A Developmental approach: A Framework for the development of an integrated Visual Perception programme

Elizabeth Daphne Vlok, B OT; M OT (Management)
Lecturer in the Division of Occupational Therapy, Department of Interdisciplinary Health Science, University of Stellenbosch

Neeltjé Elizabeth Smit, B OT, MBA (Stell), B OT Hons (Pret), DTSE (Unisa)
Accredited part-time senior lecturer, University of Stellenbosch

Juanita Bester, B OT, BSc (Hons), MPhil, Post Graduate Diploma in Program Monitoring and Evaluation
Lecturer in the Division of Occupational Therapy, Department of Interdisciplinary Health Sciences, University of Stellenbosch

ABSTRACT

This article provides guidelines for an occupational therapy framework that can be used to develop a visual perceptual programme to enhance or stimulate the development of visual perceptual skills. The developmental approach was used to organise the framework for an integrated visual perceptual programme (IVPP) including cognitive strategies, visual perceptual abilities and the visual system.

The IVPP was developed and based on experience from practice and used in a clinical experimental field trial study aimed at the investigation of the effect of ocular motor exercises in combination with a visual perceptual programme on the visual perception of seven-year-old learners with possible visual perceptual problems. Feedback on academic performance was obtained from the teachers indicating improvement in maths, reading, writing and work speed; changes in attitude of daring, perseverance, confidence and motivated behaviour. Examples from practice will be included to demonstrate how the guidelines and approaches were used.

An increasing tendency is for learners who are referred to occupational therapists to be experiencing problems performing academic tasks because of visual perceptual problems. The IVPP can be used to optimise occupational performances in academic tasks.

Key words: Visual perceptual skills; eye movements and vision; integrated visual perceptual programme; developmental approach; academic performances; occupational therapy; framework

Introduction

In this article a framework for the development of integrated visual perception programmes will be shared. The theoretical foundation and experiential basis for clinical reasoning that informed the development of the framework will also be discussed. A developmental approach is foundational to the proposed framework that includes cognitive strategies, perception and vision. Development of the integrated visual perceptual framework (IVPF) was informed by extensive practice experience (19 years) with learners who experienced perceptual and motor developmental delays and the clinical reasoning used to develop integrated visual perceptual programmes. The IVPF was further refined during a clinical study in which the implementation of an integrated visual perception programme was used. The clinical study contributed to the understanding of what should be included in a framework to enhance visual perceptual development.

In this article the theoretical principles that should guide thinking will be presented first, followed by application in a case-study. Theoretical principles will be organised into general principles for normal development, appropriate cognitive strategies to be used, trends in the development of visual perception, and the functions and development of the visual system. The focus will be on developing learning processes needed by the learner in the foundation school phase.

The need for an IVPF became clear during workshops, held by the author, on visual perception that included eye movement exercises and adaptation of activities to enhance the functions of the eyes. The framework is meant to contribute to the empowerment of young therapists who could use it to develop programmes that are tailored to the needs of the population they serve and that includes all aspects required to enhance visual perceptual development.

Occupational therapists enable learners to function optimally in their occupations, which include school typical tasks, by addressing the underlying components of function or adapting learning and teaching strategies or the environment. In South Africa poor performance in numeracy and reading[1, 2, 3] continues to be a problem, despite increased efforts. For example, in the Western Cape Province in 2002 Grade 3 learners achieved a pass rate of 35%[4] and 63% of Grade 6 learners failed a literacy test[4,5]. In 2008 the Grade 3 learners achieved a pass rate of 53.5% for literacy and 35% for numeracy[6]. The Western Cape Education Department identified an increase of visual perceptual problems as being the main underlying factor for children not being ready for school. Several researchers have demonstrated the relationship between the academic skills and the perceptual abilities of the learner[5, 7, 8, 9].

