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THE EFFECTS OF A CLASSROOM-BASED VISUAL PERCEPTUAL SKILLS PROGRAMME ON GRADE R CHILDREN FROM A DISADVANTAGED SCHOOL IN KWAZULU-NATAL

Gwynne Meda Chedzey

A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science in Occupational Therapy.

Johannesburg,
2016

DECLARATION

I, Gwynne Meda Chedzey, declare that this research report is my own work. It is being submitted for the degree of Master of Science in Occupational Therapy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

_____

Gwynne M. Chedzey

_____ day of _____, 2016.

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Postgraduate Office, Faculty of Health Sciences
Wits Medical School, 7 York Road, PARKTOWN, 2193, Johannesburg • Tel: (011) 717 2745 • Fax: (011) 717 2119 • e-mail: healthpo@healthwits.ac.za

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For my parents, Lynton & Muffy Baasch,

their loving support made this possible

ABSTRACT

The majority of South African children attend a Grade R year to prepare them for formal education in the Foundation Phase. Literacy and numeracy levels are low in disadvantaged schools and socio-economic status affects the development of important visual perceptual skills which are required for reading, mathematics and writing. Current Grade R curriculum and teacher training do not address visual perceptual skills adequately and research has shown that the Grade R year is not preparing children for Grade 1 demands. Occupational therapists are trained in visual perceptual development and to date their role in the current education crisis remains extremely limited. A pretest posttest study was conducted using the Test of Visual Perceptual Skills – 3rd Edition (TVPS 3) as a measurement tool. A low cost Visual Perceptual Skills Programme (VPSP) was designed by the researcher to develop these visual perceptual skills in a disadvantaged school. The school was selected using purposive sampling and results were analysed using effect size (*ES*). A 15 week programme was carried out in a Grade R class and the intervention group completed daily eye movement and perceptual activities over two consecutive school terms, in addition to the normal curriculum. The control group, a Grade R class at the same school did not participate in the VPSP. Results show a moderate effect on the overall visual perceptual skills in the intervention group, indicating the programme is useful in addressing visual perceptual skills. The posttest scores reveal that despite this improvement, children in the intervention group remain in the at-risk-of-dysfunction range for visual perceptual skills. Access to visual perceptual programmes and the availability of occupational therapists to consult with teachers administering the programmes remains limited. It is therefore recommended that visual perceptual activities should be incorporated into the Grade R curriculum and be a focus in the classroom.

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OPERATIONAL DEFINITIONS

Department of Basic Education:	A department of the South African government which oversees primary and secondary education in the country [1].
Figure-ground perception:	A subject's ability to find a form in a background of other visual information [2].
Form Constancy:	An individuals ability to see a form, even though it may be hidden amoung others, be it a different size or be it rotated [2].
Grade R year:	The reception year into the Foundation Phase, the year before Grade 1 [3] .
Mainstream school:	A public school which follows the CAPS curriculum [1].
Position in space:	The ability to determine the relation of figures or objects in relation to oneself [4]
Quintile:	A statistical measure used to divide a population into fifths [5].
Spatial relations:	The ability to determine directional information about forms and how they relate to each other [2].
Visual Closure:	The ability to determine complete forms from incomplete representations [2].

Visual cognitive skills:	The skills required to correctly interpret visual information once it has been received through the visual receptive functions [6].
Visual Discrimination:	The subject's ability to determine precise characteristics about a shape in order to match shapes from similar forms [2].
Visual Memory:	The ability to recall forms and identify the characteristics from memory and select the correct option from similar forms [2].
Visual perception:	The ability to interpret visual information and give meaning to what is seen [7].
Visual Perceptual Learning:	The long term improvement in performance on a visual task [8].
Visual perceptual programme:	A programme aimed at developing visual perceptual skills [9].
Visual perceptual skills:	The skills which constitute the construct of visual perception, both visual receptive skills and visual cognitive skills [6].
Visual Perceptual Skills Programme:	The intervention programme designed for and used in this study.
Visual receptive skills:	These skills are required to extract visual information from the environment, they include skills and functions needed to get the information from the environment onto the retina for interpretation further down the visual pathway [6].

Visual Sequential Memory:	The subjects ability to recall a sequence of forms [2].

LIST OF ABBREVIATIONS

ANA:	Annual National Assessments
B ed. (FP):	Bachelor of Education Foundation Phase
CAPS:	Curriculum and Assessment Policy Statement 2012
DBE:	The Department of Basic Education
DTVP-2:	Developmental Test of Visual Perception 2nd edition
ECD 5:	National Diploma in Early Childhood Education
FPL:	Food Poverty Line
TVPS R:	Test of Visual Perceptual Skills – revised edition.
TVPS 3:	Test of Visual Perceptual Skills – 3rd edition
UBPL:	Upper Bound Poverty Line
VMI:	Visual Motor Integration
VPL:	Visual Perceptual Learning
VPSP:	Visual Perceptual Skills Programme
WISC-IV:	Weschler Intelligence Scale for Children – 4th Edition

CHAPTER 1: INTRODUCTION

1.1 Introduction

The relationship between socio-economic status and its effect on literacy and numeracy levels has been well documented, with studies revealing children in poor socio-economic environments are at high risk for low literacy and numeracy levels [10]. South African studies have confirmed this trend [5], [11]. A large portion of South African learners are living below poverty lines and are therefore at risk for low literacy and numeracy levels.

Children from disadvantaged areas face many factors which contribute to poor academic performance including poverty and malnutrition, [12] and may be further disadvantaged when entering public schools where they face barriers to developing literacy and numeracy due to problems in the education system. While there are exceptions, in general schools in rural disadvantaged areas have poor basic facilities, lack resources and have less qualified teachers [11], [12].

The challenge of improving literacy and numeracy levels in South African primary schools is multifaceted as poverty alleviation is a slow process and children cannot wait for their families to be lifted out of poverty in order to obtain a good education. The National Department of Basic Education identified the need for a preschool year to improve the readiness of children to enter Grade 1 and with access to early education being addressed, focus needs to be placed on the quality of learning in Grade R classes.

Visual perception is a skill that is needed to learn to read and write. Researchers have demonstrated the relationship between the perceptual abilities of learners and their academic skills [13], [4], [14] and show that visual perception plays a crucial role in the acquisition of reading and spelling skills. Visual perception is defined as the ability to recognise, differentiate and give meaning to visual stimuli, and then relate this to previous experiences and inputs to learn new concepts [15]. Visual perceptual skills are developmental in nature [15], with rapid development between the ages of 3 and 7, Grade R learners fall within this crucial period [6].

Studies into the visual perceptual skills of learners in low socio-economic environments have found a direct relationship between socio-economic status in primary school learners and visual perceptual skills [15].

Occupational therapy in paediatrics aims at establishing developmentally and functionally higher performance in all areas of occupation in children who have barriers to learning [16]. Education and being a student is a vital occupation performed by children and as such occupational therapists are involved in assessment and treatment of functioning in this occupation [6]. Occupational therapists provide assessment and treatment of visual perceptual skills, which underlie academic skills in order to improve academic performance [6]. So the question must be asked, is there something occupational therapists should be doing to assist in the development of these vital visual perceptual skills in children who have poor academic performance?

In a consultant role the opportunity may exist for therapists to offer their services to mainstream schools in disadvantaged areas in the form of a teacher facilitated visual perceptual skills programme with minimal input from the occupational

therapist. In South Africa, there is a need for occupational therapists to provide consultation to teachers on how to adapt the classroom, modify teaching techniques and provide assistive materials and strategies to meet the demands of children in a particular environment [17]. A further developing role of the occupational therapist should include policy development. With Grade R teacher training being a focus of much criticism, research has indicated that teachers are not equipped to design and do the elementary visual training which enables a learner to develop visual perception [18]. Curriculum and Assessment Policy Statement 2012 (CAPS) is the current curriculum used in South Africa and provides an overview and orientation to visual perception, however it lacks a framework or detailed activities to develop these skills [18].

Previous international studies have shown visual perceptual training improves the visual perception of children [19]. In South Africa a framework for the development of an integrated visual perception programme was developed by a lecturer at the University of Stellenbosch in 2011 [9]. However, a programme using this framework revealed the intervention time was too short (10 weeks, one session per week) to obtain statistically significant improvements. Further research into the effectiveness of visual perceptual skills programmes was recommended by the researcher.

No study has been published in South Africa on the effect of a visual perceptual skills programme in Grade R in disadvantaged schools. Research into stimulation programmes facilitated by occupational therapists but carried out by teachers to address visual perceptual skills in Grade R children in the classroom is required.

1.2 Statement of the problem

Visual perception is a developmental process that relies on stimulation provided by the environment and opportunities to experience and practise the skills [4]. The problem facing many Grade R children is that impoverished environments with limited stimulation and exposure to perceptual learning can result in the development of visual perceptual skills being halted or diminished [14]. This can lead to Grade R children not developing the skills required for achievement in scholastic tasks such as literacy and numeracy.

Disadvantaged schools in KwaZulu-Natal have limited access to support services [20] such as occupational therapy, learners in these environments visual problems are likely to remain undiagnosed.

In disadvantaged areas the effect of a visual perceptual skills programme has not been researched and the potential for occupational therapists to assist in addressing the low literacy and numeracy levels in South Africa has not been explored.

1.3 Purpose of the study

The purpose of the study is to explore the effects of a general stimulation, classroom-based programme aimed at developing visual perceptual skills in Grade R children in disadvantaged KwaZulu-Natal. This research will ascertain whether such programmes designed and facilitated by occupational therapists but carried out by teachers, can contribute to the development of visual perceptual skills when included into the classroom activities of Grade R children.

1.4 Aims and objectives of the study

1.4.1 Aim of the study:

To explore the change in visual perceptual skills of Grade R children in disadvantaged KwaZulu-Natal after the implementation of a classroom-based Visual Perceptual Skills Programme (VPSP) conducted over two school terms i.e. a 15 week programme.

1.4.2 Objectives of the study:

- To describe the difference in the pretest (baseline) scores between the control and intervention group to determine the level of dysfunction before the VPSP programme is implemented.
- To describe the difference in posttest score between the intervention and control groups.
- To describe differences in pre and posttest scores in control group.
- To describe differences in pre and posttest scores in intervention group.
- Compare the difference in pre and posttest scores between the intervention and control group.

1.4.3 Null hypothesis

After the completion of the visual perceptual skills programme the intervention group will not exhibit statistically significant improvements in the posttest visual perceptual scaled scores when compared to the control group.

1.5 Justification of the study

South African poverty rates are extremely high, this leads to many primary school learners being at risk for low literacy and numeracy rates. Many children attending

public schools in disadvantaged areas are presenting with learning difficulties [21] and the risk of academic failure is high. Academic failure results in inadequate economic opportunities and perpetuation of the cycle of poverty [22] Improvements in the education system in South Africa are essential to the success of the country and its people.

Individual occupational therapy to address delays in visual perceptual development is not accessible to most South African children, especially in disadvantaged schools. This study is justified in its attempt to determine whether a class-room based visual perceptual skills programme can improve visual perceptual skills in Grade R disadvantaged children. Possible inclusion of such a programme in Grade R teacher training or the CAPS curriculum can be further explored should this programme prove successful.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The review of the literature will begin with a description of the literacy and numeracy problems facing primary school learners in disadvantaged areas in South Africa. The current schooling situation of Grade R children in disadvantaged areas of South Africa will be reviewed. An in-depth discussion will follow on visual perceptual skills and their role in the development of literacy and numeracy. The assessment of visual perceptual skills will be discussed, including the assessment of receptive and cognitive aspects of visual perception. The current treatment strategies of visual perceptual skills will be explored and the role of the occupational therapist in intervention will be reviewed. Research into the effect of visual perceptual skills programmes on learners implemented in primary schools will be critically analysed and a review of alternative programs will be included.

2.2 The state of literacy and numeracy levels in disadvantaged communities in South Africa

Recent South African poverty statistics reveal that 53.8% of South Africans are living in poverty [23], surviving on under R779 per-person-per-month. These South Africans are living under the Upper Bound Poverty Line (UBPL), which is the rand value below which individuals are unable to purchase both adequate food and non-food items i.e. R779 [23]. Furthermore, 21.07% of those living in poverty can be described as suffering from extreme poverty, surviving on under R335 per-person-per-month. This is below the Food Poverty Line (FPL) which describes “

the rand value below which individuals are unable to purchase or consume enough food to supply them with minimum per-capita-per-day energy requirement for good health (which is about 2 100 kilocalories) “[23].

Socio-economic status and particularly school socio-economic status has been proven as an important factor in determining academic outcomes in learners in South Africa [20], with learners in low socio-economic environments achieving lower literacy rates than students of higher socio-economic levels. International studies confirm that learners in poor socio-economic environments are at high risk for low literacy and numeracy levels [10].

Literacy and numeracy levels in South Africa are a point of contention [20], with government assessments revealing improvements year on year and prominent analysts and international studies revealing that the majority of South African pupils are unable to write, read or compute at appropriate levels [20]. National Government reported literacy levels in Grade 1 learners had improved from 58% in 2012 to 63% in 2014, assessed internally using Annual National Assessments [24]. Prominent analysts have questioned the validity of these results and the standard of the assessments used, reporting that the state of literacy and numeracy in public schools is in crisis [20]. Despite differences on exact levels of illiteracy, government and international studies concur that learners from disadvantaged, impoverished areas obtain the lowest scores in literacy [20], [12].

One cannot blame the Department of Basic Education alone for low literacy and numeracy rates in disadvantaged schools. Studies have found that children from disadvantaged areas entering the education system are at risk of being developmentally delayed at the onset of entering school [5], [25]. In a study into

the developmental potential of children in the first five years of life in developing countries, it was found that worldwide there are 200 million children not fulfilling their developmental potential due to exposure to malnutrition, poverty, poor health and lack of stimulating home environments [25]. Poverty leads to the risk of stunting in children from disadvantaged areas which is caused by irregular feeding and poor quality of food over a long period of time [22]. In the first two years of life poor nutrition causes delayed growth and cognitive development, which continue to affect a child as they enter school and stunted children score on average a grade lower than their peers in academic tests [25]. Other reasons for low literacy rates in learners exposed to poverty may include poor language use by role models, single-parent families, illiterate parents, lack of parent involvement, lack of engagement with books before entering school and substance abuse by pregnant mothers [12].

South African research identified another cause of low literacy rates in primary schools in South Africa as the absence of exposure to preschool [18]. In order to assist people living in poverty to access schooling, the Department of Basic Education awarded a no-fee status to prioritised schools in disadvantaged areas [26]. In addition to this the Department of Basic Education created an objective to provide quality Grade R centres in public schools to address low literacy and numeracy levels in South African primary schools [27]. Access to Grade R has been a success, by 2010 the KwaZulu-Natal government reported that 92% of 5 year olds were enrolled in Grade R in the KwaZulu-Natal province [27].

Despite having access to Grade R, many disadvantaged children entering the school system face barriers to developing literacy and numeracy skills. These barriers include poor basic facilities, overcrowding in classes, lack of resources,

lack of administration and storage of resources, lack of qualified teachers and lack of teacher training and support [11], [12]. District municipalities who are tasked with providing professional services and maintenance to schools are struggling to provide routine maintenance and have yet to address the performance of schools and the literacy and numeracy challenges they face [11].

Not all Grade R facilities in the public school system are equal. There are two different public school systems in South Africa, the wealthiest 20-25% of pupils are catered for in the better performing system while the large majority , 75-80% are placed in an inadequate schooling system destined to further disadvantage them [20]. Wealth, socio-economic status, geographical location and language determines the quality of schooling you receive [20]. Few exceptions exist where poorer schools are performing better than better resourced schools, however quality differences predominantly reflect historical legacies and discrimination [11].

Research has shown that a place in Grade R does not automatically mean improved school outcomes [28].The Department of Basic Education has agreed that with access addressed, a focus now needs to be placed on the quality of Grade R schooling [27].

2.3 The quality of schooling for Grade R children in South Africa

A recent study into the effectiveness of the Grade R year in South African schools shows alarmingly that there is no measurable impact of a Grade R year in the poorest three quintiles [28], yet benefits and positive outcomes were recorded in schools in the higher quintiles. Quintile rankings are used to rank the socio-economic status of schools. There are 5 quintiles, quintile 1 being the poorest

socio-economic area and quintile 5 being the highest socio-economic area [5]. Quintile 1, 2 and 3 are no fee paying schools, the department allocates a higher funding per learner in these three quintile i.e. R1116 per month in 2015. Quintile 4 schools received R559 per learner per month in 2015 and Quintile 5 schools, just R193 [29]. This is an attempt to offer schools from disadvantaged areas more money to support learners at school, however studies into the quality of schooling in South Africa show that learners attending quintile 1, 2 and 3 schools are offered a lower quality of education [20].

Some argue that the developmental trajectory of learners is established before entry into formal schooling, however a quality Grade R programme can be a powerful equaliser to reduce inequality [28]. The quality of teachers and the quality of the curriculum are vital factors in determining the success of Grade R programmes [18].

In order to provide South African children with good quality Grade R programmes, fundamental questions need to be answered: What are the needs of Grade R children? What should they be taught and how should they be taught? The role of Grade R in a child's development is complex; this year is both the last year of the preschool phase and the first year of the foundation phase [3]. Different approaches to teaching Grade R have been debated. One approach is to use preschool pedagogy with the aims of preparing a child for lifelong learning, holistically developing the child, developing learning dispositions and finally preparing them for Grade 1 [3]. Critics of this more "informal" approach argue that this is difficult to "fit" into the formal school setting and children may be disadvantaged by not learning letters and numbers in Grade R [28]. The other approach is one of more "formal" schooling where the focus is on "academics" and

the aim is preparation for Grade 1, through didactic practice using table top activities such as worksheets [3]. Critics of this approach argue that many Grade R children are not developmentally ready for a “formal” school approach. They need to be guided though the three phases of learning i.e. first experience concepts kinaesthetically (through movement), then three-dimensionally (using concrete apparatus) and finally through pen and paper tasks [3]. Neither of these approaches have been accepted in their entirety; rather a high quality play-based approach with a specific interpretation of the Curriculum and Assessment Policy Statement 2012 (CAPS) which takes into account the developmental needs and the way children learn has been recommended as the best approach for South African learners [28]. An analysis of the Grade R CAPS curriculum is required when considering the quality of schooling provided to Grade R children. The Grade R CAPS curriculum was implemented in 2012 by the Department of Basic Education, it is described as a fusion of the National Christian Education (NCE) and the Outcomes Based Education (OBE) [18]. In Grade R the daily programme is made of three components: Teacher guided activities, routines and free play or child initiated play [1];

Teacher guided activities may include but are not limited to morning ring time, creative art activities, perceptual motor activities and movement activities. Teachers are encouraged to have a clear understanding of what learning outcomes are being met in these tasks.

Routines may include bathroom time, tidy up time and snack time. Teachers are encouraged to promote literacy skills during these times e.g. word games such as all the children with “s” in their names line up at the door.

Free play involves structuring an environment for learners to explore and providing opportunity to problem solve and learn through play

This curriculum does take into account both the holistic development of a child and the development of skills to facilitate the learning of literacy and numeracy [1]. However, critics of the CAPS curriculum report a lack of practical guidelines and standards to achieve the learning outcomes specified and a limited understanding of the Grade R curriculum by teachers [28]. The training and selection of Grade R teachers and their understanding and implementation of the curriculum is vital to the overall quality of the programme that is offered [18].

Grade R teacher training has undergone many changes since 1996, most influential was the introduction of the the National Diploma in Early Childhood Education (ECD 5) in 2007 [18]. This course was available via a matric qualification or Level 4 or a Higher Certificate in ECD and involved a one year full time course or part-time (18-24 month) course which enabled graduates to teach children aged 4-6 [18]. Prior to the ECD5 diploma being introduced Grade R teachers were trained in a four year higher diploma in education (HDE), three years of this were in Junior Primary with a further year specialising in Pre-Primary [18]. This means that most Grade R teachers have 1 year of training and few have completed the 4 years of training required prior to 2007. The Department of Basic Education identified that most of the Grade R teachers are “under qualified” [18]. The task of up-skilling practitioners is a slow process, in 2015 the Department of Basic Education identified the three year Bachelor of Education (Foundation Phase) degree as the preferred degree for Grade R teachers, however many practitioners do not have the necessary school qualification to access this programme [18]. To address this the Department of Basic Education introduced

the Diploma for Grade R teaching in 2014 [18]. In South Africa not all Grade R teachers have the same qualifications and many are at various stages of being up-skilled, their level of qualification has been found to affect their ability to understand, interpret and adapt the Grade R CAPS curriculum [28]. This in part explains why some Grade R institutions show meaningful benefits in the children who attend them and why other schools show little learning benefit gained from a year in Grade R [28].

Grade R teachers require knowledge and an in-depth understanding of the development of 5-6 year old children. Furthermore, when they are tasked with teaching children who come from disadvantaged backgrounds, their understanding of the way children learn new concepts needs to be of a high standard [3].

Important skills need to be taught and developed in Grade R children and it is not adequate to teach a “watered-down” Grade 1 approach [28]. These skills include but are not limited to language, social and cognitive areas. In addition, visual perceptual skills need to be developed in the Grade R children to enable them (in combination with other skills) to learn to read, write and complete arithmetic [18]. While visual perception is in part addressed in the Grade R CAPS curriculum, research has shown that it needs more focus and clear guidelines in this area [18]. It is widely accepted that learners from disadvantaged environments are at higher risk of problems in visual perceptual skill development [5], [15].

2.4. Visual perception

The definition, components and development of visual perception will be discussed in this chapter. Dysfunction in visual perception will then be discussed and the effect of dysfunction on different areas of a child's life.

2.4.1 The definition of visual perception

"Visual perception is the mind's ability to interpret or give meaning to what is seen with the eyes" [7]. Before learning to read, all sighted children must learn and develop visual perceptual skills to enable their brains to make sense of what their eyes are seeing [18]. Schneck [4], describes vision as the dominant sense in human perception. Visual perception involves many anatomical structures including the eye, the oculomotor muscles and pathways, consisting of optic nerve, optic tract, as well as the occipital cortex and associative areas of the cerebral cortex [30].

The definition of visual perception is different from vision as it is not merely the ability to see but includes the cognitive reasoning which is gained from the experience of interaction with the environment, objects and people and allows learners to participate in everyday tasks through interpretation of visual stimuli [9].

2.4.2 Components of visual perception

In order to perceive visual information correctly a number of *visual receptive functions* and *visual cognitive functions* are required [6]. Visual receptive functions are those required to extract visual information from the environment and include skills and functions needed to get the information from the environment onto the

retina for interpretation further down the visual pathway [6] and acuity is the ability to see fine details in objects in the visual field.

It includes less discussed receptive functions such as accommodation, oculumotor skills [30], binocular fusion, convergence, stereopsis and visual fields [6]. These skills are important and cannot be excluded from the discussion of visual perception. Accommodation is the ability to focus on objects when they are at varying distances from you, the lens is subjected to reflexive action to focus on near or far objects [30]. A child would need this receptive function in order to make the transition from looking at their book (near response) to looking at the board (far response) in a split second [6]. Oculomotor skills or eye movements are required to move the eyes as a pair in order to extract relevant information from the environment, skills include fixation (the ability to watch a still object), tracking (the ability to watch a moving target) and saccadic movements (the ability to change from one point to another rapidly) [6]. Six extraocular eye muscles are responsible for working in a co-ordinated way to allow the child to scan and take in information from the environment, these muscles can be exercised and strengthened to develop better fixation, tracking or saccades [9]. Binocular fusion is the ability to combine the two images in the eyes into one percept [30]. Convergence is the ability to turn the eyes inwards as object comes closer and stereopsis is the skill which allows depth perception or 3-dimensional vision. Visual fields is the physical space which is visible to the eye [6]. These skills are needed to extract information from the environment [9].

The next set of skills needed in visual perception is *visual cognitive functions* which describe the interpretation of what is seen. These are divided into visual

attention, visual discrimination, visual memory, form perception and spatial perception.

Visual attention is the ability to attend to visual information in the environment and to select the important visual input and focus on it [31]. In order to recognise objects and sort and match them according to their properties children need visual discrimination [4]. Visual memory is the ability to store and recall information seen with the eyes [4], visual sequential memory is the skill of recalling sequences of visual information in the correct order [2].

Other visual cognitive components can be divided into two groups, form perception (what things are) including the subcomponents of form constancy, visual closure and figure-ground and spatial perception (where things are in space) [6].

