is necessary to test the proposed generic model's ability to drive excellence in learning through creating a culture of continuous improvement and innovation through the continuous cycle of Evaluation, Energizing, Experimentation, and Examination. This could perhaps be through an in-depth study of how schools drive improvement in learning and seek to raise standards.

Further research is needed to expand the findings from this study and to provide more conclusive answers. Despite its attempt to be exhaustive and cover a broad area of research, there are many areas in which future research is needed. Nevertheless, the results of this study might be of value to government policy makers as well as for schools and researchers. For government's policy makers, they may be able to examine the types of intervention and initiatives and the targets for these being to identify the underlying causes for schools. Results from this study can be used as guidelines and useful input for drafting future policies and strategies aimed at raising children's learning standards.

For researchers, the findings of this study provide a starting point for further research in this area. In particular, for researchers concentrating on holistic interventions in schools, the approach adopted in this research might be useful. The findings also serve as a documented piece of research in a school setting of which, to date, there has been very little research so far.

9.7 CONCLUSION

In conclusion, this research project was intended to provide both theoretical and practical insights into the implementation of holistic programmes in a school setting and its impact on raising learning standards. Identifying one key success factor is unfeasible

and ambiguous, due to the complexity of raising children's learning. However, this research found several factors specifically that the developmental stage and other aspects such as auditory processing ability are vital to determine whether the child is ready and able to learn effectively. When these underlying causes are identified and remediated, the child can benefit from the various and numerous interventions and strategies and initiatives that the government is implementing in schools.

This study has presented a holistic review of innovative and different interventions through a comprehensive scrutiny of the relevant literature, and a study of four parallel classes. It has provided a detailed discussion of critical factors involved in the raising of children's learning potential and performance in a generic model, depicted in Figure 8.2. The proposed model, the Child Centric Learning Effectiveness Cycle (CCLEC) is aimed at helping the drive for excellence towards raising children's learning and performance. In essence, adhering to the various levels of application of the model could ensure that schools can derive maximum benefits from the implementation of the government's initiatives and this would ultimately benefit the children academically, developmentally and emotionally. The CCLEC is termed child centric which means all the endeavours have to be appropriate, holistic, developmentally sound, customised, fruitful learning experiences for the children.

Finally, it is hoped that the research findings presented in this research will boost school effectiveness and can help tackle the underlying causes that may affect their successful implementation of related initiatives. Although various government initiatives were aimed at raising standards, to date, they have ignored the underlying cause. Changes have concentrated on national curriculum, schools inspections, League tables, assessment procedures, target setting literacy and numeracy strategies, performance management, benchmarking etc. The proposed model emphasises the importance of empowerment and child-centric approaches in helping to raise children's capacity to learn in a way that dovetails easily with existing strategies.

It is hoped that the research findings presented can help by addressing the underlying problems that children may have. To use a computer as a metaphor for the brain by metaphorically raising the capacity of the "computer" to learn and not just loading it with more and more powerful software in the hope that it will work better. Other

interventions and perspectives apart from the ones studied here need to be considered, as well as other approaches. Since this is an exploratory research only replication of the current findings will enable firm conclusions to be drawn. Finally, prevention is by far the most effective solution and early identification and intervention of problems, can lead to increases not only in children's capacity to learn but also in their self- esteem, confidence and being.

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