At school-entry level the focus of development is on the refinement of all fine motor skills[5, 9], of which eye movements is one aspect, and the refinement of cognitive and perceptual skills. The refinement of skills takes place through the engagement in games and learning activities which are used and applied in all school related tasks[9]. The structured opportunities, activities and materials provided contribute to the way that the learner develops scholastic skills of which visual perception is an important learnt skill. Todd stated that "through this learning process, vision becomes seeing and the child acquires the essential skills that permits him to deal effectively with the spatial world"[10:186]. The development and refinement of the learner's visual perceptual abilities are dependent on vision and eye movements which enable the observation of stimuli through:

- focussing on stimuli,
- scanning the environment or object to observe the big picture and detailed information,
- following stimuli to enable interpretation of information for effective learning[8,10,11] and
- application of the above three components in problem solving situations and tasks[5].

Learners use their perceptual abilities to enable optimal learning. Their visual perceptual abilities contribute to the interpretation of objects, environments and people in order to form concepts[5,10]. Children between the age of four and seven years are in the intuitive phase of intellectual development implying that they struggle with cognitive operations but react intuitively on their perceptions[5]. According to Schneck[8] the critical period for development of spatial perception is between seven to nine years. Schools expect learners to utilise visual perceptual abilities to read, write and copy from

the blackboard before these skills are optimally developed, in part because the school system in South Africa allows learners to enter the foundation phase at the age of five provided that they turn six before June of the same year[3]. At this age the child is still refining the recognition, copying and naming of shapes and forms integral to reading. The young learner is thus not necessarily ready to interpret the spatial orientation of letters and numbers on a two-dimensional level or to do the visual adaptation over distance required to maintain clear focus and correct 'place in space' as needed for copying over distance or reading in a reader.

Educators tend to refer learners for occupational therapy once a perceptual problem is well established and not when the evidence of a perceptual barrier to learning is initially observed. When intervention is started too late, wrong patterns have developed for registration of information, resulting in behaviour that resembles fight or flight reactions[9]. Fight reactions are shown for example in the extreme focus on the task or in determination to complete a task although they can stop. Flight reactions[9] are seen in for example talkativeness which is used to escape work or frequent shifts of focus to outside or away from the activity. The experiences of poor participation in school-related tasks, due to a perceptual barrier, contributes to poor self-evaluation because of poor end products, slow work speed or negative feedback[9].

Fishman-Hellerstein and Fishman[12] suggest that in South Africa the preferred model for teamwork, is one of cooperation between an optometrist and occupational therapist. However, in practice, the learner will often be referred to the optometrist and occupational therapy is resumed after completion of vision therapy from the optometrist by choice of the parents (as reported by therapists working in schools and experienced whilst working with learners in a private practice). Poor socio-economic circumstance is often the reason why parents will first complete visual therapy before continuing with occupational therapy. This leads to further delays in treatment, which means that incorrect capturing of information processing continues to take place. The promotion of eye movements is regarded as part of occupational therapy services in the USA[8, 12]. Both therapies offered at the same time is the preferred choice but should it not be possible the occupational therapist should include eye movements to enhance observations integral to therapy.

The final stage of visual information processing is the use of information to do problem-solving, creative thinking and reasoning; a stage which is not receiving enough attention in the treatment of visual perception. The definition of visual perception thus includes the cognitive reasoning which comes from the meaning gathered from the experience of interaction with the environment, objects and people and enables the learner to participate in every-day tasks. The cognitive strategies used to enable a learner to optimise his or her learning experience and the process used to gather detailed information needs to be facilitated and made explicit to the learner.

The occupational therapy literature on visual perception consists mainly of contributions by therapists utilising sensory integration or cognitive approaches. The therapeutic potential of eye movements as warm up exercises before visual perceptual tasks, adapting tasks to enhance specific eye movements, and cognitive strategies as integral components of a visual perceptual programme have not been explored in sufficient depth.

Occupational therapists use different techniques and approaches[13] in their interventions for learners with visual perceptual problems including:

- sensory integration, with a focus on the adaptive response to enhance learning,
- neuro-developmental approaches to enhance and experience normal patterns of movement, and
- the developmental approach using assumptions of a visual perceptual system approach to concentrate on the visual perceptual abilities as specified by Frostig[7,8,9,10] and refined by Schneck[8].