With a large number of components, visual perception is best described through examples of practical skills and what they enable in the classroom. Grade R children must **visually discriminate** to learn to sort objects according to shape colour and size and spot the difference in pictures to develop the later reading skill of differentiating “n” and “h” in Grade 1 [18]. They must use **visual memory** to learn to recall and answer questions on objects that have been presented and when removed, they must draw objects and shapes from memory. This will enable them to recall words from memory in Grade 1 [18]. Visual sequential memory is needed to see that the order of letters in ‘pan’ is different from the order of letters in ‘nap’. In Grade R children place objects in sequences to make a specific patterns and they have to copy specific sequences of coloured beads threaded onto a string [18].

Children need **form constancy** to recognise forms and objects as the same in different environments, positions and sizes [6]. For example a Grade R child should identify a written symbol even if it is written in a different way or match it to a printed symbol [6]. **Visual figure-ground** is the ability to recognise figures embedded in a general background [32]**,** this skill enables Grade 1 learners to correctly copy a word without being distracted by the other words around it or to read without leaving out words or skipping lines. In Grade R children must have pointed out specific objects in a picture and coloured overlapping picture objects [18]. **Visual closure** is described as the ability to determine form or objects from an incomplete representation [4] and is needed by Grade 1 learners to read in chunks, filling in the details for themselves instead of reading letter by letter. In Grade R children must have completed tasks which compares a picture of a complete object with four other fragments of objects, one of which is a fragment of the complete object, which must then be matched [18].

Spatial perception is needed to determine the position of objects in relation to oneself or other objects [2]. Children must grasp **visual spatial relations** to understand that when they invert the symbol ‘u’, a different symbol appears, for example ‘n’, and if they reverse ‘b’, ‘d’ appears. For this to occur, in Grade R they must have compared a symbol made up of two shapes or letters attached to each other in a specific way, with two other symbols, one with the same shapes or letters attached differently, the other with the same shapes or letters but turned to appear different. They must be able to turn the latter symbol back in their minds to identify it [18].

Visual cognitive skills are interrelated and cannot be considered completely independent of each other, most “real-world” perceptual tasks require the use of

several visual perceptual skills at the same time [2]. The process of visual perception and how the numerous components of visual perception develop explains both how they can be viewed somewhat independently and how they are interdependent.

2.4.3 The development of visual perception

The development of visual perceptual skills develop both with age and in a hierarchy of influence [6]. Warren (1993) developed a hierarchy of visual perceptual skill development to demonstrate that the development of basic visual skills form the basis for the development of visual perceptual skills.

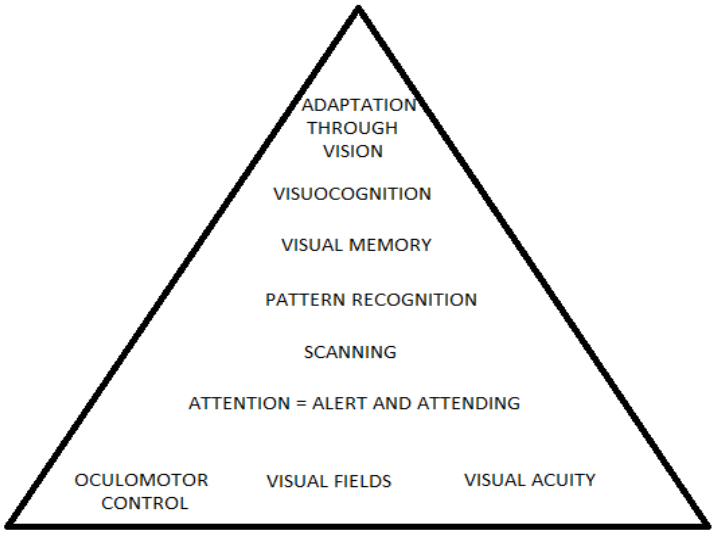

Figure 2.1 Hierarchy of visual perceptual skill development. Adapted from Warren, 1993

At birth the visual system is relatively immature compared with other systems however, rapid development occurs in the first 6 months [16]. Accommodation, oculomotor systems and convergence are established by the second month [16] and by 5 years of age a child should move their eyes with smooth control in all directions [6]. Oculomotor control, visual fields and visual acuity form the

foundation for all visual functions [31]. According to Warren (1993) the next level to develop is visual attention; to attend to important information and scanning to obtain an organised systematic representation of the scan path [6]. These lower level skills enable pattern recognition, visual memory and ultimately the ability to manipulate visual information, solve problems and formulate plans [31].

Higher level skills, those Warren (1993) terms visual cognition include skills of form and spatial perception, develop rapidly between the ages of 3 and 7 [15]. Schneck (2010) and Warren (1993) summarise the developmental ages for emergence of visual perceptual skills in Table 2.1 below [6], [31] :

Table 2.1 Table of developmental ages for emergence of visual perceptual skills, adapted from Williams H. (1983) and Schneck (2010)

Perception	**Developmental Age**	**Trend of development**
Form Constancy	6-7 years	Dramatic improvement
Figure-ground perception	3-5 years	Improves steadily
Position in Space	5-6 years	Improves steadily Development complete at 7-9 year of age
Spatial relations	5-8 years	Improves steadily Development complete at 10 years of age

Visual perception happens through maturation and learning, allowing these skills to develop as a child grows [15]. While visual perception continues to refine and

develop well into a child's primary school career i.e. ages 10-12 [16], the crucial years of development are focused at age 3-6 which correlate with the period a child spends at preschool [15]. In adults visual perceptual learning (VPL) is a field widely studied in neuroscience [8] and refers to the long term improvement in performance on a visual task. The adult brain is described as having plasticity in visual perceptual learning and changes occur in the primary visual cortex and the association areas as well as changes in the decision making centres of the brain during visual training [8]. Neuroimaging studies on VPL are not available in children, however it must be considered that changes could continue to occur in a child's visual perceptual skills even once they have passed a developmental level. Still, current research concurs that there are critical periods for the development of visual perceptual skills [9] and early intervention is the best practice for remediating future visual perceptual dysfunction.

2.4.4 Visual perceptual dysfunction

Visual perceptual dysfunction and the effect of socio-economic status on visual perceptual skills are described below. The effect of visual perceptual dysfunction on academic and other areas in a child's development are explored.

2.4.4.1 Types of visual perceptual dysfunction

Visual acuity is important in relation to classroom work, refractive errors such as near-sightedness or far-sightedness will impact on how children receive visual information and therefore affect their perception [16]. Other visual reception functions such as oculomotor control, accommodation and visual field problems similarly result in children not taking in the information correctly which they need to process [6].

In a child with no obvious disability, visual perceptual problems can be more subtle, though their impact on function is obvious [16]. Not only the academic environment is affected, other areas of a child's life can be affected as a result of poor visual perceptual skills [9]. Children may present with poor tool use i.e. have difficulty relating objects to one another e.g. scissors and paper, building toys or fastening shoelaces [6]. In dressing children with visual perceptual dysfunction struggle to orientate their clothes, in self-care activities they may have difficulty putting toothpaste on the brush. In play children may struggle to find toys, copy others and build puzzles or construction toys [6].

This research focuses on the impact of visual perceptual skills on education, these are well documented and researched [16] and described in the following paragraphs. Particular groups of children are more at risk for developing visual perceptual skill delays and according to South African research a leading cause of visual perceptual problems in mainstream children is low socio-economic status [5].

2.4.4.2 The effects of socio-economic status on visual perceptual function

In Turkey a study was conducted on 226 first grade elementary students (aged 5-6) to determine whether socio-economic level created a meaningful difference in their visual perception [15]. The study revealed that children from lower socio-economic levels have significantly lower visual perceptual scores than those from upper socio-economic levels. Upper socio-economic level children have more opportunities to support their visual perceptual development as they have access to enough stimulation, reading books and access to early schooling [15].

In South Africa research into the relationship between academic performance, socio-economic status and perceptual motor skills revealed that learners in schools in the poorest areas performed the worst in academic performance and their visual perceptual abilities were low [5].

International and local studies support the reasoning that high quality, stimulating activities that more affluent children experience at preschool are believed to improve the development of their visual perception [15].

2.4.4.3 The effect of visual perceptual dysfunction on educational outcomes

In a South African study of visual motor integration, visual perception and motor proficiency in Grade 1 learners, visual perception was identified as the critical factor resulting in poor mastery of basic academic skills [5]. Many children in South Africa enter school before mastering the recognition, naming and copying of shapes and forms needed for reading [9]; they are then expected to understand 2-dimensional letters and numbers which often results in poor participation in learning.

In a study on 53, 5-6 year old children in Greece attending preschool, researchers linked visual perceptual skill level with school readiness level. They found that visual perceptual skills were significantly higher in children with good school readiness scores [33] and reported that many children at this developmental level were not ready to process letters and numbers. The effects of visual perceptual dysfunction in the different areas of educational performance are well documented [5], [34], [35].

2.4.4.3.1 Visual perceptual dysfunction and reading

Visual receptive functions such as acuity have obvious implications on a child's ability to see what is written on a page; a child cannot begin to process letters or words if they cannot see them [36]. Similarly accommodation dysfunction results in a child struggling to read text from the board and then from their desk, their eyes not adjusting to the different demands of near and far text [6]. Binocularity problems may result in a child seeing double or repeating letters in a word, they may squint or cover an eye in an attempt to read text [6].

Eye movements/oculomotor control is another receptive function which has been studied extensively in relation to reading ability [37], [38]. Studies show that during reading the eyes move in a series of jumps (saccades) and pause (fixate) on words to extract visual information from text [37]. A child presenting with eye movement problems may struggle to keep their place when reading, omit words, require their finger or a marker to keep their place or read with poor fluency [6].

Visual cognitive functions of visual perception influence a child's ability to interpret written text [34]. In order to read effectively children need to analyse and understand a words graphic representation (the written symbols) [30], orthographics (the order or construction of the letters to form words and sentences), phonology (the sounds represented) and semantics (the meaning of the words) [16]. Poor visual cognitive functions result in compromised early learning of reading as graphic representation and orthographics are delayed.

Within the components of visual cognitive functions children can present with different problems in reading ability, for example a child with figure-ground dysfunction may battle to block out other words on a page and attend to the word

they are decoding and a spatial relations dysfunction [6] may result in a child reversing the order of letters e.g. reading “on” and “no”. Visual memory delays mean that children can’t recall symbols or link them to sounds they have learnt [4]. Children with visual discrimination dysfunction may battle to read words as they confuse letters, commonly “b” and “d” or the letters p, q and g. A study was conducted on 96 pre-reading 5 year olds to determine which measure was the best for predicting future reading ability. Researchers concluded that visual spatial abilities, including visual attention in preschoolers predicted future reading success in Grade 1 and 2 [39].

2.4.4.3.2 Visual perceptual dysfunction and spelling

In order to visualise a word children must have registered this word correctly, it must have been perceived correctly [6], therefore visual receptive and visual cognitive functions need to be intact in order for them to first read the word correctly. If visual memory dysfunction is present in a child, they will have difficulty recalling the formation and shape of letters or numbers, this negatively affecting their spelling and resulting in children relying on phonetic spelling, rather than recalling the sequence of letters from their memories [6].

2.4.4.3.3 Visual perceptual dysfunction and handwriting

In 2001, researchers found that learners with poor handwriting had lower visual perceptual scores than those with good handwriting [35]. The link between visual perception and handwriting can be explained by the concept of visual motor integration, which is the motor skill that enables a child to co-ordinate a visual stimulus with a corresponding motor action [40]. In order to attain written expression learners need to draw on visual memory and other visual cognitive

functions [41] including spatial relations (to space letters) and form constancy (to size letters correctly). Learners with poor visual perceptual skills may present with reversals in writing, poor spacing, trouble keeping in the margins, size of letters next to each other and spacing on lines [16]. In Washington, a study on 97 participants aged 5-18 researchers compared visual motor integration (reproducing geometric shapes) and visual motor co-ordination (only fine motor control e.g. staying in the lines of geometric shapes) scores to determine which area predicted academic outcomes best [41]. Researchers concluded that VMI was a strong predictor of written expression (alphabet writing skills and sentence composition), compared to visual motor co-ordination, which has no visual perceptual component and did not predict written expression [41]. In copying tasks a child's writing speed and quality can be affected as they need to know where to start and where to go next in order to make their work look the same as the example [6]. A child with poor visual memory may have problems recalling how to form a letter leading to poor legibility [4].

2.4.4.3.4 Visual perceptual dysfunction and mathematics

An understanding of numbers and numerical processing develops as a child gains an understanding of quantity through their motor interactions with the physical environment i.e. they learn to judge distance, size and speed through play and learn magnitude through these interactions [41]. Children first learn to count using concrete aids e.g. counting on their fingers, using pictures or counters, these tasks require processing of visual information [42]. Later children use visual perceptual skills to identify the graphic representation of numbers and draw on visual memory to recall these number facts when solving mathematical equations [43]. In a study exploring the link of visual perceptual ability and mathematical ability in learners,

70 Grade 6 learners in South Africa were assessed and it was found that overall visual perceptual scores were statistically significantly correlated to mathematical ability [43].

Visual perceptual problems can result in difficulties differentiating mathematical symbols and numbers e.g. + and x, 6 and 9 [4], poor alignment when doing vertical sums, difficulty recalling correct sequences of numbers e.g. 204 or 240 [43] and difficulty copying numbers.

2.4.4.3.5 The effects of visual perceptual dysfunction on other educational outcomes

Learners with visual perceptual dysfunction often display behavioural problems of sitting still, finishing their work and sustaining attention [16]. Due to visual perceptual skills being crucial to the development of many academic areas children with dysfunction are at risk of not gaining these crucial skills and not laying the foundation for learning and a positive attitude towards school [44].

According to Warren (1993) the development of lower-level visual skills allows for the expression of higher level skills which include the mental manipulation of visual information and integrating this information with other sensory information in order to reason and problem solve [31].

Visual perceptual skills are needed for the development of vital academic skills of reading, spelling, handwriting and mathematical ability. In addition they develop and foster good behaviour at school and the ability to problem solve and make decisions. Early identification of visual perceptual deficits is needed in order to address and prevent the many negative effects poor visual perceptual skills can have on a childs development [9], [45].

2.5 The assessment of visual perceptual skills in children

Early identification of visual perceptual problems is crucial for learning [15]. In South Africa perceptual tests commonly used by occupational therapists in the education setting, include the Beery Test of Visual Motor Integration – 6th Edition (Beery VMI), Developmental Test of Visual Perception – 2nd Edition (DTVP-2), Test of Visual Perceptual Skills – 3rd Edition (TVPS 3) and Motor-Free Visual Perceptual Test (MVPT). These tests were standardised in the United States (US) [46] but research using these tests on South African samples has been published [45], [47], [48].

In South Africa there is a need for a cost effective, quick simple assessment of visual perceptual skills in primary school children [9]. The possibility of using teacher checklists to identify visual perceptual dysfunction in South African primary school children was explored and compared to the use of a standardised visual perceptual test [45]. Researchers found that while teacher checklists can be helpful in identifying visual perceptual dysfunction the role of a visual perception test in diagnosing delays cannot be replaced [45]. The process of developing a visual perceptual test based on South African normative data is lengthy and to date no such test is available.

The TVPS 3 is a revised edition of a pre-existing test the TVPS – Revised edition (TVPS-R) [49]. This test does not require a verbal response and requires a minimum motor response where the child points to the answer. Gardner (1996) reported that the forms (pictures) used are not language related and are culture free [49]. The TVPS 3 has good reliability and content validity and is described as non-biased for culture and gender [2]. The TVPS – R and TVPS 3 have been

used in previous occupational therapy research on the South African population [48], [45], [47].

The DTVP-2 and Beery VMI, assess both visual perceptual components and motor components, in this study a test was required which does not involve any fine motor or written component, thus allowing the researcher to focus on visual perceptual cognitive skills.

The MVPT was considered for the study as no motor skills are required, however this test only yields one raw score total for determining the overall perceptual ability of an individual, this therefore limits the examiner from identifying problems in a specific sub-skill i.e. one cannot identify which visual cognitive skill was more delayed than others in the sample [46].

This study focuses on the assessment of visual cognitive skills, though it must be considered that visual receptive skills such as acuity and oculomotor skills form part of a complete visual perception assessment. These assessments are beyond the scope of this study.

The TVPS 3 was therefore determined to be the most appropriate test from the available standardised tests and was selected for the study. It includes simple instructions, which allowed for easier translation and less risk of learners misunderstanding the test. The test covers all cognitive aspects of form and spatial perception and includes memory subtests thus allowing a comprehensive assessment of these skills.

The TVPS 3 has 7 subtests: Visual Discrimination, Visual Memory, Visual Spatial Relationships, Visual Form Constancy, Visual Sequential Memory, Visual Figure-Ground and Visual Closure. The test measures to what extent a subject (aged 4–

13 years) can perform in these subtests. Scores are represented in scaled scores with a mean of 10 and a standard deviation of 3 [2]. No qualitative descriptions are provided for the subtest scaled scores in the TVPS 3, the widely used WISC-IV (Weschler Intelligence Scale for Children – 4th Edition) provides descriptors based on standard deviations. Table 2.2 shows these classifications [50].

Table 2.2 Qualitative descriptors of subtest scaled scores according to authors of WISC-IV, Sattler and Dumont (2004)

Scaled Score	Qualitative Description	Percentile rank
1-4	Exceptional weakness, far below average	1-2%
5-7	Weakness, below average	5-16%
8-12	Average	25-75%
13-15	Strength or above average	84-95%
16-19	Exceptional strength, superior	98-99%

In addition to subtest scores the TVPS 3 provides 4 composite scores which are obtained by adding the Sum of Scaled Scores and converting these into standard scores. The Sum of Scaled Scores – Basic Processes includes Visual Discrimination, Visual Memory, Spatial Relations and Form Constancy. The Sum of Scaled Scores – Sequencing is a measure of the Visual Sequential Memory subtest only and The Sum of Scaled Scores – Complex Processes is the sum of Figure-Ground and Visual Closure scores [2]. The Sum of Scaled Scores – Overall represents an overall visual quotient and can be described as the subjects overall visual perceptual ability [2], taking all 7 subtests into account, see Appendix B The TVPS 3 scoring sheets) [2]. According to the TVPS 3 developer standard scores

are the best way to provide qualitative descriptions of the composite scores. Standard scores have a mean of 100 and a standard deviation of 15, descriptors for these are again not provided in the TVPS 3, however Anastasi and Urbina (1997) provided classification as seen in Table 2. 3.

Table 2.3 Qualitative descriptors of composite standard scores according to, Sattler and Dumont (2004)

Standard Score	Qualitative Description
<55	Deficient
55-70	Low
70-85	Low average
85-115	Average
115-130	High average
130-145	Superior
>145	High superior

Instructions for the TVPS 3 can be given in any language and require a minimum amount of language. The test's reliability coefficients for the total score range is 0.96 [2]. Reliability coefficients for individual subtests range from 0.76 to 0.88. Content validity was achieved by ensuring internal consistency, ensuring no gender bias was present and that varying levels of difficulty were retained [49].

Once evaluation is complete, the occupational therapist uses information gained from test scores to formulate treatment plans.

2.6. The treatment of visual perceptual skills in children

2.6.1 The role of the occupational therapist in intervention

Addressing client factors such as visual perceptual deficits is within the scope of the occupational therapist with the aim of treatment being to improve a child's occupational performance [6].

"Occupational therapists enable learners to function optimally in their occupations, which includes typical school tasks, by addressing the underlying components of function or adapting learning and teaching strategies or the environment"
pg 25:[9].

Occupational therapists are therefore responsible for assessing and treating visual perceptual deficits in children when these problems interfere with academic learning [51]. Occupational therapists usually treat visual perceptual dysfunction in individual settings or in small groups and address both visual reception skills and visual cognition skills [51].

Treatment may be compensatory or developmental in approach and often therapy includes both approaches, for example a therapist may provide large print and less print to compensate for poor visual attention but work on the specific visual cognitive skills and develop these to improve class performance. [16].

Occupational therapists may play a consulting role where they assist teachers in organising classroom activities to develop visual perceptual skills needed for school readiness [16]. Activities are used to treat visual perception in group settings or individually, the therapist provides repeated experience in tasks and builds on information the child already knows to ensure the information is stored in

their memory [36]. Treatment in preschoolers focuses on multisensory approach where kinaesthetic and tactile learning are included when developing visual perception, developmentally children this age learn through movement and touch better than auditory approaches [28]. Examples of age appropriate activities which can be used in preschool classrooms to develop visual perceptual skills may include feeling shapes covered with different textures, making shapes from clay, “Simon says”, imitating games and obstacle courses [16].

Treatment must include a focus on visual receptive functions as these influence visual cognitive functions [6]. Occupational therapists develop treatment programmes according to the needs of the individuals or groups that have been identified as having a functional deficit through assessment.

2.7 Visual perceptual programmes

The need for high quality, cost effective early childhood development programmes in developing countries has been identified in a worldwide study which correlates poverty and developmental outcomes [25]. Programmes need to provide direct learning, be longer in duration, high intensity and integrated into educational systems and services [22].

In South Africa occupational therapists are involved in the development and implementation of stimulation programmes for children [48]. After studying the developmental status of street children in Potchefstroom, North-West province, researchers reported that intervention programmes aimed at sensory motor and cognitive abilities (including visual perception) were crucial [48]. As in this study of “at risk” children, the children in schools in the lowest three quintiles have lower

visual perceptual skill scores and perform worse in literacy and numeracy tests than the higher quintile schools [5].

Few visual perceptual skills programmes have been implemented in South Africa, challenging questions are raised such as who should develop these programmes? Which children need these programmes? How should programmes be implemented? Can the programme be applied to different learners with different needs? And how can the programmes effectiveness be measured?

A framework for the development of an integrated visual perceptual programme was published by occupational therapy lecturers from the University of Stellenbosch in 2011, with the goal of enabling young therapists to develop programmes to suit the needs of the population they serve [9]. With numerous years of clinical experience and the implementation and analysis of a visual perceptual programme these researchers proposed that structured opportunities, activities and materials provided in an integrated visual perception programme help the learners to develop scholastic skills. The researchers hypothesised that the program can contribute to learners development and the refinement of their visual system only if it includes components for development of eye movements, visual perceptual abilities and cognitive components [9]. Thus making it an integrated programme. The study did not show significant results for the inclusion of eye movements into the programme and concluded that the length of the study i.e. 10 one hour sessions performed weekly was too short. A recommendation from this study was that an integrated visual perceptual programme should be implemented for the duration of at least two subsequent terms. This will allow children to learn skills through frequent repetition and practice in various activities [9]. The focus of this study was to provide a framework for therapists to develop

their own programmes according to the needs of children they treat in therapy. The programme implemented using this framework did not produce statistically significant changes in the visual perceptual scores of learners, it was concluded it was too short (10 sessions) to obtain change in these skills, this programme was therefore rejected as an option for use in the current study. However, the framework and theory researched in this study was used to help develop the programme for this study.

Internationally there has been more research into the need for and the effectiveness of visual perceptual skills programmes. In Turkey, the need for training programmes to support low socio-economic families visual perceptual knowledge were recommended to address the varying levels of ability according to socio-economic levels [15]. An existing visual perceptual skills programme was used to treat learners, the Frostig Programme for the Development of Visual Perception [52]. This programme was developed in 1968 and most of the research using this programme is outdated, though in 2013 researchers in Turkey found significant improvements in the posttest scores in four of the five perceptual areas tested after learners completed the programme, there was, however no control group in this study and it is therefore difficult to prove the programmes effects [19]. Investigation into the Frostig Programme for the Development of Visual Perception revealed that it is no longer in print or available for purchase. This largely worksheet and paper based programme is not in keeping with the developmental norms of 5-6 year olds where multi-sensory learning is recommended [28]. In addition this programme this does not specifically address eye movements when treating visual perception, as has been recommended in the framework for developing visual perceptual skills programmes by researchers in South Africa [9].

In Israel, a developing country with many children described as having low socio-economic status, occupational therapists implemented an intervention programme aimed at improving the visual-motor skills of first grade children from disadvantaged communities [53]. While this study included a motor skills component, visual perceptual skills were address in the programme too. The research sought to determine the value of implementing a 12 week home programme with parent involvement combined with 12 weeks of collaborative consultation groups in the classroom, compared to the value of the collaborative consultation groups in the classroom only. The collaborative consultation group involved class activities of visual-motor tasks performed once per week with the involvement of the occupational therapist and teacher. Results showed that both groups showed significant improvement in visual motor skills but despite parental compliance the home programme had no additional impact on visual motor skills, researchers suggested perhaps the home programme was not long enough to show benefits or that parents were unsure how to guide children to get the most from the programme [53]. Therefore a home programme approach to improving visual perceptual skills in learners was rejected, the logistics of providing home programmes to families in South Africa are complex and in addition the study in Israel raises questions of their value in addressing visual perceptual skills.

In the United Kingdom, researchers focused on teacher training and mentoring to facilitate teachers abilities to use visual aids to support learning of literacy and numeracy in mainstream schools [54]. This study did not measure the children's attainment of skill from the additional input but rather the teachers compliance and confidence in using visual aids [54].

When treating visual perceptual dysfunction activities need to be prepared according to developmental age rather than chronological age due to the developmental nature of visual perceptual skills [9]. Activity grading and the “just right fit” must be considered to challenge the children in the programme [6]. Eye movements of convergence, divergence, quick localisation, scanning and focus should be addressed followed by the visual cognitive tasks [9]

Training interventions focused on pre-schoolers provides a mechanism to build and lay foundations for cognitive development before a child starts formal schooling [55]. In the current study the socio-economic status of children, their environment, their culture, language and availability of resources were considered when developing activities for the visual perceptual skills programme. Activities were selected according to the researchers 10 years of experience working in paediatric private practice predominantly with many preschool learners, many of whom have visual perceptual deficits. Two training manuals were used to draw additional activity ideas, Enhancing your Child’s Development [56] and the Beery VMI Developmental Teaching Activities [57]. Neither of these manuals are comprehensive visual perceptual skill programmes, rather they serve to provide lists of developmentally appropriate activities which can be selected according to the needs of the children they are used for. Enhancing your Child’s Development was produced by Sonja Witthaus, an occupational therapist, in 2010 as a guide for parents, caregivers and therapists to provide practical suggestions and exercises to assist children with learning disabilities or developmental delay [56]. Her manual provides developmental norms in the areas of motor skills, the senses (including visual perception) and social development and includes specific activities for children aged 0-6 years in each of these. In the area of visual perception, S.

Witthaus (2010) divides activities into level 1 (kinaesthetic stimulation), level 2 (stimulation on a 3-dimensional level) and level 3 (stimulation on a 2-dimensional level) [56], this in keeping with how visual perception develops [4] and how children learn [28]. Problems with some of the activities included many paper based, worksheet activities in the 3rd level, which were not appropriate due to high costs in providing these to learners in the current research programme. In addition it was found inappropriate to use food items such as smarties and jelly tots in the setting of learners in the current study.

The Beery VMI Developmental Teaching Activities manual includes “stepping stones” which are developmental milestones and activities to stimulate the development of each “step”, it ranges from 0-6 years and includes gross motor, fine motor, visual, visual-motor areas [57]. Within the visual area, tracking exercises are described for each developmental level, an example of a task used from this manual is a tracking task for age 5 years to 6 years 11 months, where the child is asked to look at each word in a sentence as the teacher reads it to them, after repetition and correct tracking they then learn to identify words out of sequence [57]. This manual does not provide activities under each visual cognitive function e.g. figure-ground or visual discrimination but rather group activities under vision and the functional “stepping stone” at a certain age e.g. sorting and recognising objects which are the same for a 5 year to 6 year 11 months child.

2.8 Summary of the literature review

The review of literature revealed that South African literacy and numeracy rates in primary schools are lower in learners from schools in the lower two quintiles. Poor socio-economic status puts children at risk for developing low literacy and

numeracy levels. The quality of Grade R schooling in South Africa has focused on addressing access to Grade R, however problems in teacher training and curriculum challenges raise concern about what is being taught in classes given the specific developmental needs of Grade R children. The need to teach skills such as visual perception has been identified. Visual perceptual skills including both receptive and cognitive components are crucial to educational outcomes such as reading, writing and mathematics. Occupational therapists traditionally address these skills by first completing assessment using standardised tests and the treating both receptive and cognitive aspects of visual perception. No visual perceptual test has been standardised on the South African population, several tests were reviewed and the TVPS 3 selected as the most appropriate for this study. Few studies have been conducted on the implementation of visual perceptual programmes in South Africa, current programmes used in research to date were determined to be inappropriate for the study population and a new Visual Perceptual Skills Programme was developed and implemented. The research methodology is discussed in the next chapter.

CHAPTER 3: METHODOLOGY

3.1 Introduction

The study design will be discussed, followed by a description of the study population and the sample that participated in the research. The research measurement tools are discussed in detail and the procedures used in the study are explained, including an in-depth look at the VPSP. Data analysis is discussed next and important ethical considerations are described.

3.2 Study Design

A quantitative, pretest-posttest, quasi-experimental study design was used in the study to analyse the visual perceptual scores of the participants in the intervention and control group before and after the intervention had taken place. The study is described as quasi-experimental as the two groups were established prior to the start of the study i.e. two Grade R classes at the same school. Randomisation was therefore limited, however the groups were randomly assigned as the control or intervention group and pretest scores enabled a measure of their abilities and served to identify any statistical differences prior to the start of the intervention programme [58]. The pretest was conducted in July 2015, at the beginning of the third term. The VPSP was run in the intervention group for 15 weeks i.e. in term 3 and 4 and the posttest was then conducted in the last two weeks of the fourth term i.e. November 2015. The pretest-posttest design allowed for comparison of change in the visual perception of the intervention group that received the VPSP and the control group that did not.

3.3 Study population

A public Primary School was selected using purposive sampling. This school was identified on a “no fee” list of schools [26] and selected due to the impoverished area where it is situated. This sampling technique relies on the judgement of the researcher in selecting the sample in order to best answer the research question [59]. In this study particular characteristics in the population were required, that being a school with low socio-economic status and with two Grade R classes. The primary school is in a rural disadvantaged area and has a no-fee status, as awarded by the KwaZulu-Natal Department of Basic Education, indicating it to be of low socio-economic status [26]. In addition, the school was selected for convenience as this school had two classes at the same facility [58] and participants’ normal school routines would not be interrupted by attending a programme in randomised groups but rather the programme would be administered within their classroom, saving time. Total population sampling was used in the study as each child within the two Grade R classes at the selected primary school was invited to participate in the study, this sample therefore representing the population of 76 Grade R children at the selected primary school as closely as possible [58]. The Grade R classes included 38 children in each class; the classrooms were next to each other, though separated by concrete walls. Children are taught by their register teacher and teachers do not teach children from the other class.

3.4 Study sample

The total population of Grade R children at the selected primary school and their parents were invited to participate in the study.

3.4.1 Inclusion criteria

Children that met the following criteria were included in the study:

- Children aged 5-6 years at the time of the pretesting and enrolled in Grade R in 2015.

3.4.2 Exclusion criteria

Caregivers or parents were asked to disclose information in the demographics questionnaire regarding the health of their children, this information was used to determine whether the child should be excluded from the study, that is, if they:

- Have a known learning disorder or disability which has been formally diagnosed.
- Attend or are attending occupational therapy.
- Have been diagnosed with a visual disorder including acuity. In a rural setting corrective measures may or may not be effective and further visual problems cannot be ruled out.
- Have any diagnosed medical disorder: Genetic, neurological and/or developmental disorder.

3.4.3 Sampling procedure

To account for selection bias two Grade R classes were selected from the same school, children therefore come from similar socio-economic backgrounds. All

Grade R children and their parents were invited to participate in the study. Children whose parents responded and consented to participate in the study were measured against inclusion and exclusion criteria and formed two groups of the total sample. The classes were assigned into the respective groups by each class being assigned a name i.e. Mrs. J and Mrs. S. This was sent by the researcher to a Witwatersrand University Senior lecturer who in the presence of two witnesses selected one slip from an envelope to determine which class would form the intervention group; the other class then formed the control group. Prior to the commencement of the programme, both groups baseline visual perceptual scores were assessed, to ensure the groups were comparable. The children's average age in each group was assessed to ensure groups were comparable.

3.4.4 The sample size

The sample for this study comprises of 51 Grade R pupils, 25 in the intervention group and 26 in the control group. The sample was obtained by providing the total population (76 children) with information packs and consent forms. Sixty-five forms were returned and consent provided. Of these children, 55 were assessed in the initial testing which was conducted in the first week of the school term. Ten children were not available for pretesting as they had not yet returned to school after the holidays. Fifty-one children were available for posttesting. The number of boys and girls in the two groups was not considered as the TVPS 3 does not differentiate gender in the scoring [2].

The required sample size of 25 participants per group was calculated based on a 5% significance level at 80% power with a difference of 0.80 standard deviation between the two groups after the intervention of two school terms based on the z-

scores calculated from the raw scores on the TVPS 3 [19]. The sample size was reached with 25 participants in the intervention group and 26 in the control group.

3.5 Research Measurement

3.5.1 Instrumentation

The measurement tools used in the study include the demographic questionnaire and the TVPS 3. The demographic questionnaire provided information on the socio-economic level of the participants and important information on the age and health of each child while the TVPS 3 is a test of visual perception, used in pretesting and posttesting of the control and intervention groups.

3.5.1.1 Demographics Questionnaire

A demographic questionnaire (Appendix A) was used to collect data from the parents of the participants in the study sample. The questionnaire was translated into isiZulu and parents answered in English or isiZulu. This questionnaire was purpose-designed by the researcher to gain basic information on the child's personal details (name, address, and date of birth) and medical history to determine any cause for a child to be excluded according to the exclusion criteria of the study. Basic information on the family's income (parents' employment status and range of monthly household income) was requested to assist in determining the socio-economic level of the participants in the study. This questionnaire was placed in an envelope and put in each child's school bag. It was completed by the child's parent or caregiver and returned in a sealed envelope which was given to the researcher by the teacher to ensure confidentiality.

3.5.1.2 The Test of Visual Perceptual Skills – 3rd edition (TVPS 3)

The TVPS 3 [2] was used to assess the visual perceptual skills of the intervention and control group (Appendix B). This test assesses an individual's perceptual abilities without requiring significant motor involvement. Visual perception and motor skills develop in parallel and are often closely related but the two systems can be tested separately [2]. While this test is not standardised on the South African population it has been used in a number of studies on South African children [9], [48], [45].

This test consists of seven subtests which include Visual Discrimination, Visual Memory, Visual Spatial Relationships, Visual Form Constancy, Visual Sequential Memory, Visual Figure-Ground and Visual Closure. The TVPS 3 measures to what extent a subject (4–13 years) can perform in the above subtests. Directions require a minimum amount of language and can be given in any language to ensure validity [2].

Test instructions were translated to IsiZulu (Appendix C) and an interpreter gave the instructions. It is described as a test which is nonbiased for culture, gender, and education [2]. The raw scores for each subtest are used to obtain derived scores which provide information on a subject's performance related to their age level, percentile rank and perceptual age. This allows for comparison of the subject's performance to that of typical developing children of the same age-group.

In this study, scaled scores are used to describe subtest performance, they are calculated by the raw scores being fitted onto a normal distribution with a known mean of 10 and standard deviation of 3 [2]. These scaled scores were classified into qualitative descriptions to provide an understanding of average scores and

how participant's scores related to the average scaled score of 8-12. Scores of 8-12 are average, 13-15 above average, 16-19 superior [50]. Below average scores are 5-7 and 1-4 represents exceptional weakness. In this study, the last group was further divided into 2-4 (moderate dysfunction) and 0-1 (severe dysfunction) due to the high number of participants scoring 0 on the subtests. The adapted score interpretations are in Table 3.1

Table 3.1 Adapted qualitative descriptors of subtest scaled scores

Scaled Score	Qualitative Description
0-1	Severe dysfunction
2-4	Moderate dysfunction
5-7	Weakness
8-12	Average
13-15	Above average
16-19	Superior

Composite scores are termed Sum of Scaled Scores and are converted into standard scores with a mean of 100 and a standard deviation of 15, there are 4 composite scores [2].

A total visual perceptual quotient, termed Sum of Scaled Scores Overall, is used to describe a testee's overall visual quotient; it represents the addition of all 7 subtest scores and conversion into a standard score. The Sum of Scaled Scores – Basic Processes includes 4 subtests, Visual Discrimination, Visual Memory, Spatial Relations and Form Constancy. The Sum of Scaled Scores – Sequencing only represents the Visual Sequential Memory subtest and the Sum of Scaled Scores – Complex Processes includes the Figure-Ground and Visual Closure subtests [2].

Qualitative descriptions for these standard scores are represented in Table 3.2 [60]

Table 3.2 Qualitative descriptors of standard scores, Anastasia and Urbina (1997)

Standard Score	Qualitative Description
<55	Deficient
55-70	Low
70-85	Low average
85-115	Average
115-130	High average
130-145	Superior
>145	Very superior

The test's reliability coefficients for the total score range was 0.96 [2]. Reliability coefficients for individual subtests range from 0.76 to 0.88. Content validity was established by ensuring internal consistency, lack of gender bias and that varying levels of difficulty were retained [49].

The research procedure is discussed in the following section, with details of how the TVPS 3 was used in the study.

3.5.2 Research procedure

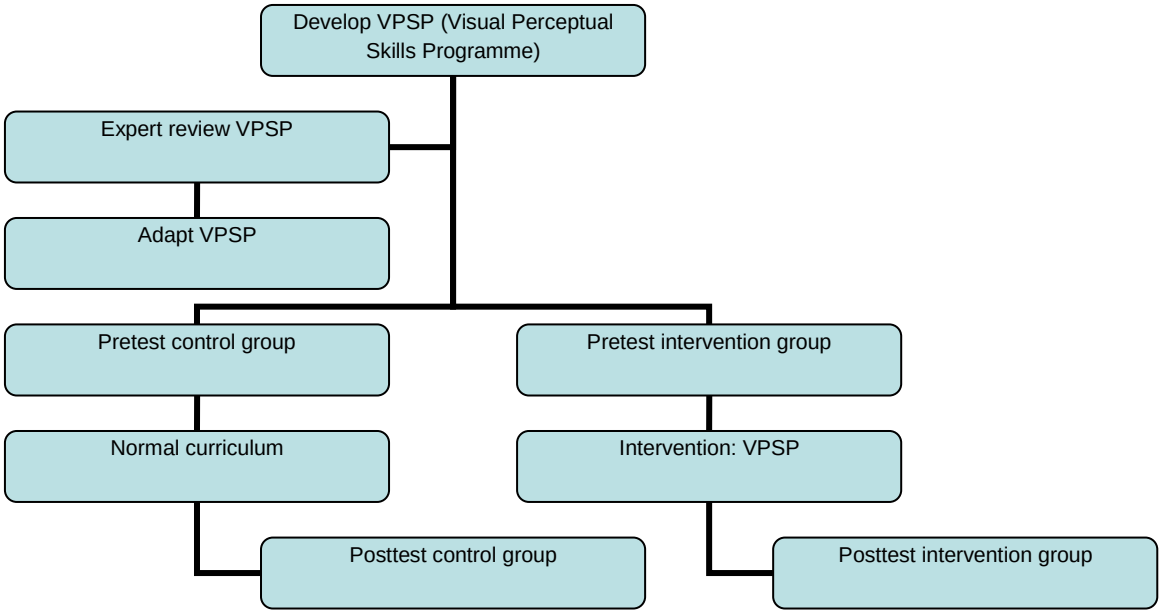

Figure 3.1 A visual representation of the research procedure used in the study

The section will discuss the development of the VPSP, including the expert review and adaptations required prior to its implementation. Pretest procedures are described and the actual implementation of the VPSP is explained in detail. Posttesting procedures are then described.

3.5.2.1 The development of the Visual Perceptual Skills Programme

Due to the lack of an appropriate visual perceptual skills programme for the study population, as discussed in the literature review, necessitated the researcher to develop the VPSP with careful consideration of the frame of reference of pupils in a rural environment with limited resources.

It is a stimulation programme aimed at improving areas of visual perception in Grade R children. The VPSP included daily activities that focus on eye movements, visual perceptual abilities and cognitive skills (such as identifying,

sorting and interpreting visual information). The programme was developed by the researcher using information from the literature review on other visual perceptual programmes which have been implemented. Activities were drawn from the Beery Developmental Teaching Activities Manual [57] and Enhancing your Child's Development Manual [56] which is a collection of activities for therapists and caregivers. Activities were adapted for the environment and resources available e.g. instead of sorting buttons into muffin tins, the learners sorted beans into empty egg boxes. Again many activities in this manual were not appropriate for the current study, such as remote control cars for developing tracking skills. Throughout programme development, activities that can be done in a group setting were selected and those which demanded low resources, careful care was taken to ensure children were engaged in play activities which had specific goals of developing visual perception. In addition to this the researcher used clinical reasoning and experience of 10 years of working in private practice with a focus on visual perceptual skills to add activities to the programme and grade the activities.

This programme was divided into 17 weeks. The tasks were divided into two sections, the first dealing with eye movements and the second section focusing on a specific visual perceptual cognitive skill. All children in the intervention class took part in the activities; such developmental activities are in keeping with meeting the curriculum outcomes e.g. learning shapes, size concept and letters. Each activity was described in detail in written form. The activities were completed every morning prior to the commencement of normal curriculum work. The intervention group therefore repeated each task each morning of the week, with small variations depending on the task e.g. changing a sequence of objects to recall or

looking for a different shape in magazines each day of the week. New activities were provided by the researcher on a Monday morning. The programme was designed to be low cost and the researcher provided the resources required for the activities. The total cost of the programme was under R500, including items such as 12 tennis balls, 10 marbles, photocopied worksheets, beans and stickers. Many items used were recyclables such as egg boxes, toilet paper cardboard rolls, magazines. These are not readily available in rural communities and could result in a higher cost of the programme. In week 1 Shape Concept was the focus, aimed at familiarising participants with the different shapes as many activities in the rest of the programme used these concepts. Week 2-15 included a set of eye movement exercises followed by a task focusing on either Visual Discrimination, Figure-Ground, Spatial Relations, Form Constancy or Visual Memory. Visual Memory and Visual Sequential Memory were treated in the same week with an activity stimulating both areas which are closely linked. Each perceptual component was stimulated for 1 week and after other areas were addressed it was stimulated again, with a more complex task. Visual Discrimination was addressed in week 2 and 8, Figure-ground in week 3 and 9, Spatial Relations in week 4 and 10, Form Constancy in week 5 and 11, Visual Closure in week 6 and 12 and Visual Memory in week 7 and 13. The remaining weeks, week 14-15 included tasks requiring a combination of perceptual components, Visual Discrimination and Figure-ground in week 14 and Spatial Relations and Form Constancy in week 15. . An example of daily activities is shown below:

<u>Week 4 - Eye movements</u>

1. Place pictures or familiar objects in a long row on the wall. 10 children at a time must stand in front of the wall and say the objects in order. Make “binoculars” with

your hands and say the objects again in order. Change the sequence each day of the week.

2. Repeat the activity with a sequence of shapes drawn on the board. Change the sequence each day of the week.

Week 4 - Form Constancy

1. Look in the room for all the square objects. Have the teacher place a sticker on all the square objects. The next day do a different shape.

2. Look in a magazine for all the squares etc, stick these on a poster for each day of the week. Do a different shape each day of the week.

(Mon=square Tues=circle Wed=triangle Thurs=oval Fri=rectangle)

A paediatric expert reviewed the programme and recommended that a diagram showing structuring of each session should accompany the instructions and that activities must be more specific e.g. rather than state “stick a shape on the end of a pencil”, it should read “stick a circle on the end of a pencil”. Another recommendation was to provide the resources and instructions for each week in a sealed box and collect it before supplying the following week’s activities. The recommendations were implemented.

3.5.2.2 Consent and demographic information

Once ethical clearance was obtained the information forms (Appendix D), parent consent forms (Appendix E) and demographics forms (Appendix A) in isiZulu were sent in large envelopes and packed into the children’s school bags on the first day of the 3rd term. The translation of forms was completed by an isiZulu teacher

employed by the Department of Basic Education, but not working at the primary school where the study was conducted. This was completed in her free time. The forms were developed by the researcher to be short and easy to understand, with only basic information requested from parents.

Some forms were completed in isiZulu and some in English. The researcher was assisted by an isiZulu speaker unrelated to the school or study. The translator's first language is isiZulu and she has a matric qualification.

3.5.2.3 Pretesting procedure

The children who met criteria for inclusion in the sample were assessed using the TVPS 3 (Appendix B) at the beginning of term 3 of Grade R. Permission to translate the TVPS 3 into isiZulu was obtained from the developers of the test (Appendix F). The test was translated into isiZulu by the same isiZulu teacher who translated the information, consent and demographic forms, to ensure instructions were understood by the participants. The process of translation included the researcher and translator sitting together using the test manual to translate into isiZulu and then re-reading the isiZulu instruction and back-translating it to English.

The test was conducted by the researcher in a separate room to the classroom, on a one-to-one basis, with the use of an interpreter. The test took 25-35 minutes per participant. The total time to test all participants was 2 weeks (8:00-13:00), this due to many children being absent in the first week due to heavy rainfall and inaccessibility to school.

The interpreter role was carried out by two teachers from the primary school where the study was conducted; they were made available to the researcher by the school principal and either was available at all times during pre and posttesting.

Prior to testing the interpreters were trained in a 30 minute meeting where the TVPS 3 was explained. Both interpreters were given the set of instructions to read through at home to ensure clear, efficient delivery of instructions according to the manual.

3.5.2.4 Implementation of the Visual Perceptual Skills Programme

During the implementation of the programme a few adaptations were required; the time set for activities was extended from 20-30 minutes to 45-60 minutes. With 36 children in the class and one teacher activities took longer than initially expected. Participants perceptual abilities were weaker than initially expected when designing the programme and thus they required additional input from the teacher which resulted in increased time spent on tasks. The tasks were mostly followed according to the programme design, however there was a strike at the school and week 8 tasks were interrupted on 3 days of the week. These were then added to week 9 activities and the class completed “double” visual perceptual tasks on three days. In addition the programme was initially 17 weeks long, however in this rural school the Grade R children do not come to school in the last two weeks of school, after their graduation ceremony. Therefore the programme was shortened to 15 weeks, to allow time for re-testing.

The teacher of the class who implemented the VPSP was trained by the researcher in the administration of the programme on a weekly basis through demonstration of the activities and verbal feedback to check understanding levels. Each Monday the researcher supplied a box with activities and instructions. The programme was intended to be run by the teacher, however this was adapted as it was observed that the teacher required the input from the researcher to follow the

activity instructions. The teacher was unsure of what to do, despite instructions and required guidance to learn the activity and how to administer it. The researcher therefore spent the Monday session with the intervention group and the teacher i.e. 45 -60 minute periods, the researcher assisted the teacher with the activities and interacted with the children and teacher until the tasks were complete. The tasks were then repeated on Tuesday to Friday but administered by the teacher only. The final visual perceptual programme used in the study is attached (Appendix G).

The weekly activities from the VPSP were kept by the teacher of the intervention group in a storage box, this was not accessible to the control group and the teachers were advised on the need to keep the control group from participating in the activities during the study. Activities were packed up after each session to prevent contamination between the two groups. The activities were removed by the researcher each week prior to starting new activities.

The VPSP was conducted over two consecutive terms of the Grade R year, term 3 and term 4. The visual perceptual programme was carried out in addition to the normal school work done in the classroom.

3.5.2.5 Posttesting procedure

On completion of the programme the participants from both classes were re-tested with the assistance of an interpreter, the same two teachers were used and the instructions closely adhered to. Assessments took place in the same room and the same procedure followed as in pretesting.

3.6 Control of Variables

Extraneous variables may include home environment, socio-economic levels, parent level of education. These factors can have an effect on the development of visual perceptual skills [12]. In an attempt to minimise the effect of the above mentioned factors children from one school in a disadvantaged area were selected for the study. Furthermore, each participant's baseline perceptual score was obtained prior to the start of the intervention programme. Each child was therefore compared with their own baseline score to determine the change in the scores.

All participants and parents in the sample were isiZulu speaking, the researcher is English speaking. To overcome this barrier an interpreter was used for all interactions with the participants. With regard to the parents, forms were translated into isiZulu.

An additional variable is the length of the programme; the full 17 week programme was cut short due to the Grade R children not spending the last two weeks of the fourth term at school following their graduation ceremony.

Absenteeism records were obtained from the class register and the number of days absent of each participant was obtained. A rate of 25% absenteeism from the intervention programme may have an effect on their participation in the programme and is a variable that was considered in the study.

The possible risk of contamination of the programme was addressed by ensuring each week's activity was collected prior to supplying the following week. This prevented activities "lying around" and risking that participants may repeat tasks or may share tasks with the control group.

Only at the onset of the programme was it clear that the teacher would need assistance implementing the programme. Thus the variable of having an occupational therapist assist the teacher once per week to run the programme must be considered.