Feedback from therapists (working with children with visual perceptual barriers to learning) who attended workshops by the author on the inclusion of eye movements in visual perceptual programmes and rethinking visual perception, confirmed the need to include eye movements into activity requirements and using a cognitive approach to enhance visual perceptual skills with learners of all ages.

Experience-base that informed the development of the IVPF

During the 1980's the researcher worked at a school for children with neurological dysfunctions and special educational needs where occupational therapists were trained by an optometrist to do daily eye exercises with specified learners. The researcher worked in a private practice for occupational therapy in which eye movement exercises, for children with learning difficulties, formed part of therapy, when indicated. Observations of the learners seemed to indicate an improvement of focus and ability to scan for information. However, even better functional outcomes, over a shorter time, were observed when additional cognitive strategies were used to facilitate the process of active involvement in an activity. The skills developed in this way were more transferable to academic performance resulting in increased motivation, confidence in own abilities and courage to try new tasks. The conclusion reached was that an integrated visual perception programme should include opportunities to practice basic eye movement skills, visual perceptual skills and cognitive strategies to enhance active learning needed for participation in classroom activities. These insights led to the research and the development of a framework to be used in the formulation of a visual perceptual enhancing programme for a group of learner.

Refinement of the IVPF through clinical research

The development of an IVPF was further refined during a clinical trial which aimed to investigate the effect of ocular motor exercises in combination with a visual perceptual program on the visual perception of seven year old learners with visual perceptual problems. An integrated visual perception programme was developed as a first step.

Development of an integrated visual perception programme for the clinical trial

During the development of an integrated visual perceptual programme (IVPP) for use in the clinical trial the following questions were asked and reflected on. What is visual perception? What is the function thereof? How does it develop? Is there grading and a hierarchy for the development of visual perception? What are the visual perceptual abilities? What are vision and eye movements? How does the learner utilise and apply visual information? What is the role of maturation in learning and in the readiness to learn new concepts and skills to master occupation specific tasks? What will the right fit be for learners to optimise their occupational performances?

The visual perceptual programme used in the study focussed strongly on the inclusion of selected activities to enhance visual perceptual skills. Activity selection and grading was informed by the general principles for child development[5,7]and cognitive development strategies[13] with consideration of the critical period for the development of vision and visual perceptual abilities[8]. The influences that shaped programme development will be discussed under the theoretical foundation for the IVPF.

Methods used in the Clinical Trail

Aim and Study design

The aim of the clinical trial was to investigate the effect of ocular motor exercises, in combination with a visual perceptual programme, on the visual perception of seven-year-old learners with visual perceptual problems. The study used a quantitative experimental design with an experimental and a control group of learners.

Study population and Sampling

A convenience sample was drawn from learners in the foundation phase of education at two mainstream schools within the same neighbourhood of the Bellville area.

Learners who were diagnosed with a neurological dysfunction; intellectual impairment and visual perceptual difficulties (receiving

or having received occupational therapy) were excluded from the study.

Criteria for inclusion were as follows:

- Afrikaans or English speaking,
- In the age range 6 years 6 months - 7years and 6 months (the optimal period for the development of shape perception, ability to maintain focus (fixations) and observe objects. Grade one learners need to differentiate between objects to enable copying and identification of letters and numbers),
- both genders,
- right and left handed learners and
- learners who experience difficulties in any area of visual perceptual performance as observed by the teacher and found during screening, using the "Beery-Buktenica Developmental Test of Visual-Motor integration"[14] (VMI).

From a possible 96 learners 32 were included in the study.

A screening test was done by an optometrist to establish the occurrence of eye movement problems within the sample. Only two learners did not have a problem and they were allocated to the experimental and control group.

The sample was matched according to their age and the General Visual Perceptual Quotient score of the VMI. The coded names of a matched pair for example (sm1 and sf6) were placed in one container and two papers individually printed as E (experimental group) and C (control group) in a separate container. The sample was divided, with the simultaneous drawing of two papers from the different containers by an independent person and allocated equally into an experimental and a control group. The researcher documented the group allocation. The group identification was only known to the researcher.

Measurement tools

The VMI test was used as a screening test to determine which children had a visual perceptual problem. This test was done as a group by an independent experienced occupational therapist (not the researcher).

The pre- and post-test namely the Developmental Test of Visual Perception, 2nd edition, by Hammil, Pearson and Voress[15] to measure effectiveness, was done individually by an independent experienced occupational therapist (not the researcher).

The above tests are norm based and were done according to test protocol at the schools that the learners attended.

The Developmental Test of Visual Perception, 2nd edition, by Hammil, Pearson and Voress[15] (DTVP-2) was used as the pre - and post programme measurement to determine effectiveness because of the reliability for test–retest, inter-test reliability and content validity that are all above r = 0.90 for the quotient scores of the visio-motor integration; motor reduced visual perception and general visual perception subtests. The test consists of 8 sub tests covering the motor reduced tests of position in space; figure ground; visual closure and form constancy as well as eye-hand coordination, copying, spatial relations and visio-motor speed.

The VMI test correlates with the DTVP- 2 Visio-motor integration and general visual perceptual subtest with a correlation of higher that r = 0.80. Both tests are good to use for research purposes but the VMI has a six month time laps before re-administration of the test. The DTVP-2 enabled the researcher to see if there was an improvement due to the intervention programme.

Intervention Programme

Evident from the questionnaires completed by the teachers was that the whole spectrum of visual perceptual abilities needed to be included in the intervention programme. The visual perceptual intervention programme was developed[16:61-64] and implemented by the researcher. The framework for the programme forms the main body of this article and will be referred to later.

The programme was presented to the experimental and the control groups over ten sessions. However, a 15 minute eye movement exercise routine, called the warm-up exercises, was added to the exposure received by the experimental group in each session. Intervention took place weekly over 4 afternoons at the same time slot for each group for example Group A at school A on Monday, Group B at school A on Tuesdays, Group A2 on Wednesday at school B and Group B2 on Thursdays at school B. Each group received intervention for an hour for the experimental group and 45 minutes for the control group. The researcher presented the intervention for the groups to ensure that the groups were handled the same and they received the same intervention in terms of eye warm-up exercises for the two experimental groups and activities to enhance eye movements and paper exercises for all the groups. The cognitive strategies were used for all the groups and facilitation of visual perception. All activities were done from a stable sitting posture to ensure proximal stability for distal mobility.

Field notes were kept and feedback from the teachers was obtained on their opinion of the performance of the learners in the class.

Ethics

Permission for the study was obtained from the University of Stellenbosch Ethical Research Committee; the Heads of the school as the research took place after hours in the school; the teachers from the foundation phase classes and informed consent was obtained from the parents and their children

The learners knew that they could withdraw their participation at any stage of the research process to ensure autonomy. The parents received a written report of the results and recommendations to ensure beneficence. No promise of outcome was made to the parents or payment received for the intervention. Participation in activities caused no harm to the learners. The learners were treated with respect from all professionals involved during the research process.

Results

The results of the pre and post tests were analysed using repeated measurements ANOVA that are non-parametric statistical procedures. The Pearson correlation method indicates the relation between two variables and is presented as a correlation coefficient (r) and the population correlation coefficient as (p). Tendency of improvement was noted for Hand eye coordination (p= 0.97) but none of the subtests showed statistic significance for change of period of time. Subtests position in space (p=0.13) and spatial relations (p= 0.22) was the nearest to p=0.0 but is still statistically insignificant. A Good correlation between the general visual perceptual quotient (r = 0.60) and the visio-motor integration quotient (r=0.61) with the VMI test was found. Although the researcher was not able to show a statistically significant change over time for the inclusion of the warm-up eye exercises in a visual perceptual programme there were functional benefits for the learners as observed by the researcher and teachers.

The researcher noted that the experimental group was able to focus on the task at hand quicker than the control group and was able to maintain the focus. The experimental group was also able to work at a faster speed to complete the tasks. As it was not the focus of the research, the exact time was not noted. Both groups showed improvement in task evaluation and confidence to participate and perform in the presented activities. Less flight reactions were observed and also rubbing of the eyes.

Additional feedback on academic performance obtained from the teachers indicated improvement in maths, reading, writing and work speed; changes in attitude of daring, perseverance, confidence and motivated behaviour. The biggest improvement was seen in maths, reading and in the confidence of the learners of both groups.