3.7 Data Analysis

Data were gathered and entered into Microsoft Excel. The data gathered from the measurement tools in the study is quantitative; it is quantifiable and statistical as data was counted and measured [58]. The researcher performed descriptive statistics on the information received in the demographics questionnaire to determine details about the sample including socio-economic status. Results were compiled into descriptive tables and figures, results were converted into comparable frequencies and ranges.

The Mann Whitney U test was used to determine the change between the two groups as the data was not normally distributed. This test is used to determine the differences between means of two independent groups [58]. First the test was used to analyse the difference between the baseline scores of the control and intervention group and then to compare the differences in scores between pretest and posttest and whether there were significant differences when comparing the two groups.

The Wilcoxon Signed Rank Test was used to determine the change of each participant within a group between pretest and posttest. This test is used to determine whether there are significant differences in each individual within the group [58].

The change within the control group was compared to the change within the intervention group using effect size (ES). This measure was used to determine the clinical significance of the differences between the groups [61]. Effect sizes calculate the magnitude of treatment or intervention effects. An effect size (ES) of 0.2 represents a small effect from the intervention. An ES of 0.5 a moderate effect and 0.8 a large effect [61].

For the purpose of this study the TVPS 3 overall sum of scaled scores of each group were used to determine the overall visual quotient of each group. In addition to this the scores of each subtest i.e. visual discrimination, visual memory, spatial relationships, form constancy, sequential memory, visual figure-ground and visual closure was analysed, to provide information of the participants performance in specific visual perceptual areas [2].

3.8 Ethical considerations

Ethical clearance was first obtained from the Human Research Ethics Committee at the University of the Witwatersrand (Appendix H). Permission was obtained from the KwaZulu-Natal Department of Education (Appendix I), the principal of the school received an information sheet (Appendix J) and was asked to consent (Appendix K) and the Grade R teachers received an information sheet (Appendix L) and gave consent (Appendix M).

An information sheet (Appendix D) in isiZulu was handed out. It was explained that parents have the opportunity to consent or decline their child's participation in the study, that participation was voluntary and there would be no negative consequence to a parent or child declining participation. It was further emphasised

that there would be no cost to the parent or school. A sticker was placed on the front of each envelope, asking parents in isiZulu to seal the envelopes and return these to school. The sealed envelopes were given to the researcher by the teachers in each class. The parents of the participants in the study gave informed consent (Appendix E). Prior to testing each child was asked to give verbal assent to participate (Appendix N). Confidentiality was kept throughout the study and the results of individual children were not disclosed to teachers or the school. Each child was given a code which appeared on the test booklets. The information pack included two parts, the first page included personal details, the second page was a request for demographic information including health of the child, income of the household, employment status and access to water and electricity. This page and the TVPS 3 scoring sheet were given a subject code which was written on the front page, thus enforcing confidentiality. Only the researcher and the supervisor will have access to the records. Records will be stored and locked in a filing cabinet at the researcher's private practice for a period of 6 years according to the HPCSA regulations.

It is ethically responsible to advise parents of visual perceptual problems identified in their children i.e. scores of 2 or more standard deviations below the score of 10. However due to most of the participants scoring in this range, parents were not contacted individually, rather a presentation was given at the Grade R graduation to explain the concept of visual perception and simple ways to address these skills at home.

CHAPTER 4: RESULTS

4.1 Introduction

This chapter will discuss the demographics of the participants and compare the age, gender and socio-economic status of the control and intervention group. The baseline pretest scores will be presented and the control and intervention group compared. Posttest scores, following completion of the VPSP by the intervention group are then compared between the control and intervention group.

Results within separate subtests are then presented, followed by the comparison of change from pretest to posttest scores within the control and intervention group. Finally the comparison of the changes in the pretest posttest scores between the control and intervention group is presented.

The total number of participants in the study was 51 Grade R children from the selected primary school. The participants were tested using the TVPS 3. Initially 55 children were pretested, two dropped out of school during the study and two were unavailable at the time of posttesting; the loss to follow up rate was 7.27%.

4.2 Demographics

An analysis of the demographics of the participants is crucial to this study which aims to explore the effects of the VPSP on disadvantaged children. In addition, any differences between the control and intervention group demographics needs to be considered when analysing the results.

4.2.1 Age and gender of the participants

The ages of the 51 participants ranged from 5 years 1 month to 6 years 3 months, the median age of the intervention group was 5 years and 6 months and of the control group was 5 years 2 months. There was no significant difference between the control and the intervention groups with regard to the age of participants (p value=0.40) (Table 4.1).

With regard to gender, 45% of the participants in the total sample were girls. The intervention group consisted of 64% girls compared to 50% girls in the control group. The difference in gender between the intervention and control groups was not significant (p=0.32) (Table 4.1).

The control and intervention groups were comparable in terms of age and gender.

Table 4.1: Age and gender of children

		Total n= 51	Control Group n= 26	Intervention Group n= 25	p-value
Age in months	Median	5 years 5 months	5 years and 2 months	5 years and 6 months	0.40
Gender	Male	43.14% (n=22)	50 % (n=13)	46 % (n=9)	0.32
	Female	56.86% (n=29)	50 % (n=13)	64 % (n=16)	

Significance p≤ 0.05*

Significance p≤ 0.01**

4.2.2 Socio-economic status of the participants

The study focuses on participants from resource constrained circumstances and therefore parents in the study were asked to disclose household income and employment status. The majority of the sample (48.78%) live in families with an income of R500-R1000 a month with 34.15% reporting no income (Table 4.2). In the control group the highest percentage of participants reported no income (42.86%), while in the intervention group the highest percentage of participants' reported an income of 500-1000 (65%). Only 2.41% of the total sample earn in the range of R3000-R6000, with no participants in this income range in the control group and 5% in the intervention group. The two groups were comparable in terms of income (p=0.69).

The majority of the sample have unemployed parents, only 19.61% of the mothers are employed and 34.69% of the fathers are employed. The intervention group had 45.83% of fathers employed, while the control group has 24% employed. Just two of the 51 participants have both parents employed. The guardian employment rates for the total sample show that 20.41% of the sample have employed guardians. When comparing the groups no significant difference was noted in employment of mothers (p=0.57), fathers (p=0.25) or guardians (p=0.28) between the intervention and control groups (Table 4.2).

Most of the participants' families have access to electricity (98%) (Table 4.2). Each participant (100%) had access to electricity in the intervention group, and 96% had access in the control group.

Seventy four percent of the total sample had access to water. In the control group only 61.54% of children have access to running water, compared to 88% in the

intervention group, this resulted in a statistically significant difference between the two groups for this aspect (p=0.03).

The majority of the sample were described as healthy by their parents (84.31%). In the intervention group 80% were described as healthy and in the control group 88.46% were reported to be healthy. No statistical difference was recorded between the two groups with regard to number of healthy children participating in the study.

Table 4.2 shows that the intervention and control group were comparable in terms of socio-economic indicators with the exception of access to running water.

Table 4.2: Income, mother employment status, father employment status, health status access to water and electricity

		Total n= 51	Control Group n= 26	Intervention Group n= 25	p value
Income	None	34.15 % (n=14)	42.86 % (n=9)	25 % (n=5)	0.69
	500-1000	48.78 % (n=20)	33.33 % (n=7)	65 % (n=13)	
	1000-3000	14.36 % (n=6)	23.81 % (n=5)	5 % (n=1)	
	3000-6000	2.41 % (n=1)	0 % (n=0)	5 % (n=1)	
Employment status	Mother employed	19.61% (n=10)	23.08 % (n=6)	16 % (n=4)	0.57
	Father employed	34.69 % (n=17)	24 % (n=6)	45.83 % (n=11)	0.25
	Guardian employed	20.41 % (n=10)	24 % (n=6)	16.67 % (n=4)	0.28
Access to resources	Access to electricity	98 % (n=49)	96% (n=24)	100% (n=25)	0.38
	Access to running water	74.5% (n=38)	61.54% (n=16)	88% (n=22)	0.03*
Health status as described by parent or caregiver		84.31 % (n= 43)	88.46 % (n=23)	80 % (n=20)	0.42

Significance p≤ 0.05*

Significance p≤ 0.01**

4.3 Results of the Test of Visual Perceptual Skills (III)

The participants were tested on two occasions using the TVPS 3. After the pretest the intervention group received the VPSP for 15 weeks, during term 3 and 4, while the control group continued with the normal curriculum. Posttesting of both groups was completed after four and a half months.

4.3.1 Comparison of the pretest posttest scores between the control and intervention group

The pretest scores of the control and intervention groups are presented and a comparison between the two is made, followed by a comparison of the posttest scores of each group.

4.3.1.1 Pretest scores of the control and intervention group

The Mann-Whitney U test was used to analyse the differences between the baseline scores in the control and intervention group.

The pretest median score in each subtest as well as the combined scaled scores for both the control group and the intervention group are represented in Table 4.3.

The scaled scores for the subtests indicate that none of the median scaled scores in the control or intervention group fell in the average range of ability (8-12). For Visual Discrimination, Visual Memory, Form Constancy and Figure-ground the median scores for both groups fell in the “weakness” range (5-7). Median scaled scores for Visual Closure for both groups were 5. In the Spatial Relations and Visual Sequential Memory subtests both groups obtained a median scaled score of 0.

The Sum of Scaled Scores – Overall; Sum of Scaled Scores – Basic Processes; as well as Sum of Scaled Scores - Sequencing for both groups fell below average with standard scores below 85 (Average = 85 – 115) and there was no significant difference between the groups (Table 4.3).

The median standard score for Sum of Scaled Scores – Sequencing in both groups was 0, reflecting deficiency in this area. All subtest pretest scores and overall sum of scaled scores showed no significant difference between the intervention and control groups. The groups were therefore comparable in terms of baseline visual perceptual scores prior to the implementation of the VPSP. Both groups had similar perceptual abilities despite being taught by different teachers and being in different class environments.

Table 4.3: Comparison of the intervention group and the control group pretest scores

	Control Group n=26	Intervention group n=25		
	Pretest assessment scaled scores Median and lower and upper quartile ranges		Difference	p-value
Visual Discrimination	6.00 (5 – 7)	6.00 (5 – 6)	0	0.33
Visual Memory	6.00 (3 – 11)	7.00 (5 – 8)	1	0.87
Spatial Relations	0.00 (0 – 6)	0.00 (0 – 7)	0	0.82
Form Constancy	5.50 (3 – 8)	6.00 (4 – 8)	0.5	0.61
Visual Sequential Memory	0.00 (0 - 6)	0.00 (0 – 6)	0	0.94
Figure-ground	7.00 (5 – 8)	7.00 (6 – 8)	0	0.58
Visual Closure	5.00 (0 – 7)	5.00 (0 – 6)	0	0.63
Sum scaled scores -overall	74 (65-78)	72 (69-80)	2	0.52
Sum scaled scores - basic processes	72 (67-85)	75 (69-81)	-3	0.55
Sum scaled scores – sequencing	0 (0-80)	0 (0-80)	0	0.88
Sum scaled scores - complex processes	75 (68-85)	78 (70-85)	-3	0.65

Significance $p \leq 0.05$*

Significance $p \leq 0.01$**

4.3.1.2 A comparison of the posttest scores of the control and intervention group following completion of the Visual Perceptual Skills Programme by the intervention group

Following completion of the VPSP by the intervention group both groups were re-tested and the comparison of the posttest assessment scores is represented in Table 4.5. A Mann Whitney U test was used to determine whether the difference in scores in the posttest were significant when comparing the two groups.

When comparing the posttest median scaled scores in each subtest the results show the median scaled score is higher in the intervention group in 6 of the 7 subtests namely, Visual Discrimination, Visual Memory, Spatial Relations, Form Constancy, Visual Sequential Memory and Figure-Ground. In the control group the posttest median scaled scores are lowest in the Spatial Relations (scaled score 2) and Form Constancy subtest (scaled score 3), in the intervention group the lowest post test median scaled score is Visual Closure (scaled score 5). The highest scores were obtained in Figure-ground (6) and Visual Memory (6.5) in the control group and in the intervention group Visual Discrimination (7), Visual Memory (7) and Figure-ground (8) were the highest median scaled scores

Both groups scored a median scaled score of 5 in the Visual Closure subtest during posttesting.

The difference in the posttest results between the control and intervention group is significant in three subtests: Visual Discrimination ($p=0.00$), Spatial Relations ($p=0.04$) and Figure-Ground ($p=0.02$).

The Sum of Scaled Scores - Overall indicates a significant difference ($p=0.03$) in the posttest scores between the intervention group who participated in the visual

perceptual programme as compared to the control group. In addition the Sum of Scaled Scores – Basic Processes showed a significant difference in posttest scores (p=0.02). In the intervention group this composite score is in the average range (85-115). However in all the other sum of scaled scores, in both groups, the scores remain below average (70-85).

Table 4.4: Comparison of the intervention group and the control group posttest scores

	Control Group n=26	Intervention group n=25		
	Posttest assessment scaled scores Median and lower and upper quartile ranges		Difference	p value
Visual Discrimination	5.00 (3 – 6)	7.00 (5.- 9)	2	0.00**
Visual Memory	6.50 (5 – 10)	7.00 (5 – 9)	1.5	0.58
Spatial Relations	2.00 (0 – 6)	6.00 (4 – 11)	1	0.04*
Form Constancy	3.00 (2 – 8)	6.00 (4 – 8)	3	0.09
Visual Sequential Memory	5.50 (0 – 11)	6.00 (0 – 8)	1.5	0.90
Figure-ground	6.00 (3 – 7)	8.00 (6 – 10)	2	0.02*
Visual Closure	5.00 (0 – 8)	5.00 (0 – 6)	0	0.29
Sum scaled scores -overall	77 (69-83)	83 (72-88)	6	0.03*
Sum scaled scores -basic processes	75.5 (71-81)	85 (74-91)	9.5	0.02*
Sum scaled scores – sequencing	77.5 (0-105)	80 (0-100)	2.5	0.9
Sum scaled scores - complex processes	75.5 (68-83)	80 (70-85)	4.5	0.38

Significance p≤ 0.05*

Significance p≤ 0.01**

4.3.2 Distribution of visual perceptual components of participants

From the comparison of the intervention and control groups' posttest scores it is clear that both groups have median scaled scores of below average (below 8 scaled scores), with the exception of Figure-Ground in the intervention group where the median scaled score is 8.

The frequency of the scaled scores was analysed to determined and compare scores in each subtest and compare these to a normal distribution. This will allow for discussion around which subtests participants performed better in and in which worse.

4.3.2.1 Visual Discrimination

In the pretest most of the participants fell into the 'weakness' range for (5-7) for Visual Discrimination, 69% in the control group and 68% in the intervention group.

In the posttest a total of 46% of the control group presented with a scaled score of below 5, i.e. 38% with moderate dysfunction and 8% with severe dysfunction, compared to just 24% with moderate dysfunction (2-4) and no participants in the severe dysfunction range in the intervention group. Thirty six percent of the participants in the intervention group scored in the normal range (median scaled score 8-12) on the posttest assessment compared to 11.54% in the control group. Overall the majority of participants in both groups obtained scaled scores in the range of 5-7.

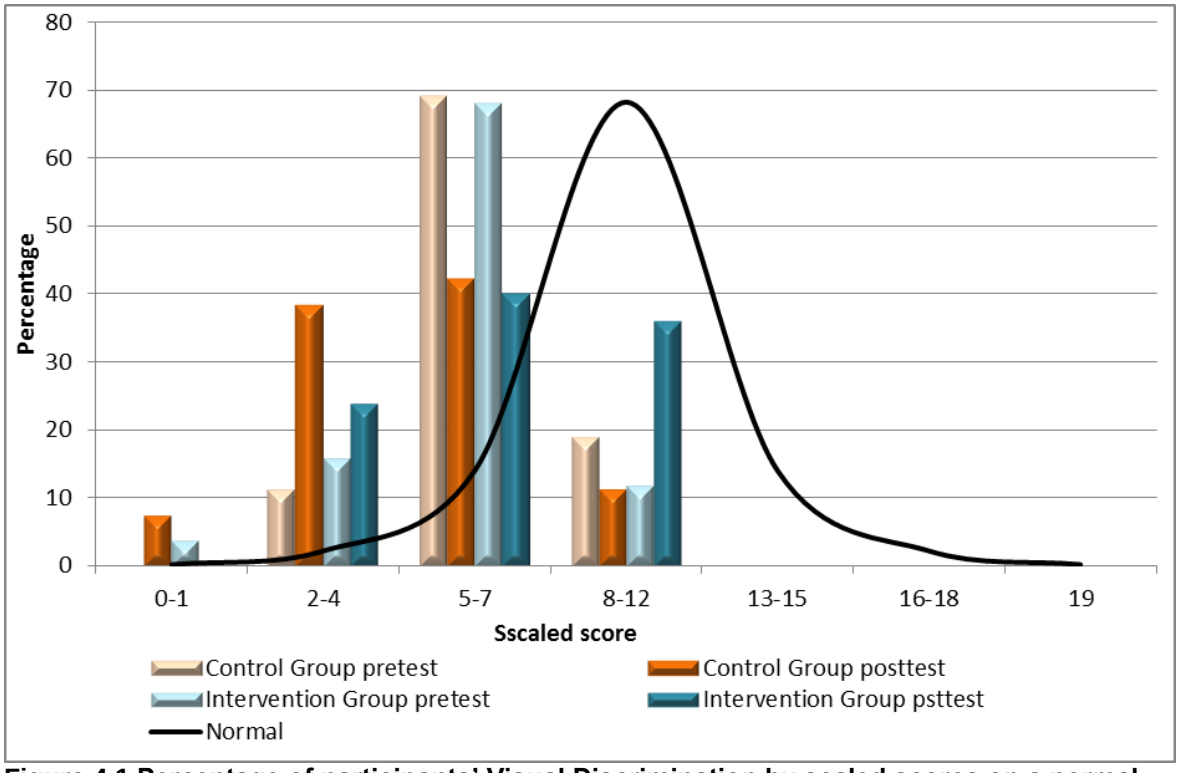

Figure 4.1 Percentage of participants' Visual Discrimination by scaled scores on a normal distribution for pretest and posttest (n=51)

4.3.2.2 Visual Memory

Pretest scores for visual memory in both groups show that 58% of the control group and 56% of the intervention group fell in the below average (8-12).

After the Visual Perceptual Stimulation Programme none of the intervention group scored in the range of severe dysfunction (0-1), compared to 4% in the control group with severe dysfunction in visual memory.

The posttest scores show that in both groups participants' posttest scores remained similar to those in the pretest, with 47% of the control group and 48% of the intervention group in the average or above range.

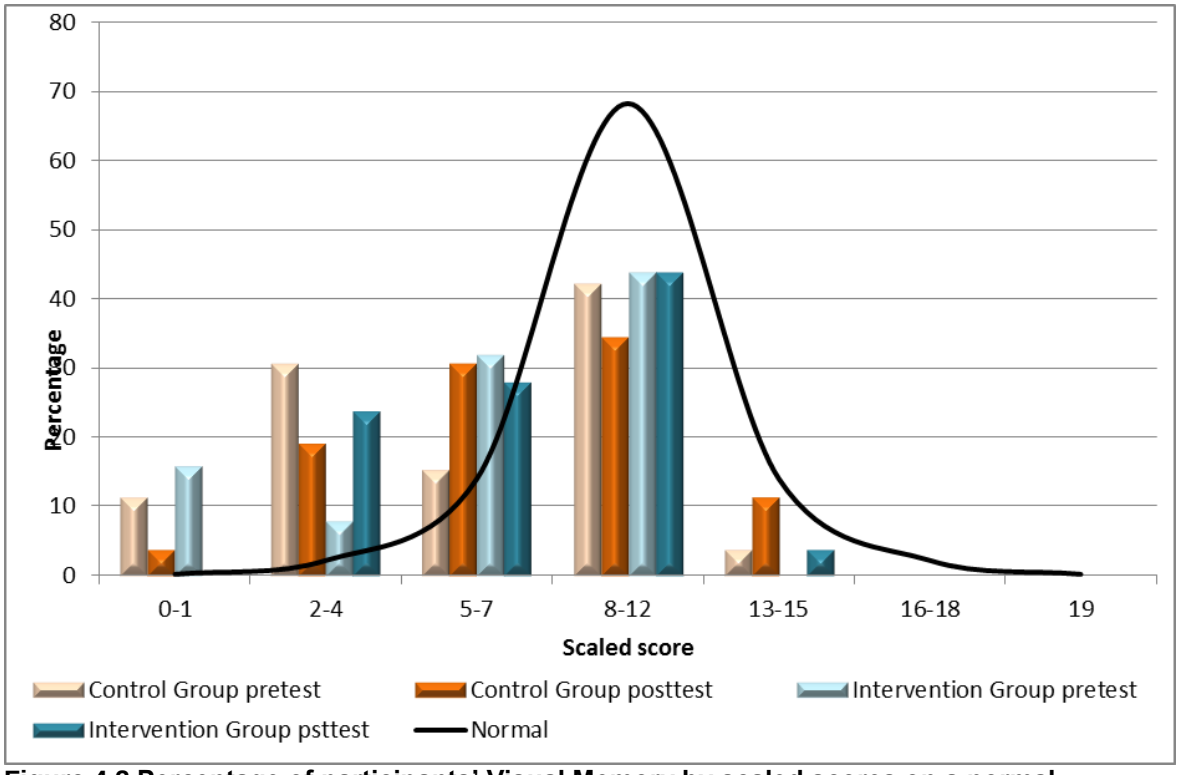

Figure 4.2 Percentage of participants' Visual Memory by scaled scores on a normal distribution for pretest and posttest (n=51)

4.3.2.3 Spatial Relations

The majority of the participants fell into the severe dysfunction range on pretesting: 58% of the control group and 52% intervention group scored between 0 and 1 scaled score.

Posttest results show 50% of the control group remained in the severe dysfunction category for Spatial Relations, compared to just 16% of the intervention group. Forty four percent of the intervention group fell into the 'weakness' group posttest, scoring in the range of 5-7 scaled score.

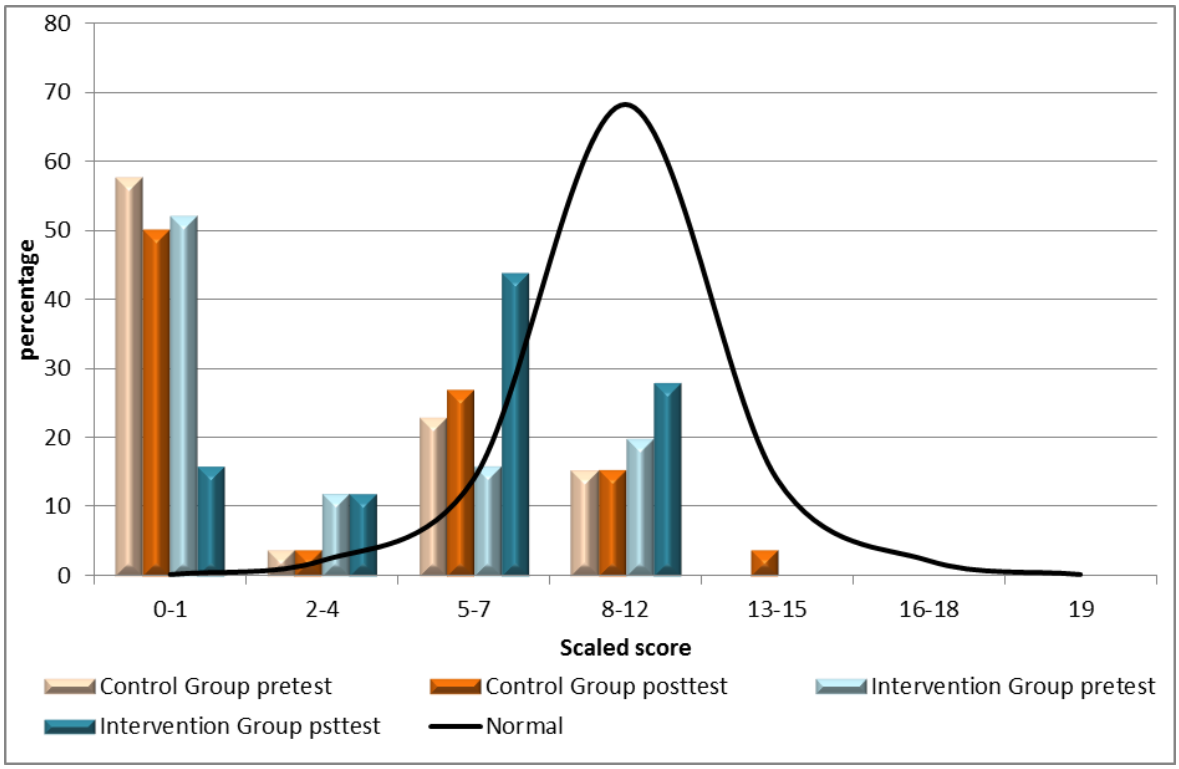

Figure 4.3 Percentage of participants' Spatial Relations by scaled scores on a normal distribution for pretest and posttest (n=51)

4.3.2.4 Form Constancy

In the control group pretest scores 69% of participants scored below the average range of 8-12, 19% in the severe dysfunction range, 27% in moderate dysfunction and 23% in 'weakness' range. Similarly, 72% of the intervention group scored below average, 12% in severe dysfunction range, 20% in moderate and 40% in 'weakness' range.

Posttesting revealed that the the number in this below average range group remained at 69% in the control group. In the intervention group the percentage dropped from 72% to 60%. Posttest there is a high percentage of participants in the control group (57%) who fell into the moderate to severe dysfunction (below 5) range posttest, compared to only 24% in the intervention group.

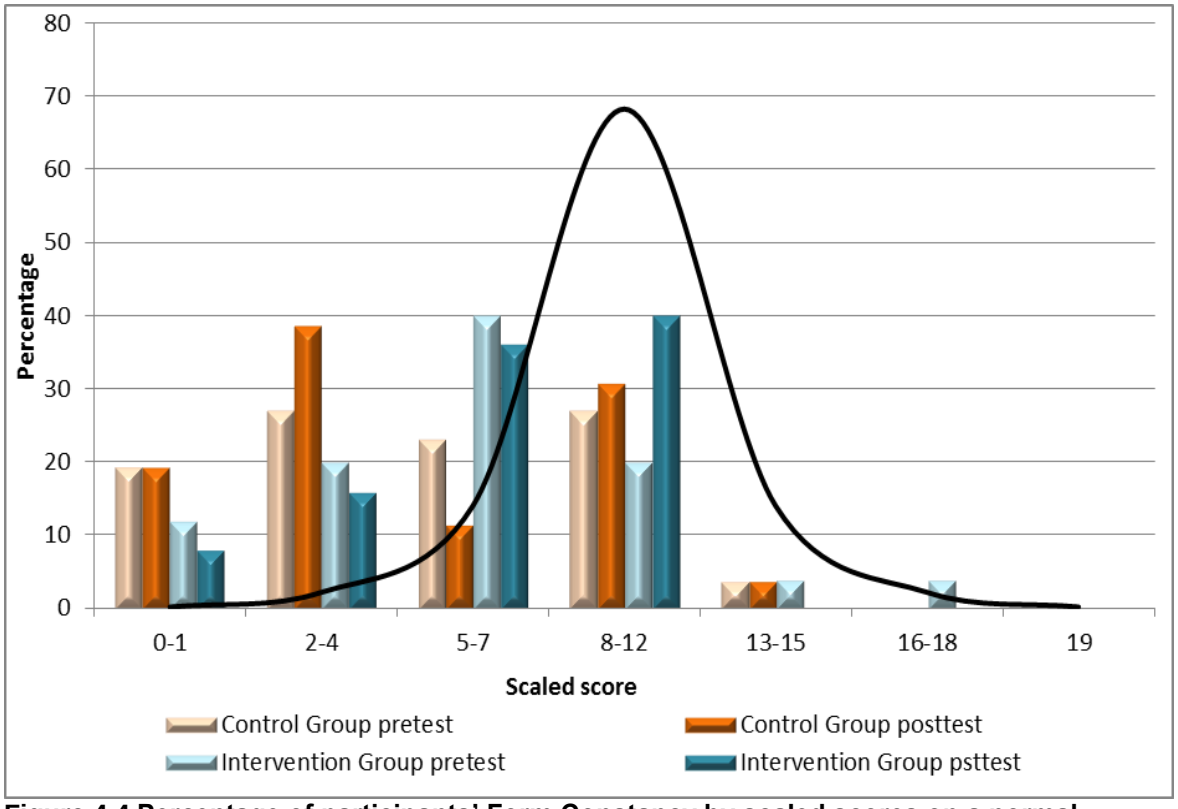

Figure 4.4 Percentage of participants' Form Constancy by scaled scores on a normal distribution for pretest and posttest (n=51)

4.3.2.5 Visual Sequential Memory

Pretest scores were markedly low in both groups with the majority of participants in both groups falling into the severe dysfunction range (0-1) with 62% percent in the control group and 64% in the intervention group in this range. Following the intervention programme on post testing 38% of the control group remained in this poorly performing group as did 32% of the intervention group.

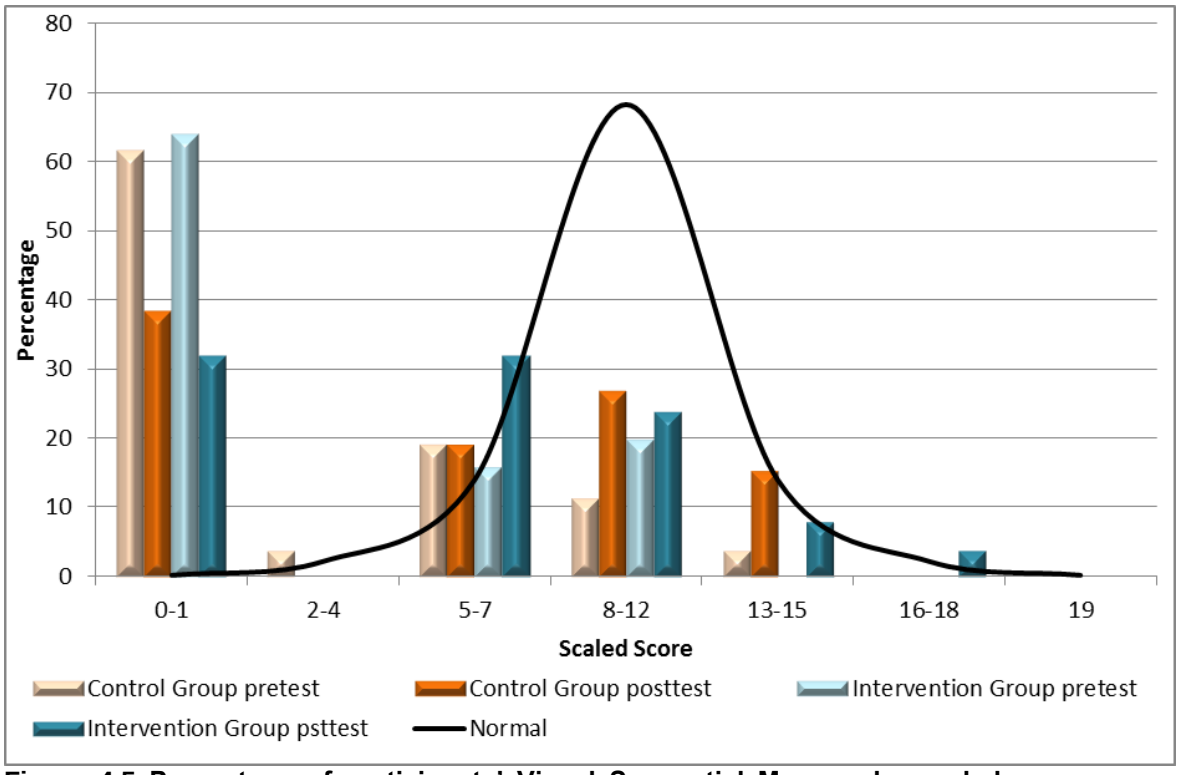

Figure 4.5 Percentage of participants' Visual Sequential Memory by scaled scores on a normal distribution for pretest and posttest (n=51)

4.3.2.6 Figure-ground

Figure-ground scores in the control and intervention group in the pretest had most participants scoring below the average scaled score of 8-12: the control group had 65% below this level and the intervention group had 72%. Of this the largest percentage were in the 'weakness' range, 46% of the control group and 60% of the intervention group.

Posttest majority of the participants in the intervention group (56%) scored in the average range (8-12) for this subtest with a further 8% scoring above average. In the control group the majority of the participants (71%) remained in the below average range (<8) for Figure-ground, with 31% recording moderate dysfunction and 4% with severe dysfunction.

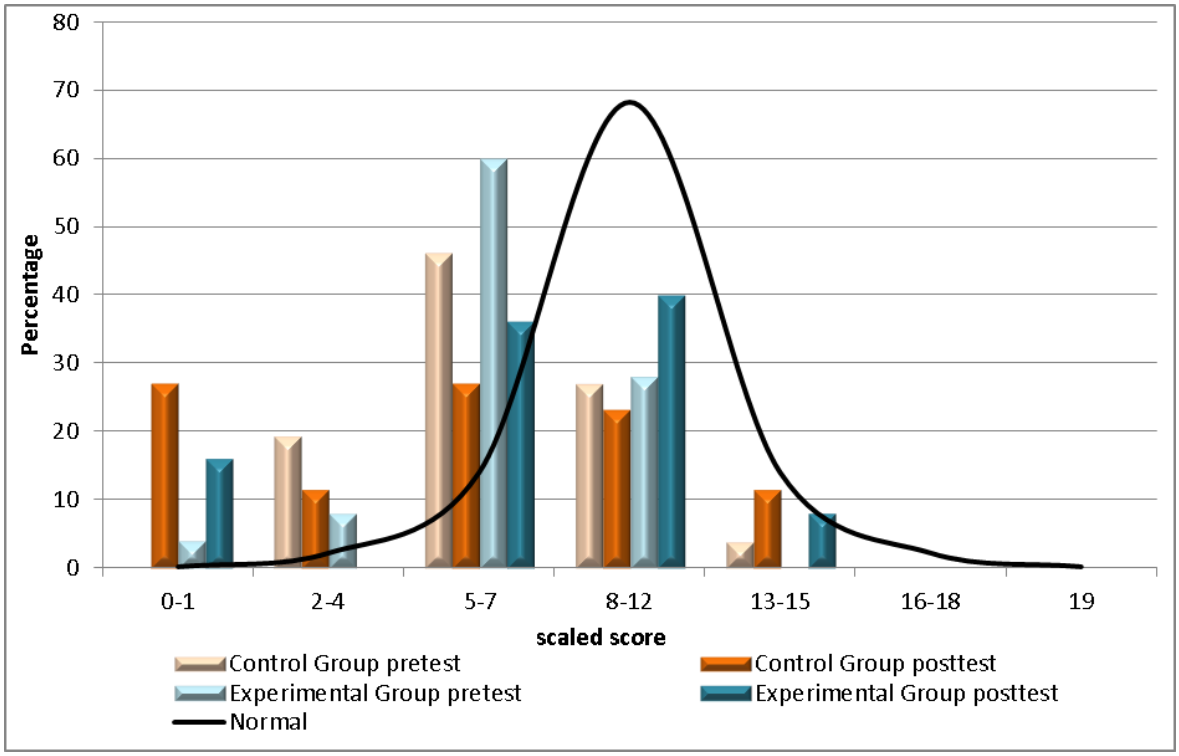

Figure 4.6 Percentage of participants' Figure-ground by scaled scores on a normal distribution for pretest and posttest (n=51)

4.3.2.7 Visual Closure

Visual closure results show that 38% of the control group and 40% of the intervention group scoring in the severe dysfunction range (0-1). On posttesting many of the participants remained in this range in both the control and experimental group, 31% and 36% respectively.

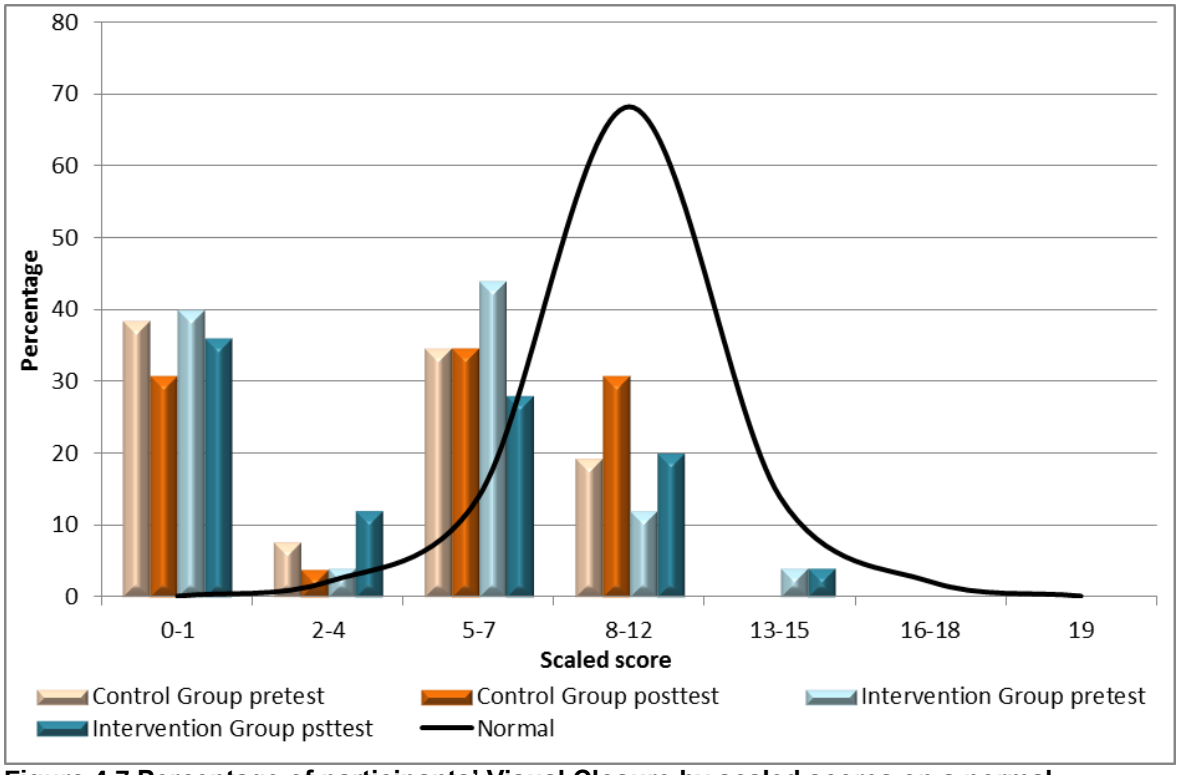

Figure 4.7 Percentage of participants' Visual Closure by scaled scores on a normal distribution for pretest and posttest (n=51)

The control and intervention pretest and posttest scores have been discussed within each subtest; the next section will compare changes within the control and intervention group from pretest to posttest.

4.3.3 Comparison of changes within the control and intervention group from pretest to posttest scores

The pretest and posttest scaled scores for both groups were compared to establish change within the groups over the intervention period using a Wilcoxon

sign ranked test. The changes within each group between pre- and post test scaled scores are represented in Table 4.3 with significant changes indicated.

Within the control group a decrease was recorded in the median scaled score on posttest in 3 of the 7 subtests i.e. Visual Discrimination, Form Constancy and Figure-Ground although this change was significant only for Visual Discrimination. There were no subtest median scores which decreased in the intervention group posttest when compared to the pretest scores.

Visual Closure remained the same from pretest to posttest in the intervention group, as was the case in the control group. Both groups scored a median scaled score of 5 on the pretest and posttest respectively.

Within the intervention group significant change was recorded in 3 of the 7 subtests following the completion of the VPSP, these include Visual Discrimination ($p=0.03$), Spatial Relations ($p=0.01$) and Visual Sequential Memory ($p=0.00$). Figure-ground did improve though the difference from pretest to posttest was not significant. In the control group improvement from pretest to posttest was recorded in 3 of the 7 subtests, these include Visual Memory, Spatial Relations and Visual Sequential Memory. However, only Visual Sequential Memory was a significant difference ($p=0.02$).

None of the median scaled scores were 7 or above in the control group in any posttest, in the intervention group Visual Discrimination, Visual Memory and Figure-ground were 7 and above in posttesting.

The Sum of Scaled Scores - Basic Processes groups Visual Discrimination, Visual Memory, Spatial Relations and Form Constancy together. In keeping with significant changes in 2 of these 4 subtests in the intervention group i.e. Visual Discrimination and Spatial Relations, there was a significant difference between pretest and posttest scores (p=0.00) for this group. No significant difference (p=0.09) was recorded in the control group for Sum of Scaled Scores – Basic Processes in keeping with decreases recorded in Visual Discrimination and Form Constancy.

Both groups scored significant differences in the Sum of Scaled Scores – Sequencing between the pretest and posttest, thus reflecting the improvements in Visual Sequential Memory median scaled scores.

The Sum of Scaled Scores – Complex Processing groups Figure-Ground and Visual Closure, neither the control (p=0.87) or intervention group (p=0.65) scored statistically significant differences between pretest and posttest scores.

The Sum of Scaled Scores - Overall which is used to describe the visual quotient of each group and is the overall test score, it shows that within the intervention group there was significant change (p=0.00) and in the control group there was no significant change (p=0.25) in the Sum of Scaled Scores Overall.

Table 4.5: Comparison of changes within each group from pretest to posttest scores

	Control Group (n=26)				Intervention group (n=25)			
	Pretest	Posttest	Differ - ence	p value	Pretest	Posttest	Differ - ence	p value
	Median Scaled Scores (lower and upper quartile ranges)				Median Scaled Scores (lower and upper quartile ranges)			
Visual Discrimination	6.00 (5 – 7)	5.00 (3 – 6)	-1	0.00**	6.00 (5 – 6)	7.00 (5.- 9)	1	0.03*
Visual Memory	6.00 (3 – 11)	6.50 (5 – 10)	0.5	0.20	7.00 (5 – 8)	7.00 (5 – 9)	0	0.20
Spatial Relations	0.00 (0 – 6)	2.00 (0 – 6)	2	0.06	0.00 (0 – 7)	6.00 (4 – 11)	6	0.01**
Form Constancy	5.50 (3 – 8)	3.00 (2 – 8)	-2.5	0.45	6.00 (4 – 8)	6.00 (4 – 8)	0	0.52
Visual Sequential Memory	0.00 (0 - 6)	5.50 (0 – 11)	5.5	0.02*	0.00 (0 – 6)	6.00 (0 – 8)	6	0.00**
Figure-ground	7.00 (5 – 8)	6.00 (3 – 7)	-1	0.13	7.00 (6 - 8	8.00 (6 – 10)	1	0.74
Visual Closure	5.00 (0 – 7)	5.00 (0 – 8)	0	0.33	5.00 (0 - 6	5.00 (0 – 6)	0	0.74
Sum scaled scores -overall	74 (65-78)	77 (69-83)	-3	0.26	72 (69-80)	83 (72-88)	11	0.00**
Sum scaled scores -Basic Processes	72 (67-85)	75.5 (71-81)	3.5	0.87	75 (69-81)	85 (74-91)	10	0.00**
Sum scaled scores – Sequencing	0 (0-80)	77.5 (0-105)	77.5	0.04*	0 (0-80)	80 (0-100)	80	0.00**
Sum scaled scores - Complex Processes	75 (68-85)	75.5 (68-83)	0.5	0.96	78 (70-85)	80 (70-85)	2	0.74

Significance p≤ 0.05*

Significance p≤ 0.01**

4.3.4 Comparison of the changes in the pretest posttest scores between the control and intervention group

The difference in change between the intervention group and control group were analysed using effect sizes (ES).

4.3.4.1 Subtest scaled score comparison of changes in the pretest posttest scores between the control and intervention group

A statistically significant difference (p=0.00) was recorded for Visual Discrimination when comparing the change in the control group to the change in the intervention group. The other subtests revealed no statistically significant differences.

A strong effect size (ES=1.1) was recorded for Visual Discrimination. Spatial Relations and Figure-Ground, both reflected an ES of 0.4 and 0.4. This is below the moderate effect size level of 0.5.

The effect size for Form Constancy is 0.2 which is a small effect size.

Visual Memory, Visual Sequential Memory and Visual Closure have effect sizes below 0.2.

Table 4.6: Comparison of the change in subtest scores between the intervention group and the control group

	Control Group n=26	Intervention group n=25			
	Change in scaled scores from pretest to posttest		p value	Effect size	Effect size (rounded)
Visual Discrimination	-1	1	0.00**	1.13^^^	1.1^^^
Visual Memory	0.5	0	0.97	0.10	0.1
Spatial Relations	2	6	0.22	0.40	0.4
Form Constancy	-2.5	0	0.32	0.19	0.2
Visual Sequential Memory	5.5	6	0.90	0.07	0.1
Figure-ground	-1	1	0.09	0.42	0.4
Visual Closure	0	1	0.50	0.11	0.1

Significance p≤ 0.05* Significance p≤ 0.01**

Small ES 0.26^ Moderate ES 0.5^^ Large ES 1.0^^^

4.3.4.2 Comparison of changes in the Sum of Scaled Scores standard scores pretest and posttest scores between the control group and the intervention group

None of the composite scores showed statistically significant differences when comparing the change in the control group to that in the intervention group (Table 4.7). However, a moderate effect size of 0.5 was recorded for The Sum of Scaled Scores – Overall. Therefore 69% of the control group scored below the average subject in the intervention group.

A moderate effect size (0.6) was obtained when comparing the changes in the Sum of Scaled Scores – Basic Processes between the control and intervention

group. Seventy three percent of the control group scored below the average subject in the intervention group.

Effect sizes in Sum of Scaled Scores – Sequencing (ES=0.1) and Sum of Scaled Scores – Complex Processes (ES=0.0) were negligible.

Table 4.7: Comparison of the change in composite scores between the intervention group and the control group

	Control Group n=26	Intervention group n=25			
	Change in scaled scores from pretest to posttest		**p value**	**Effect size**	**Effect size (rounded)**
Sum scaled scores –overall	-3	11	0.16	0.47	0.5^^
Sum scaled scores -basic processes	3.5	10	0.06	0.58	0.6^^
Sum scaled scores – sequencing	77.5	80	0.9	0.07	0.1
Sum scaled scores -complex processes	0.5	2	0.9	0.03	0.00

Significance p≤ 0.05* Significance p≤ 0.01**

Small ES 0.26^ Moderate ES 0.5^^ Large ES 1.0^^^

4.4 Summary of Results

There were no statistically significant differences between the groups with regard to gender or age, making them comparable at baseline. With regard to income the

two groups showed no significant statistical difference with the exception of access to running water, however household income was not statistically different between the two groups and the groups are comparable with regard to socio-economic status.

Pretest results show that both groups scored similarly in the baseline assessment and there were no statistically significant differences in overall scaled scores or within each of the subtest scaled scores. Prior to the implementation of the VPSP the two groups were comparable with regard to visual perceptual abilities.

Following completion of the 15 week VPSP, statistically significant differences in pretest and posttest scores within the intervention group were recorded for Visual Discrimination, Spatial Relations and Visual Sequential Memory. In addition the difference between the pretest and posttest of the intervention group for Sum of Scaled Scores – Overall, Sum of Scaled Scores – Basic Processes and Sum of Scaled Scores – Sequencing scores were statistically significant. In the control group statistically significant differences in pretest and posttest scores were recorded for Visual Discrimination and Visual Sequential Memory and the Sum of Scaled Scores – Sequencing which is deduced from the Visual Sequential Memory subtest.

On comparing the posttest scores between the control and intervention groups, Visual Discrimination, Spatial Relations and Figure-Ground scores were significantly higher in the intervention group.

With the exception of the Figure-Ground median scaled score in the intervention group posttest, all scores in the intervention group and control group were below average.

Effect sizes reveal a moderate effect as a result of the VPSP on Visual Discrimination. Small to moderate effects for Spatial Relations and Figure-Ground were recorded. In addition the Sum of Scaled Score – Overall indicates a small to moderate effect from the intervention.

The null hypothesis of the study was that after the completion of the visual perceptual skills programme the intervention group will not exhibit statistically significant improvements in the posttest visual perceptual scaled scores when compared to the control group. The null hypothesis is therefore rejected as results show the visual perceptual programme had a small to moderate effect on the intervention groups' overall visual perceptual skill.

These results and the reasons for changes related to the visual perception programme will be discussed in Chapter 5.

CHAPTER 5: DISCUSSION

5.1 Introduction

The discussion will integrate the results by firstly setting the scene of the challenges faced by children in disadvantaged areas, describing their socio-economic status and environmental factors that can impact on their ability to develop literacy and numeracy. The baseline (pretest) results of the TVPS-3 will be discussed as well as the posttest results for the intervention and the control groups. Each subtest will be discussed. This will then be followed by a discussion on differences in visual perceptual scores from pretest to posttest between the intervention and control group. A final comparison of the changes between the pretest and posttest scores in the control group and the changes between pretest and posttest scores in the intervention group will be discussed and the VPSP effect on the intervention group. The changes in the intervention group will be related to the VPSP and possible reasons for changes in the control group will be discussed. Finally, study limitations, recommendations for future research, programme development and policy changes will be discussed.