The time for intervention was short and the researcher is of opinion that the test used to evaluate effectiveness of the programme should only be used as a indicator of visual perceptual problems to find a starting point for intervention. As occupational therapists we are interested in functional outcomes and it was evident in the feedback from the teachers and from the observations of the researcher that some positive changes occurred within the 10 weeks. The researcher however, recommends a longer period of time for intervention but the optimal number of weeks needed to show effectiveness should be researched.

Theoretical Foundation for the IVPF

The theory that guided clinical reasoning in terms of the "what" and "how" for activity requirements included in the IVPP will now be discussed. Practical examples will be used to demonstrate the use of the theory in development of a framework for the intervention of visual perception. The focus of the IVPF presented here is on the foundation phase learner. However, the same reasoning and principles used can be generalised for use in the development of programmes for different age groups. The theory discussed will include:

- the learner as a developing child,
- the occupation of learning with a focus on cognitive maturation and strategies,
- the learner and visual perception and
- vision and the learner.

The learner as a developing child

Development may be defined as the sequential changes in function that occur with maturation of the individual[13,17,18,19]. Piaget's theory states that there are age appropriate tasks and milestones to be achieved according to the specific age group[13] and that change will take place accordingly in the social, cognitive, affective and physical development of the child. The child will successfully reach the set tasks if the environment, abilities of the child and the tasks that are integral to the occupation of being a learner are aligned in a 'just right' fit as referred to in the Person Environment Occupation model[15]. Should there be barriers in any of the mentioned areas it will have an effect on the next developing stage[18]. Difficulties experienced by the child in mastering basic skills of visual perception needed for making sence of different tasks or experiences required for optimal learning will interfere with the use of information for abstract thinking, reasoning and application.

The child entering the foundation phase of school in the South African school context will typically be in the Early School – to Middle School Year developmental age group[3,5]. Therapists working with foundation phase learners, verbally report in discussions, an increasing underachievement in performance in relation to their peers. The choice of the visual perceptual tasks could be guided by the sequential development trend for activities according to the developmental age, rather than to the chronological age. This enables mastery which will then support 'carry over' into the next development tasks required in academic related activities according to the school curriculum.

The requirements and structuring of activities should enable active participation and engagement of the learner. If the challenge, inherent in the activity, presents a 'right fit' to the child, three benefits should be evident, namely:

- active participation that will encourage active learning[17],
- sustained attention and motivation to continue the experience of participation[17] and
- enablement to face the inherent challenges set by the activity.

O'Brien and Williams[19] suggested that a child's engagement in activity can be improved by involving the child in the selection and design of the activity or task. During the visual perceptual programme that was presented to the experimental and control groups, learners were required to work in pairs for certain activities. During one such activity each learner had to construct a three-dimensional model, using shapes, beads or blocks, behind a screen before revealing their construction to their partner. The learners could use their own initiative in deciding what to build, but were given instructions in terms of the quantity and colour they could use. Both learners were then allowed to observe and memorise the detail of their partner's construction for a specified period of time before they were expected to copy the construction as best they could. On completion of this step the original constructions were revealed, one at a time, and both learners asked to work together to ensure the model was made into a precise replica of the original. Learners were encouraged to do an evaluation of the model, in a sequential manner, from left to right and from top to bottom ensuring that form, colour and space orientation was correct. Active involvement and increased attention was observed as the learner used and developed the skill to match and find differences between models. They were thus identifying mistakes through analysis and making corrections through discussion. Once the learners developed the skill required for quality control, the expectation on speed with which to memorise, duplicate and monitor was increased. The learners were motivated to build a challenge for their peers, participate in the process of evaluation and rebuilding to ensure success. They were also encouraged to give constructive feedback to each other.

As visual perception is a learnt skill the therapist would want to engage the learner optimally in order to encourage repeated participation for further skill development and refinement. The first indicator for a good choice of activity will be interest in the activity, implying readiness for learning[20] and participation, and the second will be the ability to maintain engagement to meet the inherent challenge set by the activity requirements.