5.1.1 Sample Demographics

The ages of the children in the sample ranged from 5 years 1 month to 6 years 3 months, with the median age being 5 years 5 months (Table 4.1). At the time the study started the Grade R children had been in Grade R for two terms, this means some children start school before they have turned 5 years old. Teachers at the

school state that these younger children often spend two years in Grade R if they are enrolled at age 4. All participants in the study met the inclusion criteria of being 5-6 at the time of testing and though the youngest participant was 5 years 1 month old and the oldest 6 years 4 months old, the TVPS 3 provides age bands in which a child's age is factored in i.e. a younger child is developmentally expected to have less visual perceptual abilities than an older child. Activities in the programme were appropriate for children in the range of 5-6 years and at the onset of the programme all participants in the sample had turned 5. There was no significant difference between the two groups with regard to the age of the participants (p value=0.40) or the gender (p=0.32) and the two groups were therefore considered comparable.

The sample of participants was selected from a school in rural Kwa-Zulu Natal. The school was accessed by dirt roads and is 20 minutes from the nearest small town, Mtunzini. The sample can be considered disadvantaged by the no-fee status awarded to the school which they attend and their low socio-economic status was confirmed by the results of the demographics questionnaire. Thirty one percent of the sample comes from families with no income and a further 45.1% live in families with a household income of R500-R1000 (Table 4.2). These children live below the poverty line [23], this putting them at risk for lower visual perceptual abilities [5]. There was no statistical difference between the two groups income levels, though most of the control group (42.86%) reported no income and most of the intervention group (65%) reported an income of R500-R1000. None of the participants in the control group reported an income of 3000-6000 per month and only 1 participant in the intervention group was from a family in this salary level. These results show that the participants in this study are from a disadvantaged

background, families are focused on obtaining sufficient food and basic household goods [23]. Early stimulation of visual skills though exposure to books, text and educational toys is limited in households affected by poverty, this leading to delays in a child's development of visual perceptual skills [28]. The control and intervention groups in the study were comparable in terms of income level, both groups exposed to low socio-economic environments.

Another demographic factor reflecting the socio-economic status of the sample is the employment rates, low employment rates reflect the disadvantaged state of the homes the children come from. Results showed that just 19.61% of the total sample have mothers who are employed and 34.69% of their fathers are employed. The control group had more mothers employed (23.08%) than the intervention group (16%), conversely the intervention group had more fathers employed (45.83%) compared to (24%) in the control group. The higher percentage of employed fathers in the intervention group might be viewed as an advantage over the control group, however this must be linked to the reported income of the majority of this group (65%), which is R500-R1000, therefore while more fathers are employed they are earning low salaries. No significant difference was found between the two groups in terms of employment status of father, mother or care-giver. Despite the rural setting, 98% of the total sample had access to electricity, in the intervention group every participant had access to electricity; in the control group 2 of the 26 participants did not have access to electricity. The groups were comparable in terms of access to electricity. The only demographic data that showed a significant difference ($p=0.03$) between the control and intervention group was access to running water. In the intervention group 88% of participants had access to running water, while only 61.54% had access in the

control group. Within the area families without running water collect water from the river or use communal water pumps to fill buckets and carry them home. Limited access to running water may affect a child in that collection of water may take valuable time away from play and education. In addition, drinking contaminated water may result in illness and time off school. Further investigation into the effect of limited access to water would be required to determine its influence on visual perceptual skills.

The health status of participants in the study was requested to determine if any condition in the exclusion criteria were present, such as genetic, neurological or developmental disorders or visual disorders. Forty three of the 51 participants in the study were described as healthy, there was no significant difference between the control group (88.46%) and intervention group (80%) in percentage of healthy participants. Of those described as “unhealthy” only one reported a diagnosed condition i.e. asthma and another was reported to have “a natural disease”, both in the intervention group. Other illnesses reported included “cold” or “flu” or “coughing”. None of the participants wore glasses and no parents reported eye problems, however formal testing is not offered through the school and it is unlikely that many children have had their eyes tested. The sample size of 51 represents 71% of all the children in the school population of Grade R children, each class consisted of 36 children with one teacher per class. All 72 children in the study were sent information and consent forms. Reasons for children not participating in the study included forms not being returned, absence from school during the week of initial testing, children dropping out of school (2 children) and absence from school during the week of posttesting. No parents declined to participate in the study although non-returning of forms was regarded as non-

consent. No children were excluded for health reasons, visual problems or diagnosed visual perceptual problems. Two participants exceeded the 25% absenteeism levels, however they were included in the study as the repetitive daily tasks were considered sufficient to have given them exposure to the program. In the total population absenteeism rates are high and many children do not attend school if it is raining, due to the dirt roads and lack of transport.

The sample size of 26 in the control group and 25 in the intervention group met the required sample size of 25 per group based on a 5% significance level at 80% power with a difference of 0.80 SD between the groups after the intervention of two school terms based on the z-scores calculated from the raw scores on the TVPS 3 [62].

5.1.2 School environment

The school environment showed signs of poor infrastructure with frequently no electricity in the classes, outside toilets which were broken and unclean, broken windows, concrete floors with numerous cracks, few resources, few toys (many broken), high temperatures inside the classrooms and too few chairs. The class numbers are 36 pupils to 1 teacher. Children mostly worked seated on the floor or seated in a circle on chairs. This confirms the demographic information obtained that the children in the study are from disadvantaged home environments and are in schools which can be described as disadvantaged.

Obvious differences in the environment between the control and intervention group include different teachers with different qualifications (though neither are fully qualified teachers), different classrooms and different tasks on a given day. The children do work from the same curriculum and have the same Grade R

workbooks, however details of how much of these are completed and in what order were not obtained. It was observed that classes were not doing the same activities on the same day, often no structured activities were present. The researcher was only in classes on Monday mornings and observed few structured tasks. Tasks were mostly focused on pencil work in the Grade R workbook or rote counting. It must be considered that more activities may have been completed on other days, however the observations on Mondays indicate possible lack of stimulation with few resources and few activities for the children to complete. Of concern was the lack of availability of materials such as crayons and paper. These problems were observed in both classes and this offers greater comparability of the groups as neither had a specific programme.

5.1.3 Baseline (pretest) visual perceptual scores for Grade R participants for the control and the intervention group

In order to confirm previous research findings that children in disadvantaged schools have poor visual perceptual skills [5], [15] and to determine the need for a visual perceptual stimulation programme the sample's baseline perceptual scores had to be assessed. This was part of the first objective of the study. The TVPS 3 test was used to determine these scores. This test has disadvantages in that it has not been standardised on a South African population and questions over the children's ability to understand instructions and relate to the Western designed test, have been raised. However this test is described as non-biased to culture and has limited motor demands, with simple instructions. The test was translated into isiZulu and a familiar person was used as the interpreter to explain the test to the children. The test uses shapes which are part of the Grade R curriculum and are taught in their classes. The test does not require identification of shapes or

language output and as such can be considered to focus on only visual perceptual abilities. It must be considered that concepts such as “the same as”, “different” need to be understood in order to understand certain subtest questions and despite the instructions given in isiZulu some participants did not know these concepts at the time of testing. Two examples are completed in each subtest and the interpreter used clear descriptions to help participants understand.

In the baseline assessments two children were excluded who appeared ‘overly’ anxious at the testing situation. They were asked if they wanted to continue or return to class. Both participants chose to return to class their assent was retracted and they were excluded from the study. The majority of the participants were eager to participate in the pretest. Signs of poor concentration were noted in some participants, fidgeting, impulsive responses and not visually attending to the test items. Poor concentration can affect a child’s performance on the TVPS 3 [2]. These participants were not excluded from the sample as concentration problems were not formally diagnosed.

Baseline scores from the pretest indicated that both groups scored in the below average range (<8) for median scaled scores in all seven subtests (Table 4.4). The highest baseline scores were recorded for Figure-Ground where both groups obtained a median score of 7. This was followed by Visual Memory with a median score of 6 for the control group and 7 for the intervention group. Form Constancy median scores were the next highest with 5.5 for the control group and 6 for the intervention group. Both groups obtained median scaled scores of 5 for Visual Closure. These 5 subtest scores in both groups fell into the ‘weakness’ group (5-7 scaled score). Figure-ground scores at the baseline assessment were the highest, though a median score of 7 in each group still indicates an area of concern and

“weakness” in this skill. The remaining two subtests fell into the severe dysfunction group with a median scaled score of 0. Spatial Relations and Visual Sequential Memory were the weakest visual perceptual skills at baseline assessment. These pretest scores in all subtests in both groups confirm previous research findings that children in disadvantaged communities have a higher risk of visual perceptual delays [5]. Despite attending two terms of Grade R these visual perceptual skills are well below average, visual perceptual skills are not adequately addressed in the classroom [18]

The weakest scores were obtained in the Visual Sequential Memory and Spatial Relations subtests. Possible reasons for these markedly low scores in Visual Sequential Memory were observed in pretesting as many of the participants did not scan the visual information from left to right, they would recall shapes from right to left or not take note of the order of shapes at all. Eye movement exercises were an integral part of the visual stimulation programme, with the aim of helping children visually attend and to track information from left to right. The reason for the low Spatial Relations scores was more difficult to understand, participants did not appear to understand the term “which is different”, or “which is not the same as the others”. The test instruction in isiZulu was back translated by the interpreter and is the same as the TVPS 3 description yet participants battled to grasp this concept. Through the two test examples the interpreter used different ways to show the participant which one was orientated differently but baseline scores indicate this concept is a problem. It was therefore difficult to determine how much of the low score was due to not understanding the concept of “different” and how much was poor spatial relations abilities. Still, the marked weakness in this subtest indicated a need for it to be addressed in the programme.

In several subtests children in initial testing scored 0 for the raw score. The developers of the TVPS 3 warns that raw scores of 0 may be due to factors such as fatigue, inattentiveness or uncooperativeness [2], however if these factors are ruled out it can be considered the child's abilities. During testing care was taken to discontinue testing if a child appeared agitated or overly anxious/distracted. Poor visual attention was frequently observed, children were engaged, trying their best but often not visually focusing on each answer. At times children performed so poorly that nearly all the raw scores were 0. In the absence of a diagnosed learning disability or cognitive impairment these children were not excluded from the study.

Many children showed excitement at the presence of a new person at the school and a few showed concern or fear. This was addressed by the presence of a familiar person (a teacher from the school) and providing the child with clear instructions of what was expected, which were interpreted for the child by the teacher.

Comparing the control and intervention groups revealed no statistically significant differences between the two groups in any of the seven subtests in the pretest.

In the Sum of Scaled Scores – Overall, a measure of the visual quotient or overall test score, both groups fell below average with standard scores below 85 and there was no significant difference between the groups ($p=0.5$). This confirms the need for intervention in the area of visual perception

In the Sum of Scaled Scores the median standard score for Sum of Scaled Scores – Sequencing in both groups was 0, reflecting deficiency in this area. Due to this marked weakness it was considered that the children did not understand the test

instructions, however the instructions are similar to those in the Visual Memory test which did not reflect such markedly low scores. Through observation during testing it was observed that many participants did not scan the images from left to right, they looked in the middle of the page or from right to left. This resulted in them recalling the sequence incorrectly. The integration of eye movements into the VPSP was to assist in tracking and scanning problems such as these observed during testing in this subtest.

Despite being in different classes, with different teachers and from different homes the participants were functioning on a comparable level with regard to visual perceptual abilities. It is concerning that after spending two terms in Grade R, these children are functioning on a markedly low level in their visual perceptual abilities. The results confirm recent research which has raised concerns over the impact of low socio-economic status on visual perception [5] and the lack of awareness and understanding among teachers of visual perceptual skills, the lack of teacher training in these skills and the fact that the curriculum does not adequately address these in Grade R [18]. These baseline scores indicated the urgent need for intervention and stimulation of visual perceptual skills.

5.1.4 Posttest visual perceptual scores for Grade R participants for the control and the intervention group

The first objective of the study was to determine the two groups' pretest and posttest scores. Having determined that the two groups were comparable in all subtest scores and sum of scaled scores in the pretest phase of the study it was important to compare the posttest scores in a similar fashion, once the intervention group had completed the VPSP.

The intervention group posttest scores are higher than the posttest scores in the control group in 6 of the 7 subtests, with statistically significant differences in Visual Discrimination (p=0.02), Spatial Relations (p=0.04) and Figure-ground (p=0.02). The possible reasons for these three subtests showing statistically significant improvement compared to Visual Memory, Visual Sequential Memory and Visual Closure is that they were addressed for 3 weeks in the VPSP, where Visual Memory, Visual Sequential Memory and Visual Closure were only addressed for two weeks. Form Constancy was treated for three weeks, yet posttest scores show no significant difference to the control group, this activities in the programme aimed at improving Form Constancy need to be reviewed.

Posttest scores of the intervention group remain at below average levels, with a median scaled score of under 8, in 6 of the 7 subtests despite the implementation of the VPSP. This is in the 'weakness' range for visual perceptual skills needed as the foundation for reading, spelling, and mathematics [18], [42]. The only median scaled score in the average range (8-12) was Figure-Ground, with a score of 8. According to Warren (1993) Figure-ground develops at an earlier age than other visual perceptual skills (Table 2.1), i.e. between 3 and 5 years of age. Participants in the intervention group were developmentally more ready for the stimulation of Figure-ground, than for example Form Constancy which develops between 6 and 7 years, resulting in an average score.

In the control group all posttest median scaled scores were under 8, with Spatial Relations (scaled score=2) and Form Constancy (scaled score=3) falling into the moderate dysfunction range (5-7) and the remaining areas in the 'weakness' range (5-7). These are markedly low scores and place children at a disadvantage when entering Grade 1 [3].

Despite improvements in some perceptual scores in the intervention group, the visual perceptual scores remain below average, with the exception of one subtest (Figure-Ground). Possible reasons for these posttest scores remaining below average will be discussed in section 5.1.5 where the programme's effectiveness is analysed.

The Sum of Scaled Scores – Overall, indicates a significant difference (p=0.03) in the posttest scores between the intervention group who participated in the visual perceptual programme as compared to the control group. Though improved this composite score representing overall visual quotient remained in the below average range in the intervention group, despite participation in the VPSP.

In one composite score the intervention group obtained an average score (85) for the Sum of Scaled Scores – Basic Processes, this composite score includes Visual Discrimination, Visual Memory, Spatial Relations and Form Constancy. This posttest score reflects that the intervention group has improved in these basic skills as represented in the TVPS 3, however overall visual perceptual quotient remains below average as does complex processing. In the control group all composite scores were below average, reflecting even the basic processing skills have not developed in Grade R. There was a significant difference in posttest scores (p=0.02) between control and intervention group.

5.1.5 The within group changes from pretest to posttest of the intervention group and the control group

The second objective of the study was to compare within group changes from pretest to posttest, this to show how each group changed independently, the

control group who participated in the curriculum and the intervention group who participated in the VPSP and the curriculum.

Of importance in this analysis is the decrease in the median scaled scores in the control group from pretest to posttest in 3 of the 7 subtests. In the control group the Visual Discrimination median scaled score decreased from 6 to 5, the Form Constancy from 5.5 to 3 and the Figure-ground from 7 to 6. The children in the control group performed worse in these subtests despite attending two terms of Grade R. One may be tempted to conclude that the Grade R curriculum does not therefore address these skills sufficiently, however the extent to which the control group followed the curriculum is not clear and examining the curriculum was not part of the objectives of this research. None of the posttest scores in the intervention group were lower than the pretest scores.

The Visual Sequential Memory subtest posttest scores showed a statistically significant difference ($p=0.02$) from the pretest in the control group as well as the intervention group too ($p=0.00$). In both groups the pretest median scaled score was 0, a low level to start from. Still, this area was improved to a median scaled score of 5.5 in the control group, without the use of the VPSP and to 6 in the intervention group. A possible reason for improved Visual Sequential Memory may include exposure to more ‘formal’ activities involving rows of letters and numbers that children participate in as they prepare for Grade 1, making them more aware of working form left to right and then more inclined to recall answers in sequence during posttesting.

Several improvements were seen within the intervention group, though Visual Memory, Form Constancy and Visual Closure remained the same score from

pretest to posttest. It is encouraging that these skills did not decrease as was the case with 3 subtests in the control group, however reasons for these scores remaining the same were explored. It is likely that the programme being cut short affected the Visual Memory and Visual Closure scores as these areas were only addressed for 2 weeks, instead of the 3 weeks planned. Form Constancy was addressed for 3 weeks and these activities should be reviewed. It is possible the tasks set were too challenging, given the low level that the children started at during pretesting.

5.1.6 Comparison of the changes in the pretest posttest scores between the control and intervention group

To determine the effects of the VPSP the best measurement is the comparison of the change from pretest to posttest between the control and the intervention group.

No statistically significant differences were recorded for the comparison of change between the two groups, with the exception of Visual Discrimination where the change was significantly higher ($p=0.00$) than in the control group. Over reliance on statistical significance (p-values) can lead to the effects of treatment or intervention in small sample studies being undermined [61]. Determining the effect size (ES) in a study provides a tool to quantify the size of difference between the control and intervention group. A large effect (1.13) was recorded in the Visual Discrimination subtest, therefore 84% of the control group have a score below the average subject in the intervention group for this subtest. This subtest was the most improved following stimulation of visual perceptual skills with the VPSP. Visual Discrimination falls in the Sum of Scaled Scores – Basic Processes in the

TVPS 3 and is a foundation skill [16], the programme had its greatest effect on this lower order perceptual skill which develops earlier than more complex visual perceptual skills in a child.

Spatial Relations and Figure-Ground reflect an ES of 0.4 and 0.42 respectively; this is below 0.5 level needed to record a moderate effect of the intervention. Still, these results show that 66% of the control group have a score below the average subject in the intervention group for Spatial Relations and Figure-Ground. These effects can be attributed to these skills being addressed for the full 3 weeks as planned in the VPSP. The length of programme required to obtain greater effect on these skills needs to be researched.

Low effect size was recorded for Form Constancy (ES=0.19), this is close to a small effect size (0.2). This skill was stimulated for the full 3 weeks and activities were complete. It must be considered that the activities need to be reviewed. Form Constancy is the only aspect where letters of the alphabet were used in the activity (see Appendix G – week 11). The children may not have been developmentally ready to complete this activity and the typed letters in different fonts may have confused them and been unfamiliar to them. This may have led to this skill being less affected by the programme.

Week Visual Memory, Visual Sequential Memory and Visual Closure have effect sizes well below 0.2. These skills were only addressed for 2 weeks, rather than the planned 3 weeks, as the programme was cut short. Greater effect sizes are seen in the skills which were treated for longer in the intervention programme. In addition Visual Memory and Visual Sequential Memory were treated together in

the VPSP leading to less exposure to tasks in each area and a resultant lower effect size.

5.2 Evaluation of the Visual Perceptual Skills Programme

The VPSP was developed by the researcher using 10 years of clinical experience, available literature on Visual Perceptual Programmes in South Africa, in addition activities were drawn from the Beery Developmental Teaching Activities Manual [57] and Enhancing your Child's Development Manual [56].

5.2.1 Components of the VPSP

The programme was designed to integrate eye movements (receptive components) and visual perceptual cognitive skills. These were divided into Visual Discrimination (VD), Figure-Ground (FG), Spatial Relations (SR), Form Constancy (FC), Visual Closure (VC) and Visual Memory (VM) was combined with Visual Sequential Memory (VSM). Each skill was treated for 1 week in this sequence, the following week, a more challenging activity in each skill was completed and in the last week, VD and FG were treated together and SR and FC were treated together. The developmental theory of visual perception was considered when selecting which skill would be treated first [16, 31], starting with Visual Discrimination and Figure-Ground and ending with Visual Memory and Visual Sequential Memory which require an additional cognitive process to recall information [6].

5.2.2 Challenges in carrying out the programme

A concern was identified when planning the programme as to whether the teacher would be able to follow the programme independently from the written instructions

and diagrams. At the onset of the programme implementation it was noted that the teacher was unsure of the visual perceptual components and did not understand the activities well. The programme was then adapted to having the researcher, an occupational therapist, facilitate the first session on the Monday, with the teacher. The teacher then repeated the tasks Tuesday to Friday until the new session was introduced.

Another concern was whether the teacher would independently carry out the tasks as requested and whether she would cope with high class numbers and new demands? In determining the level of participation of the intervention group in the programme several methods were used. Firstly, some tasks (7 of the 15 weeks) had an end product and these were collected by the researcher each week. In addition activities collected were observed to be worn and used (worn beans, tennis balls, bent/dirty cards and papers). Each week activities were discussed with the class and children were asked about what they had learnt the previous week. These factors support that the children in the intervention group did complete the activities and the results in the posttest reflect their achievements following 75 sessions of stimulation activities for visual perceptual skills.

The initial programme was 17 weeks long, this included one session to stimulate Shape Concept; this was an introductory session. 12 sessions addressing the 6 areas (VD, SR, FC, FG, VC and VM/VSM)). The remaining 4 sessions were planned to combine two skills in the session e.g. Visual Discrimination and Figure-Ground. However the programme was cut short by 4 weeks due to the Grade R children not returning to school after their graduation ceremony. Therefore some visual perceptual areas were treated in 3 weeks i.e. VD, FG, SR and FC, while others were only treated in 2 weeks (VC and VM with VSM). The visual

components with no statistical differences can potentially be explained by the fact that the programme was cut short by 2 weeks. Visual Memory, Visual Sequential Memory and Visual Closure were only addressed for two weeks during the programme, not three as were the other components which show significant differences from the control group. Adding to this problem was a programme design error where Visual Sequential Memory was not addressed independently from Visual Memory; these two areas were treated together in Week 7 and 13. In week 7 Visual Sequential Memory was addressed as the children copied 3 shapes from memory in a sequence but in week 13 the activity included recalling 5 objects drawn on the board, no emphasis was placed on the sequence. This can explain why no effect was recorded on in Visual Memory (0.1), Visual Sequential Memory (0.1) and Visual Closure (0.1). These activities should be reviewed.

A small effect size was obtained for Form Constancy, despite being treated for 3 weeks. This identifies the need to review the Form Constancy activities in the programme.

Visual Discrimination showed a large effect size (1.1), it was treated for 3 weeks. Visual Discrimination is a basic visual perceptual process and it is encouraging that the intervention group responded well to stimulation of this skill. This skill forms the foundation for the development of more complex skills [16] and it is the skill which responded most to intervention. Spatial Relations and Figure-Ground reflect 0.4 ES; this is close to the moderate effect of 0.5. This means that 66% of the control group scored lower than the average subject in the intervention group. It is expected that longer intervention programmes will effect great change in the skills treated, however the length of the programmes required needs to be researched.

In the control group the posttest Sum of Scaled Scores – Overall scores is significantly lower than in the intervention group (p=0.03). These alarming results show that despite spending term 3 and 4 in Grade R, participants in the control group did not improve in visual perceptual abilities. This confirms results found in the recent study where Grade R attendance in disadvantaged schools had little benefit for academic learning [28]. Of concern too is that despite a statistically significant difference within the intervention group from pretest to posttest (p=0.00), the visual quotient (83) remains in the below average range (70-85). Reasons for this may be the markedly low pretest scores and challenges in running the programme such as large class numbers and a shorter programme.

When the two groups are compared using effect size, a moderate effect can be seen in the Sum of Scaled Scores – Overall (0.5). The intervention group did obtain a statistically higher change in score due to the VPSP. Sixty-nine percent of the control group scored below the average subject in the intervention group.

5.3 Limitations of the study

Limitations in the study include the absence of a screening test for acuity by an optometrist. This has not been provided for in the school where the study was conducted. While no children were reported to “not see well” by the teachers and none wore glasses, there is no surety that acuity problems were not present in some of the participants.

Due to the rural, disadvantaged area where the study was conducted and due to limited occupational therapy services in the Department of Education it was assumed that participants in the study have not received prior occupational

therapy intervention. This assumption is a limitation of the study and this aspect should have been addressed in the demographic questionnaire to rule out previous exposure to occupational therapy intervention.

A possible problem with the instructions in the Spatial Relations subtest was identified. In the pretest many participants did not understand the term “different” or “not the same as”. Despite these being explained in isiZulu, pretest results show that the majority of the participants scored poorly in this subtest.

The initial 17 week programme was not completed; rather an adapted 15 week programme was carried out. Due to this 3 visual perceptual subtests were treated for 2 weeks rather than 3 weeks. The intervention groups’ subtest scores reflect this as Visual Closure, Visual Memory and Visual Sequential Memory showed the lowest effect size.

Only one expert in the field of occupational therapy was used to review the VPSP. This is a limitation to the study as more experts may have resulted in better programme adaptation.

This programme requires an occupational therapist (once per week for 1 hour) to assist in implementing the programme. This is a limitation as realistically there are only a few occupational therapists employed by the Department of Education who would be available to implement the programme at the many schools where development of visual perceptual skills are needed.

This study was non-blinded as the researcher knew which group was the control and intervention group. This is a limitation and an independent tester would have been preferential.

5.4 Recommendations

More needs to be done for Grade R children, this research study will be submitted to the Education Head of Department, Mr. N.S.P. Sishi, highlighting recommendations and the need for more emphasis on visual perceptual skills in Grade R children.

It is recommended that more research be conducted into the area of visual perceptual skills in Grade R children, both in the measurement and practical assessment of these skills and in the stimulation and treatment to develop these vital skills.

In addition research in children below Grade R level is recommended, it is clear that children from disadvantaged communities are at risk for entering Grade R with visual perceptual delays, due to lack of stimulation within these skills in their home or preschool/crèche environments.

Due to high class numbers it is recommended that future intervention programmes ensure that activities done involve the whole class all the time, as in this study.

Getting visual perceptual skills programmes to the many schools which would benefit from them is a challenge. The stimulation of visual perceptual skills should be integrated into the curriculum, to reach all Grade R children within the public school system. The curriculum does include visual perceptual skills within guided activities, however the practical guidelines for developing these skills are vague, it is recommended that more focus be placed on these visual perceptual skills. As other researchers in South Africa have recommended specific headings should be included within the curriculum i.e. under “visual skills”. This will place more

emphasis on these skills. Teacher training at an undergraduate level should include training modules in visual perception and teachers already in service would benefit from training to improve their knowledge of these skills in Grade R children. It is recommended that the movement to include visual perceptual skill training in Grade R teacher training and the need to make curriculum changes needs more input and further research. This research will add to the body of research available to the Department of Basic Education showing the need for more to be done in the area of visual perceptual skills in Grade R children.

Until changes are made to address these skills in the curriculum, it is recommended that children in disadvantaged areas where an occupational therapist is available have access to programmes such as this in the study. A programme facilitated by an occupational therapist is more likely to succeed as follow-up can be carried out. Many community service therapists are posted close to schools in disadvantaged areas, with this programme they would need to spend 1 hour a week at a school to run the programme. The Department of Health employs these therapists but through collaboration with the Department of Basic Education, these occupational therapists could reach many schools without taking many hours out of their Department of Health work demands.

It is recommended that a clear full year of visual perceptual activities be set out in the curriculum for teachers to follow to address these skills in Grade R. Activities low cost, clearly specified activities to develop these visual perceptual skills be included in the Grade R curriculum. These should be completed daily and careful consideration of large class numbers and other challenges teachers face must be carried out to ensure these activities are feasible.

5.5 Summary

Baseline scores indicated that both groups had poor visual perceptual skills, the two groups were comparable at the start of the intervention programme as the perceptual skills of the participants were poor across the subtests and composite tests in both groups. The research question to be answered was whether a visual perceptual programme could stimulate these skills in the intervention group.

While challenges in implementing the VPSP were recorded, the participation of the intervention group was good and activities were carried out as prescribed.

The TVPS 3 test is often used to track progress of a therapeutic program and is described as ideal for use in research studies and it was used to assess participants following the completion of the programme [2].

The moderate effect size was obtained for the visual quotient of learners in the intervention group (0.5). While encouraging, the posttest scores of the intervention group remain at below average levels (70-85). The null hypothesis of the study is therefore rejected as results show the visual perceptual programme had a small to moderate effect on the intervention group's overall visual perceptual skill.

Two terms of stimulation activities are insufficient to improve visual perceptual skills to an average level in disadvantaged Grade R children and the programme requires adaptation in 4 of the 5 subtests: Visual Memory, Visual Sequential Memory, Form Constancy and Visual Closure.

It is recommended that visual perceptual activities be included on a daily basis in the Grade R year. It is possible to improve these skills but it will require specific

stimulation activities with high repetition over a longer period of time (more than two terms). Indeed it must be considered that intervention before entry into Grade R would be ideal, this through Early Childhood Development Centres.

CHAPTER 6: CONCLUSION

This study confirms the many challenges facing Grade R children in disadvantaged areas. Research has shown that children in poorer areas have lower literacy rates and are at risk for developing learning disabilities. In this study marked weaknesses were recorded in the children's visual perceptual skills needed for the development of literacy and numeracy skills. These children enter Grade R with fewer skills needed for academic learning and are further disadvantaged by a school system which is not addressing their early developmental needs. Access to education is not enough, the curriculum needs to change and teachers need to be qualified and have training in visual perceptual skills. This is vital to giving these children a chance to "catch up" on these visual perceptual skills which have not been adequately developed prior to school going age.

Grade R children cannot learn letters and numbers efficiently without foundation skills such as visual perceptual abilities. This study confirms that a programme including eye movements and addressing visual perceptual skills for 45-60 minutes a day resulted in a moderate effect on the children's overall visual perceptual quotient. While the skills improved, the average score remained in the below average range. Two terms addressing these skills is not sufficient and it is recommended more research is conducted to determine the optimal time needed to improve these skills to an average level. Currently learners are "drilled" to learn letters and numbers in Grade R, a so-called "watered down" Grade 1, or worse

they are merely at school to be looked after. Grade R children are not ready for Grade 1 literacy and numeracy, current Grade R programmes have been proven to be inadequate in many schools with little effect on their academic learning. These children's skills are disadvantaged and their visual perceptual skills are below average, they need support and special activities to develop eye movements and visual perceptual components. How can a child be expected to read letters and numbers, when they cannot focus on visual information, when they cannot scan from left to right, when they cannot see the letters in a background of other letters, when they cannot see which way letters are facing, when they cannot tell the difference when letters are similar and when they cannot remember letters when they look away from the board?

Occupational therapists are specialists trained in treating visual perceptual skills dysfunction. They are, however a scarce resource, particularly in the Department of Basic Education, where their skills are being used to treat children with more obvious disabilities in Special Needs and Remedial schools. This study confirms that children in disadvantaged areas need more support and visual perceptual skills are not currently being addressed. While their "disability" may not be visible it is disabling these children from achieving their learning potential. The outcome of low literacy and numeracy rates and ultimately the risk of unemployment serve to perpetuate poverty.

Of course the enormity of the education crisis in primary schools in South Africa has no quick solution. Learners in all foundation phases need a strong curriculum, good teachers, adequate resources and infrastructure. In addition the Grade R children need a system which develops early visual perceptual skills, a concept which to date has not been considered sufficiently in curriculum development.

In this study clear visual perceptual deficits in this Grade R population were identified using the TVPS 3 and functional problems in visual perception such as delayed shape recognition, poor visual memory and poor copying are common. In South Africa, we need a short, cost efficient way of assessing our learners visual perceptual skills, standardised to our population. Visual perceptual skills have been identified as a major cause of low literacy and numeracy rates, yet they are difficult and costly to measure. In the interim addressing these skills should not be delayed, each year Grade R children spend hours and hours at school, often not receiving the vital skills they require to bridge the gap for school readiness by Grade 1. Children are innately eager to learn, what they are provided with is up to the Department of Basic Education, their teachers and the specialists in the field who can make a difference.

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Appendix A

Demographics Questionnaire

Age of child _____

Gender of Child_____

Who lives at home with the child?.....

.....

Is the child healthy or sick?.....

What illness does the child have now?.....

.....

Is the mother employed?.....

What is the occupation?.....

Is the father employed?.....

What is the occupation?.....

Is the guardian employed?.....

What is the occupation?.....

Please make a tick (✓) in the correct box:

Is there electricity at home? Yes ☐ No ☐

Is there running water at home? Yes ☐ No ☐

Please indicate which range of income the family earns monthly:

No income ☐

Between R500-R1000 per month ☐

Between R1000-R3000 per month ☐

Between R3000-R6000 per month ☐

Over R6000 per month ☐

TEST OF VISUAL PERCEPTUAL SKILLS
3RD EDITION

Name: _____ Gender: _____ Grade: _____

School: _____ Examiner: _____

Reason for Testing: _____

Date of Test _____ year _____ month _____ day

Date of Birth _____ year _____ month _____ day

Chronological Age _____ year _____ month _____ day*

*Do not round months up by one if days exceed 15

Student has known (diagnosed) attention problems? ☐ Y ☐ N

Student has known (diagnosed) visual problems? ☐ Y ☐ N

Subtests	Subtest Scores			Index Scores			
	Raw Score	Scaled Score	Percentile Rank	Overall	Basic Processes	Sequencing	Complex Processes
1. Visual Discrimination (DIS)							
2. Visual Memory (MEM)							
3. Spatial Relations (SPA)							
4. Form Constancy (CON)							
5. Sequential Memory (SEQ)							
6. Figure Ground (FGR)							
7. Visual Closure (CLO)							
			Sum of Scaled Scores				
			Standard Scores				
			Percentile Rank				
				Overall	Basic	Sequencing	Complex

%ile Rank	Scaled Score	SUBTEST SCALED SCORES							INDEX AND OVERALL SCORES				Standard Score	%ile Rank
		DIS	MEM	SPA	CON	SEQ	FGR	CLO	OVERALL	BASIC	SEQUEN.	COMPLEX		
>99	19												145	>99
>99	18												140	>99
99	17												135	99
98	16												130	98
95	15												125	95
91	14												120	91
84	13												115	84
75	12												110	75
63	11												105	63
50	10												100	50
37	9												95	37
25	8												90	25
16	7												85	16
9	6												80	9
5	5												75	5
2	4												70	2
1	3												65	1
<1	2												60	<1
<1	1												55	<1

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Refer to the TVPS-3 manual for complete instructions.

TVPS-3 subtests do not have basals.

A ceiling is established for each subtest when a student has answered all 16 items or misses 3 items in a row. Then proceed to the next subtest.

Record the student's answers in the Response column. Each correct answer is scored "1"; errors are scored "0". Tally the scores for each subtest in the spaces provided. **Do not score the examples.**

Upon completion of the *TVPS-3*, transfer the subtest raw scores to the front page of this protocol. Use the norms tables in Appendix B to derive subtest scaled scores, index standard scores, the overall standard score and percentile ranks.

Scaled and standard scores can be graphed on the front page of this protocol. The shaded area represents one standard deviation above and below the mean.

SUBTEST 1: Discrimination

Item #	Correct Answer	Response	Score
DIS Ex A	*(3)*		
DIS Ex B	*(5)*		
DIS 1	(3)		
DIS 2	(2)		
DIS 3	(3)		
DIS 4	(2)		
DIS 5	(1)		
DIS 6	(1)		
DIS 7	(5)		
DIS 8	(2)		
DIS 9	(4)		
DIS 10	(4)		
DIS 11	(5)		
DIS 12	(4)		
DIS 13	(2)		
DIS 14	(5)		
DIS 15	(3)		
DIS 16	(1)		
		Total Subtest 1	

Do not turn to the next plate until you've read the directions for the next subtest.

SUBTEST 2: Memory

Reminder: Present the target item for 5 seconds. Response is not timed.

Item #	Correct Answer	Response	Score
MEM Ex C	*(3)*		
MEM Ex D	*(2)*		
MEM 17	(3)		
MEM 18	(1)		
MEM 19	(2)		
MEM 20	(2)		
MEM 21	(3)		
MEM 22	(2)		
MEM 23	(4)		
MEM 24	(1)		
MEM 25	(2)		
MEM 26	(1)		
MEM 27	(3)		
MEM 28	(4)		
MEM 29	(2)		
MEM 30	(4)		
MEM 31	(3)		
MEM 32	(1)		
		Total Subtest 2	

Do not turn to the next plate until you've read the directions for the next subtest.

SUBTEST 3: Spatial Relations

Item #	Correct Answer	Response	Score
SPA Ex E	*(2)*		
SPA Ex F	*(4)*		
SPA 33	(1)		
SPA 34	(2)		
SPA 35	(5)		
SPA 36	(3)		
SPA 37	(3)		
SPA 38	(5)		
SPA 39	(1)		
SPA 40	(2)		
SPA 41	(2)		
SPA 42	(1)		
SPA 43	(4)		
SPA 44	(3)		
SPA 45	(4)		
SPA 46	(5)		
SPA 47	(2)		
SPA 48	(4)		
		Total Subtest 3	

Do not turn to the next plate until you've read the directions for the next subtest.

Appendix C

Namhlanje ngizokubonisa imidwebo bese ngikubuza imibuzo ngomdwebo ngamunye. Uzokhetha impendulo eyodwa kulezo ezibhaliwe ephepheni. Zonke izimpendulo ekugcineni kwekhasi zimakiwe ngezinombolo 1,2,3 njll. Khomba umdwebo owukhethayo oyimpendulo yakho, noma usho inombolo engaphansi kwawo. Zama ukusebenza ngokushesha . Umbuzo ngamunye unempendulo eyodwa. Uma ungayazi impendulo, kulungile-ke qagela. Khululeka, zama ukusebenza ngokuzimisela. VD
Kulungile-ke okokuqala sizozama (*). Buka lesisibonelo sokuqala. Phezulu kukhona umdwebo (*), yimuphi kulemidwebo engezansi (*) ofana ncamashi nalona ongenhla? (***)
Yebo, unombolo 3 (*) uyefana nomdwebo ongenhla.

Manje asizame okunye futhi (*). Buka lokhu: Phezulu ubona umdwebo (*). Yimuphi kulemidwebo engenzansi (*) ofana ncamashi nalona ongenhla? (***)

Yebo, unombolo 5 (*) uyefana nalomdwebo ongenhla: lona ukhombe endaweni efanayo nalona ongenhla.

Manje-ke asenze okunye okufana nalokhu okubili osukwenzile. Ukhumbule ukubuka umdwebo ofana ncamashi nalona ongenhla nokhomba endaweni efanayo. Uma ungazi, kulungile uzoqagela.

Yimuphi kulemidwebo engezansi (*) ofana ncamashi nalona ongenhla?

VM
Manje asenze okwehlukile. Ngizokukhombisa umdwebo imizuzwana emibalwa , uzowukhumbula bese uzama ukungitholela wona kwelinye ikhasi. Okokuqala ake sizame (*).
Buka lomdwebo isikhashana bese uwukhumbula (5sec)

Yimuphi umdwebo ofana nalona oqeda kuwubona? (***)

Yebo, unombolo 3 (*) iwona oqeda kuwubona.

Asizame senze lona-ke manje (*)

Manje, buka lomdwebo isikhashana bese uyawukhumbula (5 sec)

Yimuphi umdwebo ofana nalona oqeda kuwubona? (***)

Yebo, unombolo 2 (*) iwona oqeda kuwubona.

Manje sizokwenza okuningi okufana nalokhu. Ukhumbule ukuthi uma ungazi , kulungile ukuqagela.

Buka lomdwebo isikhashana bese uwukhumbula (5sec).

Yimuphi kulemidwebo okade uqeda ukuwubona?

SR
Manje-ke asenze okunye futhi. Sizozama njengoba kade senza ekuqaleni (*).
Buka lemidwebo elapha (*). Yimuphi ohlukile kuyoyonke lena? (***)

Yebo, unombolo 2 uyena ohlukile, ukhombe endaweni ehlukile. Uzobuka imidwebo ingxenye yawo ebheke kwenye indawo engafani neminye kulelikhasi noma umdwebo wonke uphendukezelwe.

Manje akesizame ukwenza lokhu (*).

Buka lemidwebo lapha (*). Yimuphi ohlukile ongafani neminye? (***)

Yebo, unombolo 4 ohlukile, umbala omnyama nomhlophe kunombolo 4 usemaceleni ahlukene omdwebo kunakweminye imidwebo. Khumbula, ubuka imidwebo enezingxenye zawo ezikhombe kwenye indawo engabhekile lapho kubheka khona eminye ekhasini noma umdwebo wonke uphendukezelwe. Uma ungazi kulungile ungaqagela.

Buka kulemidwebo (*) Yimuphi ohlukile kuyo yonke lena? (***)

FC
Manje asenze okunye. Sizokuzama kuqala, njengoba kade senza ekuqaleni. Buka lomdwebo ophezulu (*). Ufuneke manje lapha ngezansi (*), ungaba mncane, mkhudlwana, mnyamana noma uphendukezelwe. Kukuphi laphaya ezansi lapho ubona khona umdwebo ofana nolaphaya phezulu? (***)
Yebo, Unombolo 3 (*) unesimo esifanayo nalesiya esiphezulu, kodwa sincane.

Manje asizame neminye imidwebo (*)

Buka lomdwebo ophezulu (*) manje uthole laphaya phansi (*), ungaba mncane, mkhulu, mnyamana, noma uphendukezelwe. Laphaya ezansi kukuphi la sibona khona umdwebo ofana nalona ophezulu? (***)

Yebo, unombolo 5 (*) uyefana nalona ophezulu kodwa uphendukezelwe.

Kulungile-ke asenze okunye futhi okufana nalokhu okubili esesikwenzile. Khumbula, ubuka umdwebo ofana ncamashi nalona ophezulu, omncanyana, omkhudlwana, omnyamana, okhanyayo noma ophendukezelwe. Uma ungazi kulungile ukuqagela kodwa zama ukuphendula imibuzo eminingi. Usulungile? Asiqale-ke.

Buka umdwebo ophezulu (*), manje uthole laphaya ezansi (*). Kukuphi laphaya ezansi la ubona khona umdwebo ofana nalona olaphaya phezulu?

VSM
Manje-ke sesizokwenza okuhlukile. Lokhu kuzofana kancane nalokhu esesikwenzile. Ngizokukhombisa izimo bese uyazikhumbula ngendlela ezilandelana ngayo bese uzithola kwelinye ikhasi. Ake sizame ngalokhu.
Buka lomdwebo isikhashana (5 sec). Yimiphi kulemidwebo ekhombisa izimo ngokulandelana kwazo njengoba uzibonile?

Yebo, unombolo 2 (*) ukhombisa izimo ngokulandelana kwazo njengoba ubuzibonile.

Manje-ke akesizame ngokunye futhi.

Buka lomdwebo isikhashana (5sec). Yimiphi kulemidwebo ekhombisa izimo ngokulandelana kwazo njengoba uzibone ekuqaleni?

Yebo, unombolo 3 (*) ukhombisa izimo ngokulandelana kwazo njengoba ubuzibonile ekuqaleni.

Sesizokwenza okuningi-ke okufana nalokhu. Khumbula ukuthi uma ungazi, ungaqagela.

Buka lomdwebo okwesikhashana bese uyawukhumbula (5sec). Yimiphi kulemidwebo ekhombisa izimo ngokulandelana kwazo njengoba kade uzibona?

FG
Masenze okunye-ke futhi. Manje uzongitholela izimo ezicashe ezithombeni. Kwesinye isikhathi kuzoba nemigqa phezu kwesimo osifunayo, noma siphendukezelwe noma singaba sikhulu noma sincane, kodwa kuzobe kuseyisimo esifanayo.
Asizame-ke. Bukisisa kahle lokhu kuqala; Phezulu kukhona isimo (*). Yisiphi isithombe ngenzansi (*) ozothola kuso isimo esicashile esifana naso ncamashi? (***)

Yebo, isimo esiphezulu sicashe laphaya esithombeni 2 (*).

Asizame futhi okunye. Bukisisa kahle lokhu kuqala; Phezulu kukhona isimo (*). Yisiphi isithombe ngenzansi (*) othola kuso isimo esifana naso esicashile? Ukhumbule, kungaba khona imigqa ngenhla kwaso, noma siphendukezelwe, singaba sikhulu noma sincane, noma sibe nombala ohlukile kodwa kuzobe kuseyiso. Sisitholaphi lesisimo? (***)

Yebo, lesisimo esiphezulu sicashe laphaya esithombeni esiwu nombolo 1 (*). Manje sizokwenza okuningana okufana nalokhu. Khumbula ukuthi kulungile ukuqagela uma ungayazi impendulo.

Lapha phezulu ubona isimo (*). Kukusiphi isithombe ngenzansi (*) lapho uthola khona isimo esifanayo?

VC
Sekuyisigaba sethu sokugcina lesi, sisazokwenza futhi okunye okuhlukile.
Asizame kuqala. Uma lemidwebo engenzansi (*) ibiphelele nemigqa ingagudluzwanga, yimuphi obungabukeka ufana ncamashi nalona ongenhla? (***)

Yebo, uma imigqa kanombolo 4 (*) ibingahlanganiswa, ubungafana ncamashi nomdwebo ongenhla.

Asizame futhi ngalokhu. Uma lemidwebo engenzansi (*) ibingaqedelwa nemigqa inganyakaziwanga, yimuphi obungafana ncamashi nalona ongenhla? (***)

Yebo, uma imigqa kanombolo 2 (*) ibingahlanganiswa, ubungafana ncamashi nomdwebo ongenhla.

Manje sizokwenza okuningana okufana nalokhu. Ungakhohlwa ukuthi ungaqagela uma ungayazi impendulo.

Uma lemidwebo engenzansi (*) ibiphelele futhi ingamiswanga ngendlela ehlukile, yimiphi ongafana nawo ncamashi kulena engenhla? (***)

Occupational Therapy

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The effects of a visual perceptual skills programme on Grade R children in KwaZulu-Natal

Information sheet – Parents/Legal Guardian

Dear Parents,

Good day, I am Gwynne Chedzey, an occupational therapist currently completing my Masters degree at the University of the Witwatersrand. I am conducting research investigating "The effects of a visual perceptual skills programme on Grade R children in rural KwaZulu-Natal"

I have a special interest in children and especially Grade R children because they need to be equipped with skills to help them to cope in Grade 1. Visual perception is the skills we use to learn information through sight.

Children in Grade R need to develop their eye muscles and their visual skills to understand and process the information that they see. Visual perception is needed for children to learn shapes, letters and numbers.

The programme which I would like to implement at your child's school is aimed at improving the visual perceptual skills of Grade R children. This visual perceptual programme includes fun games and exercises to develop children visual perceptual skills. If your child is selected for the study they will continue with normal classes but in addition they will participate in a programme for 20-30 minutes per day with others from their class. Activities include eye exercises and other activities such as copying pictures and making puzzles. The programme will run for 2 terms.

Prior to starting the programme I will assess children who participate in the study using the TVPS 3 (Test of Visual Perceptual Skills – 3rd Edition). The test involves the child pointing to the correct picture/shape from a number of options, is will takes 20-30 minutes and an intepretter will be used. After the programme is completed the test will then be redone to determine any changes in the scores.I am inviting you and your child to participate in this study. Before your child participates in the study I will request that you fill out short form to consent to your child's participation. The research will not cost you or the school any money. Please be aware that you and your child's participation is voluntary. You and your child may withdraw at any point in the research without consequence.

Please note that confidentiality will be maintained and records of the data collected will be stored at the researchers premises where only access to her will be granted. The names of the children will be kept confidential.

If you have any further queries please do not hesitate to contact me on 0723714897. If you agree to your child's participation in the study please complete the attached consent form.

_____

Gwynne Chedzey BSc (OT) Wits

Appendix E

Informed Consent

I _____ agree to take part in the study and to allow my

child, _____, to participate in the study investigating “the effects of

a visual perceptual skills programme on Grade R learners in rural KwaZulu-Natal” which has

been explained to me by an interpreter or as set out in the information sheet.

Parent/Guardian: _____

Signature: _____

Date: _____

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August 27, 2015

Gwynne Chedzey
Department of Occupational Therapy
University of Witwatersrand
7 York Rd.
Parktown 2192
South Africa

Dear Ms. Chedzey,

You are approved to translate the *Test of Visual-Perceptual Skills-3* into isZulu for the purposes of your masters thesis research titled *"The effects of a visual perceptual skills programme on Grade R children from a disadvantaged school in KwaZulu-Natal."*

The translated version may only be used for the purposes of your research and may not be sold or distributed.

Please let us know if there is anything further we can do to assist you.