The IVPF takes cognisance of the principle that refinement of skills is developmental stage specific[20]. A normal developing child will reach milestones at an age appropriate stage. Age appropriate norms[7,21] thus have to be used to guide clinical reasoning for determining the activity levels that should be included in the programme. Although this line of thinking is aligned with a bottom up approach[19] the developmental system approach should be included to enhance visual perceptual abilities as referred to later in the article under visual perceptual abilities.

The next developmental principle included in the IVPF is that there is a definite sequence in behaviour and that it is species specific[18]. Visual perception follows the same age appropriate tasks and various authors[5,8,9,21] have suggested that there is a sequence in development that is linked with a development age. The refinement of visual perceptual development on a two-dimensional level will be at the middle school year age[19] when learners will be in the foundation school phase. Learners in the Foundation phase do not necessarily

Table I: Developmental age for the critical period for Visual Perceptual skills

Visual Perceptual skill	Development age
Visual Perceptual skill	
Infant uses visual and tactile perception to guide fine motor development and begin to develop an awareness of object placement in space.	During the first 6 Months after birth Some infants match *haptic perception* before 6 months
Infant adjusts the hand in response to object characteristics such as size and shape.	6- 12 months
Child can identify familiar objects by touch	2 years and 6 months
Child shows good haptic perception of unfamiliar objects	5 years
Form and Object Perception Figure ground perception.	
Form constancy	Improves between 3 to 5 years and stabilizes at 6 – 7 years.
Spatial Perception Position in space	Dramatic development between 6-9 years with further refinement at the age 8-9 years.
Spatial Relations	Develops optimally at the age of 7 – 9 years
	Improves until the age of 10+ years.

Source: Adapted from Exner[22:276] and Schneck[23:389]

all master age appropriate skills by the middle of the school year age for various reasons that may include genetic qualities implying poor capacity to conceptualise and learn, deprivation of stimuli, or lack of good role models to enhance the specific learning needed for school tasks. Thus, it is important to follow the sequence for development by grading activity requirements and find the right fit to challenge the learner to develop the necessary skills required for the participation in a curriculum that will be age and stage specific.

The IVPF was developed with an intention to stimulate development as quickly as possible - to enable the learner to be on par and ready for participation in class activities. Therefore the therapist would want to consider the critical period for learning[8] and critical periods for the development of visual- perceptual abilities[8] as shown in *Table I*. These tasks for development of visual-perceptual abilities[21]are proposed as a starting point for intervention, for grading of participation and to set performance goals. The learners will be able to use the visual-perceptual abilities optimally to provide meaning to the self of the learnt opportunities, skills and tasks.

During implementation of the IVPF the therapist will have to give consideration to the influences that shape learning as an essential step. Although each learner will have unique ways of learning, there are general factors to consider during the planning a programme approach; these will be discussed in the next section.

The occupation of learning as a developing child

The occupation of learning implies a cognitive developing process wherein the child engages actively in the tasks that comprise his/her developing occupations. Information and experiences obtained via the senses during engagement in tasks must be conceptualised and stored for future use. Piaget believed that the child organises his/her experiences into mental themes (concepts) through mental operations, referred to as cognitive methods, to make sence of his/her experiences and store it for future use[21]. It is thus essential to select and structure activities in accordance with the operational skills and concepts of the child. By using cognitive strategies of facilitation, awareness and repetition in an integrated visual perception programme, learners should be able to observe more information. The observation of more detailed information will in turn help the learners to connect different observations and information, thus enabling them to analyse and evaluate tasks more appropriately for correctness and task completion. These strategies should be aligned, firstly with the hierarchy of cognitive development as suggested by Piaget and referred to by Case-Smith et al[24:29] as "being from simple to complex; concrete to abstract; from personal to worldly concerns". Secondly, strategies should be considered within the context of the four maturation levels of cognitive function, namely, sensory-motor, pre-operational, concrete operational and formal operational thinking[24:29]. Although Piaget and other researchers[17] have linked the above mentioned maturation levels with specific developmental ages it is more important to identify the maturation level that the learner has reached and matches that with the hierarchy of cognitive levels in order to find a starting point for activities in an integrated visual perception programme. Once a good starting point has been determined, it can be used to grade the activity requirements.