Sincerely,

Stacy Frauwirth, MS, OTR/L
Assessment Editor

James A. Arena
President
John and Anna Arena
Founders

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Week 1

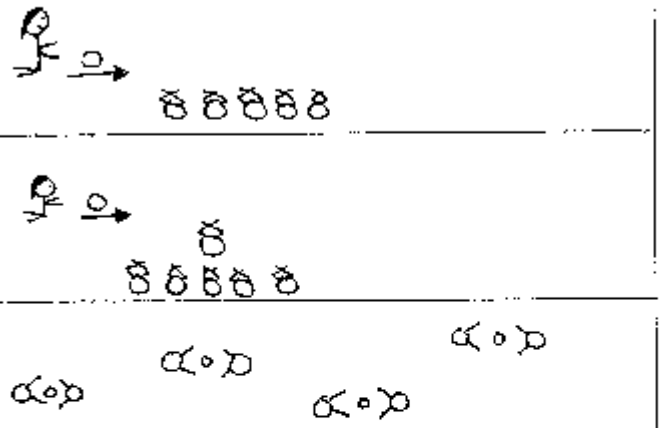
Task - Eye movements

1. The teacher must roll tennis balls on the floor from left to right, children must sit on the floor with crossed legs and follow balls with their eyes. Repeat 12 times.

2. Now allow each child the chance to catch the ball as it is rolled on the floor by the teacher (12 balls). Others must watch continue to watch the ball as it moves across the floor.

3. Children must be put in pairs and sit opposite each other, legs open. They must roll a ball to each other.

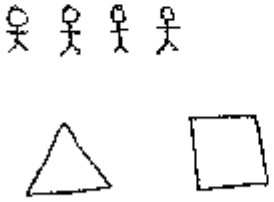
Diagram



Task - Shape concept

1. Using coloured chalk the teacher must draw big shapes in a line outside on the corridor i.e circle, triangle and square with chalk on the floor outside. Children must line up against the wall. One at a time let the children walk on the outline of each shape, from left to right. They must name the shape in Isizulu repeatedly as they walk.

Diagram



Week 2

Task - Eye movements

1. Stick a shape onto the top of a stick. Children must sit opposite each other and follow the shape as the other child moves it from side to side, keeping the head still and moving only the eyes. They must take turns to hold the stick.

2. The teacher will call each pair to do the same activity with her. Place a sticker on the end of a stick. Children must sit opposite each other and follow the sticker from side to side, keeping the head still and moving only the eyes.

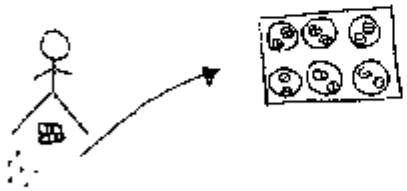
Diagram

Task – Visual Discrimination

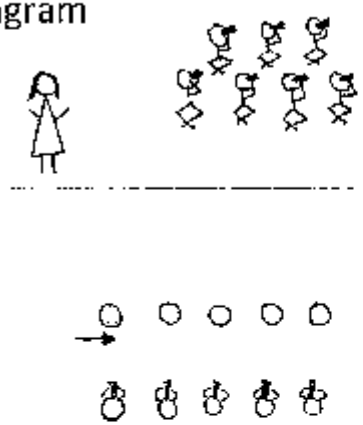
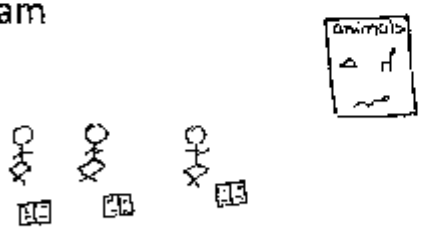
1. Give each child an egg tray and a big handful of beans. They musty look at the markings and sort the beans into the 6 cups i.e. all the dots together, all the circles together etc.

2. When they are finished let them show the teacher and she can check their work.

Diagram



Week 3

Task - Eye movements 1.While the children are sitting down. Use the plastic pipe/cardboard tube to look through using one eye. Listen to the teacher and look at the object which she names e.g. board, door, chair. 2.Children to stand in two lines, facing each other. Using the same pipes/tubes one line of children must look at each child in the next line with the tube and say the child's name, then next child etc. Always from left to right. Now let the others try	Diagram 
Task – Figure ground 1. Look in magazines for objects that are a certain colour or for certain groups. Do a different object for each day of the week and stick these on a poster. For Monday do animals. For Tuesday do juices/drinks. For Wednesday do anything red. For Thursday do people. For Friday do anything blue.	Diagram 

Week 4

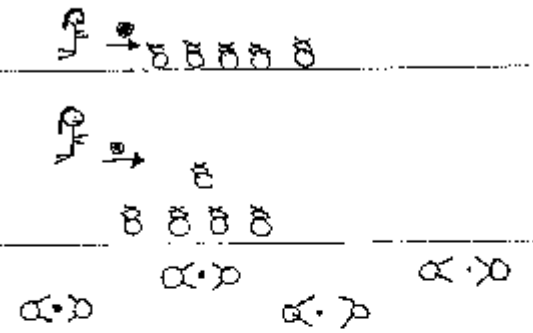
Task - Eye movements

1. The teacher must roll marbles on the floor from left to right, children must sit on the floor with crossed legs and follow the marble with their eyes. Repeat 10 times.

2. Now allow each child the chance to catch 10 marbles as they are rolled on the floor by the teacher (12 marbles). They must use a plastic cup turned upside down to "trap" the marble. Others must continue to watch the marbles across the floor.

3. Place children in pairs, sitting opposite each other, legs open. The must roll a marble to each other.

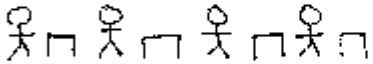
Diagram



Task – Spatial Relations

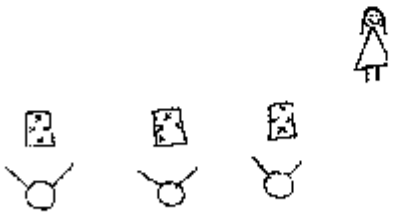
1. At their chairs the teacher must tell the children to stand "behind the chair", in front of the chair, next to the chair, on the chair and under the chair".

Diagram



2. At the desk/floor the child must point to the top of their piece of paper, bottom of the paper, left and right side. The teacher will tell them to draw a shape at the top, then bottom then left then right. Do a different shape each day of the week. paper in front of them. Look in a magazine for all the squares etc, stick these on a poster for each day of the week. Do a different shape each day of the week.

Mon=square
Tues=circle
Wed=triangle
Thurs=oval
Friday=rectangle



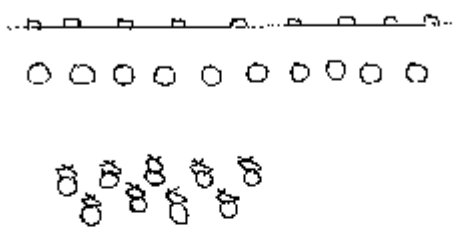
Week 5

Task - Eye movements

1. Place pictures of familiar objects in a long row on the wall. 10 children at a time must stand in front of the wall and say the objects in order. Make "binoculars" with your hands and say the objects again in order.

2. Repeat the activity with a sequence of shapes drawn on the board. Change the sequence each day.

Diagram



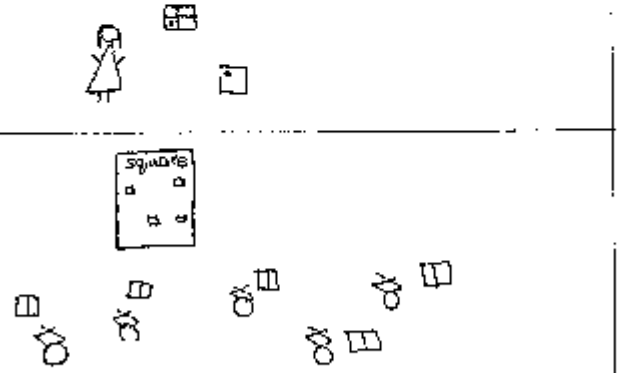
Task – Form Constancy

1. Look in the room for all the square objects etc. Have the teacher place a sticker on all the square objects. The next day do a different shape.

2. Look in a magazine for all the squares etc, stick these on a poster for each day of the week. Do a different shape each day of the week.

Mon=square
Tues=circle
Wed=triangle
Thurs=oval
Friday=rectangle

Diagram



Week 6

Task - Eye movements	Diagram
1. Have 12 children stand in a line and using the tennis balls they must play bounce and catch with the ball. The teacher must say go before each attempt. The children must count to 10 catches.	
Task – Visual Closure	**Diagram**
1. Give each pair of children a set of cardboard pieces (2 circles, 1 triangle, 1 square and 8 rectangles). One must build a boy and one a girl using these shapes. Now each child must show the teacher their end product and say if it is a boy or girl. 2. Repeat and let the child who built the boy, now make the girl and the child who made a girl first can now build the boy.	

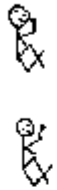
Week 7

Task - Eye movements

1. Give each child a star, which must be stuck on their thumb nail. Have the children follow there thumb with their eyes, they must hold their thumb at arms length from their body at head height.
First tell them to follow up and down, then try left to right. Now tell them to follow the star to their nose and then back out again.

2. Now mix up the instructions and see if the children can follow the instructions and keep focus on the stars.

Diagram



Task – Visual Memory

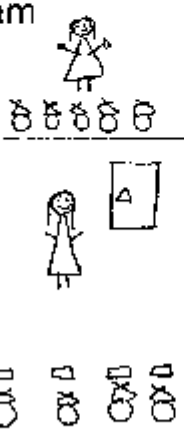
1. The teacher must show the children 2-3 objects in her hands. Now place them behind her. Each child must have a turn to say what they saw in her hands.

2. Now on the board the teacher must draw one shape. Then cover it and ask the children to draw the same shape on their paper strip. Turn it over and try another shape.

Next draw two shapes on the board, see if the children can copy them in sequence once they are covered. Repeat on the back with a new sequence.

Lastly try three shapes in sequence.

Diagram



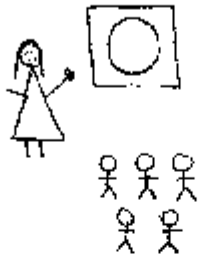
Week 8

Task - Eye movements

1. Class to stand in front of the large circle. The children must follow the hand of the teacher as she traces the circle with her finger. They must keep their heads still. When she stops the children must point to the part of the circle she was touching last.

2. Now place the children in a line, one traces the circle with their finger, the next child in the row must point to wear they last touched the circle. Then its their turn.

Diagram



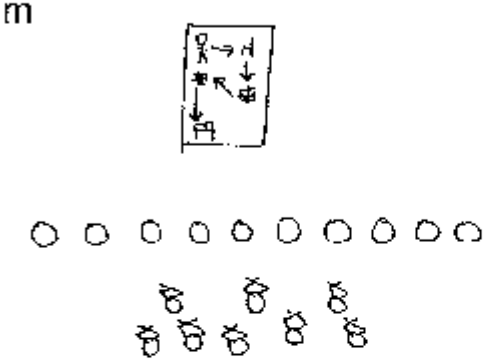
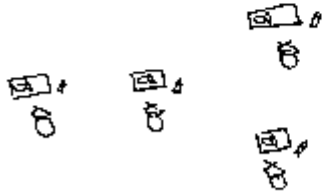
Task – Visual Discrimination

1. Snap. Give the children each one card with a picture on it. Now the teacher must hold up one card in front of the class. the child with that picture must say "snap" (isiZulu) and stand in a line on the other side of the class. Continue until all the children are in a line.

2. Now put the teacher cards on the floor and let the children try and find the shape that matches there shape. Once they have it they must sit down so the teacher can check.

Diagram

Week 9

Task - Eye movements	Diagram
1. On the poster have groups of 10 children stand in front of the poster, they must follow the arrows with their eyes e.g. start at one object (name it) and then move with eyes to next object. The other children must watch what they are doing so they can try afterwards. 2. Now try a different poster that has snapes on it. Move the shapes and the arrows each day to make it more difficult.	
Task – Figure ground.	**Diagram**
1. Give the children a worksheet each. Now help them to mark each shape the correct colour on the key. Now they can colour by number e.g. all the spaces with a circle will be one colour etc.	

Week 10

Task - Eye movements	Diagram
1. The teacher must use the arrow and point it up (the children must go on their toes), or down (they must sit down), or right (they must walk to the right) or left (they must walk to the left). 2. Now repeat the task, but the children must only move their eyes. If the teacher points the arrow up, the children must look up (not moving heads). Then to the right and they all look to the right. Continue with different directions. If a child is wrong let them sit down but keep practising while the others continue in the game. See who stays standing through all the directions.	 
Task – Spatial Relations	**Diagram**
1. On the worksheet the child must place a stone/bean on the object that is facing the wrong way. They must then put up their hand when thye are complete so the teacher can check their work.	

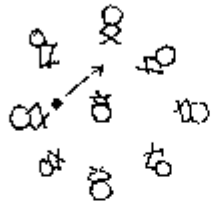
Week 11

Task - Eye movements

1. Place the children in a circle (they are the mice) and one child will be in the centre, he is the owl. The children must try to roll the tennis ball to each other (the mice) and the owl must try to catch the marble. Other children must watch the marble to see if the owl catches it and they can cheer when he does. Rotate so each child has a turn to be the owl.

2. Repeat the game but use the marble instead.

Diagram

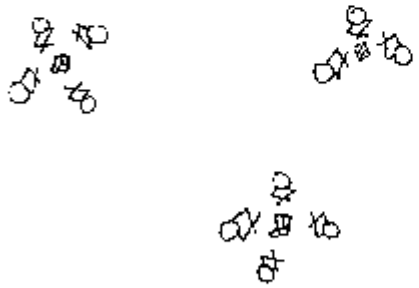


Task – Form Constancy

1. Give each child a letter from the alphabet in "normal" font. Now they must find 2 other letters that are the same but in a different font. They must come and show the teacher who will be sitting on a chair. If they are right they can have another letter from the alphabet to try and find the matching 3.

Diagram

Week 12

Task - Eye movements	Diagram
1. Teach the children the rhyme "look to the left, look to the right, look up, look down look all around". They must keep their heads still and repeat the rhyme. Increase the speed of the rhyme and see who can keep the sequence going.	
Task – Visual Closure	**Diagram**
2. Give each child a piece of a puzzle with a dot on it. Now they must get together in groups according to the colour cardboard piece they have. They must use the other halves provided to complete their puzzles. Once they are done each colour group must put all the pieces in the middle and then pick one piece up (with a dot) and try and complete the puzzle again.	

Week 13

Task - Eye movements

1. On worksheets the children must follow the lines using their eyes to find which animal is connected to the object e.g. which lion will get the meat. They must place a paper clip on the correct picture. Then swap worksheets with another child and let them try again.

Diagram

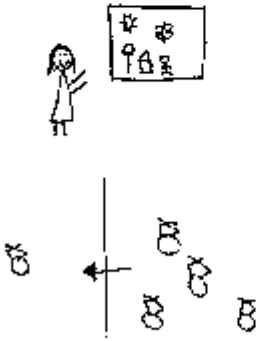
Task – Visual Memory

1. The teacher will draw a simple picture on the board consisting of 5 objects. Ask the children to look carefully (30 seconds). Then cover the picture and ask the children to tell you what they remember: As they recall something, let them cross the line on the floor. Now draw another picture, continue until all children are on the side that has recalled something.

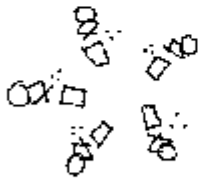
Examples of pictures;

1. a house, a tree, a cloud, a flower and a dog
2. a table, an apple, a mouse, a butterfly and a shoe

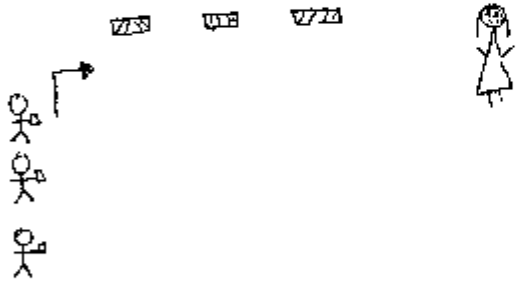
Diagram



Week 14

Task - Eye movements	Diagram
1. Using a simple sentence such as "I love school, it is fun." Written in isiZulu on the board. Read this to the children each morning. One child must point to each word using a stick as you read it. Each child must have a turn every morning. Repeat each day of the week.	
Task – Visual Discrimination and Figure Ground	**Diagram**
1. Spot the difference. Place beans on all the differences. Find 2 in each picture. Now let each child swap their picture and try a different spot the difference worksheet. Give the complex worksheet to those who are finding the differences easily. Here they must spot 5 differences.	

Week 15

Task - Eye movements	Diagram
Put the children in pairs, sitting opposite each other. Now let them use a cup to roll a marble to each other.	
Task – Spatial Relations and Form Constancy Give each child a card with a sequence of line on it e.g. /\/. Now let the children walk past the cards laid out on the floor. They must match their pattern with that on the floor. Once they find that pattern they can put theirs with the matching card. Swap cards with other learners and try again.	**Diagram** 

Appendix H

R14/49 Mrs Gwynne Meda Chedzey

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M130939

NAME: (Principal Investigator)	Mrs Gwynne Meda Chedzey
DEPARTMENT:	Occupational Therapy Private Practice at Grantleigh School Department of Education, Mvuze Mvuse Primary School, Kwazulu-Natal
PROJECT TITLE:	The Effects of a Visual Perceptual Skills Programme on Grade R Children from a Disadvantaged School in Kwazulu-Natal
DATE CONSIDERED:	27/09/2013
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Lizelle Jacobs
APPROVED BY:	Professor PE Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	30/10/2013

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report.**

Principal Investigator Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix I

education

Department:
Education
PROVINCE OF KWAZULU-NATAL

Enquiries: Nomangisi Ngubane | Tel: 033 392 1004 | Ref.:2/4/8/488

Mrs GM Chedzey
PO Box 2
MTUNZINI
3867

Dear Mrs Chedzey

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"THE EFFECTS OF A VISUAL PERCEPTUAL SKILLS PROGRAMME ON GRADE R CHILDREN FROM A DISADVANTAGED SCHOOL IN KWAZULU-NATAL"**, in the KwaZulu-Natal Department of Education Institutions has been approved. The conditions of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and Institutions are not identifiable in any way from the results of the research.
5. A copy of this letter is submitted to District Managers, Principals and Heads of Institutions where the intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 20 July 2015 to 31 August 2016.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Connie Kehologile at the contact numbers below.
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report / dissertation / thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education.

Nkosinathi S.P. Sishi, PhD
Head of Department: Education
Date: 14 July 2015

KWAZULU-NATAL DEPARTMENT OF EDUCATION
POSTAL: Private Bag X 9137, Pietermaritzburg, 3200, KwaZulu-Natal, Republic of South Africa
PHYSICAL: 247 Burger Street, Anton Lembede House, Pietermaritzburg, 3201. Tel. 033 392 1004
EMAIL ADDRESS: kehologile.connie@kzndoe.gov.za / Nomangisi.Ngubane@kzndoe.gov.za
CALL CENTRE: 0860 596 363; Fax: 033 392 1203 WEBSITE: WWW.kzneducation.gov.za

Appendix J

Occupational Therapy

School of Therapeutic Sciences • Faculty of Health Sciences • 7 York Road, Parktown 2192, South Africa
Tel: +27 11 717-3701 • Fax: +27 11 717-3709 • E-mail: denise.franzsen@wits.ac.za

Permission for the study.

Mr/Mrs.
The Principal,
** Primary School,

Dear Sir/Madam,

I, Gwynne Chedzey, am an occupational therapist currently completing my Masters degree at the University of the Witwatersrand. I am conducting research investigating, “The effects of a visual perceptual skills programme on Grade R children in rural KwaZulu-Natal”.

Several researchers have demonstrated the relationship between academic skills and the visual perceptual abilities of the learner. Visual perception enables individuals to meaningfully recognise and interpret visual information such as shapes, letters and numbers with the goal of understanding information received by the eyes. Children with visual perceptual problems have difficulty with academic skills such as reading, spelling and writing.

I am inviting learners at ** Primary School who are currently enrolled in Grade R for 2015 to consider participating in this study with their parent’s consent. I would like to request your permission to include learners in the research and conduct this study at your school.

The research will involve the children undergoing visual perceptual testing by the researcher, a qualified occupational therapist. The test is called the TVPS 3 (Test of Visual Perceptual Skills 3rd Edition). This is a test which requires children to look at pictures and select the correct answers by pointing at the page. The test takes 20-30 minutes to administer and an interpreter will be used to ensure children understand the instructions. The test would be conducted on each child individually from both Grade R classes at ** Primary School. The initial test data will be collected over two days, each child will be tested in a room away from the classroom. A stimulation programme will then be introduced to one group in the study, this programme is in addition to the

Occupational Therapy
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current curriculum and involves daily short (20-30 minute) activities. The other Grade R class will continue with their normal curriculum. The programme will be run by the teacher and include visual perceptual activities such as catching a rolling ball, sorting different objects into groups and building puzzles. The therapist will provide the activities on a bimonthly basis and supply resources needed for the programme. The programme will be conducted over two terms and on completion a re-assessment of the children's skills will be conducted by the therapist using the same test (TVPS 3). The re-assessment will again be done over two days.

The study will investigate if the visual perceptual programme effects the visual perceptual scores of Grade R children. Research has shown that developing visual perceptual skills can help a child with literacy skills. The intention of this study is to provide stimulating activities that will assist learners with the basic skills needed when learning literacy.

Please note that confidentiality will be maintained and records of the data collected will be stored at the researchers premises where only access to her will be granted. The names of the children will be kept confidential and all information and records will be destroyed following six years of the publication of this study.

Participation will be voluntary and parents and children will be invited to participate in the study. Participants may withdraw or be withdrawn by their parents without consequence. No cost will be incurred by the parents or ** Primary School.

Should the intervention programme yield positive results in the experimental group it will be made available to the control group once the study is complete. This study aims to provide evidence for using occupational therapy based programmes to stimulate the visual perceptual skills in Grade R learners and determine the need for intervention programmes in rural schools in KwaZulu-Natal.

If you have any further questions please don't hesitate to contact me on 072 371 4897. For any concerns about the ethics of the study you may contact Prof P Cleaton-Jones, the chairman of the Human Research Ethics Committee at 011 7171234.

Regards,

_____

Gwynne Chedzey

BSc (OT) Wits

Appendix K

Principal Consent

I _____ agree to take part in the study

Investigating “the effects of a visual perceptual skills programme on

Grade R learners in rural KwaZulu-Natal” which has been explained to me by the

researcher and as set out in the information sheet.

Teacher name and surname: _____

Signature: _____

Date: _____

Occupational Therapy

School of Therapeutic Sciences • Faculty of Health Sciences • 7 York Road, Parktown 2192, South Africa
Tel: +27 11 717-3701 • Fax: +27 11 717-3709 • E-mail: denise.franzsen@wits.ac.za

Permission for the study.

Mr/Mrs.
Grade R teacher,
** Primary School,
Dear Sir/Madam,

I, Gwynne Chedzey, am an occupational therapist currently completing my Masters degree at the University of the Witwatersrand. I am conducting research investigating, “The effects of a visual perceptual skills programme on Grade R children in rural KwaZulu-Natal”.

Several researchers have demonstrated the relationship between academic skills and the visual perceptual abilities of the learner. Visual perception enables individuals to meaningfully recognise and interpret visual information such as shapes, letters and numbers with the goal of understanding information received by the eyes. Children with visual perceptual problems have difficulty with academic skills such as reading, spelling and writing.

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current curriculum and involves daily short (20-30 minute) activities. The other Grade R class will continue with their normal curriculum. The programme will be run by the teacher and include visual perceptual activities such as catching a rolling ball, sorting different objects into groups and building puzzles. The therapist will provide the activities on a bimonthly basis and supply resources needed for the programme. The programme will be conducted over two terms and on completion a re-assessment of the children's skills will be conducted by the therapist using the same test (TVPS 3). The re-assessment will again be done over two days.

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If you have any further questions please don't hesitate to contact me on 072 371 4897. For any concerns about the ethics of the study you may contact Prof P Cleaton-Jones, the chairman of the Human Research Ethics Committee at 011 7171234.

Regards,

_____

Gwynne Chedzey
BSc (OT) Wits

Appendix M

Teacher Consent

I _____ agree to take part in the study

investigating “the effects of a visual perceptual skills programme on Grade R

learners in rural KwaZulu-Natal” which has been explained to me by the

researcher and as set out in the information sheet.

Teacher name and surname: _____

Signature: _____

Date: _____

Appendix N

Verbal assent from each child

Hello _____

My name is Gwynne and I am here to see how well you your eyes can see all the work in class.

I will show you some pictures and will ask you to match them to other pictures. Is it alright if I do this with you?

You can say no if you want to.

_____ _____

Witness Date