In learning a new skill, intensive intervention can produce positive changes in functional performance. It is not always clear how much intervention is needed to ensure internalised skill development. The duration of the integrated visual perception programme developed for use in the clinical case research introduced earlier was 12 weeks. A recommendation from that study was made that such a programme should be implemented within at least two subsequent school terms. Children learn skills through frequent repetition and practice in various activities[19]. Therapists should thus build sufficient repetition into their programmes to ensure improvement of visual perceptual ability. However, variation in activities that practice the same skill is preferred because learners are motivated by successful participation and the challenge of different activities.

Feedback[25] from peers and therapist encourage and reinforce successful performance. Feedback was given during the IVPP with a "well done"; smile or nod. Positive feedback to learn from was given as follows: "you need to change one block, namely the green one, then your product is completed". Frowning or headshake indicated that there was a mistake. Guiding questions[12] about the task enabled the learner to analyse and identify mistakes. The suggestion is made that feedback should be given in line with Bandura's view on social cognitive learning as referred to in Case-Smith[17].

The therapist can also use incidental learning to enhance motor learning[17] by using a slightly different approach, or to practice an emerging skill during typical activities. For example, learners are generally asked to copy the sequence of beads from a model of strung beads in front of him/her. The direction of the beads can be changed to vertical alignment in order to get a shift of attention and focus to a linear-vertical orientation; also the distance between beads may vary to practice convergence and divergence over a distance, simulating copying from the board.

To enable the learner to develop on a cognitive level, through repetition and active participation in new skills, eye 'warm-up exercises' should be included to focus the movement of the eyes to extract information from the environment (namely convergence, divergence, eye-following, focus, quick localisation and scanning), before the eye movements are utilised in function through participating in a game. A game or activity could be used, for example, a frog leap competition, where a toy frog will be tapped on to jump towards a colour coded goal. The learner that tapped the frog in one leap to reach the goal is the winner. Implicit to the activity is the ability to focus, convergence and divergence of the eyes, shift and focus on a horizontal level. This 'warm-up' activity can then be followed with an activity simulating 'copying from the board'. An example would be to copy a three-dimensional example of something that could be copied on to a piece of paper (two-dimensional) or vice versa. Variation in the types of activities used will give learners the opportunity to practise their skill to utilise eye-movements for information search and use. This skill is transferable to everyday activities as could be seen in the improvement of reading skill of children that were included in the clinical study mentioned earlier[16].

Vygotski stated that the child needs the assistance of another being within a social interaction before the child can mentally process on his own[21]. To develop the learner's cognitive processing the learner could be asked how he/she -would like to approach a task. However, during initial stages of a programme it might work better for the therapist to make suggestions about the best approach to take. Mediation of learning by another can similarly be used to ensure precision and accuracy for task completion. In the activity example presented earlier learners were asked to construct a model (for spatial relationship, sequence and visual memory) and learning was mediated through interaction with peers during task completion and evaluation. During the repeated participation[25] and with increased challenge within the same activity the learner will be able to practice and refine observational, perceptual and cognitive skills.

Case-Smith et al.[24] explained the use of 'scaffolding' as decreasing the amount of input by the therapist and encouraging the learner to formulate questions about the task. Thinking about the best way to go about doing a task will encourage learning that can be internalised through active participation in the learning process[21].

The use of 'shaping' (breaking down complex behaviour into components and reinforcing behaviour individually and systematically until it approximates the desired behaviour) as a behaviour approach can help a child achieve a higher level of skill[24:29]. For example, the activity of copying beads can be broken down into 'eye movement warm-up exercises', doing eye-following, focus and shift of focus. The learner is asked to identify the three colours of the sample beads starting from left to right, using a green coloured bead indicating 'go'. The learner then strings his/her beads and, once completed, is asked to put the string in parallel with the sample to see if the sequence of beads match. The activity requirements can be increased by using more beads or different sizes and shapes, by increasing the level of orientation from near horizontal to far vertical and by increasing the distance from the sample. This is done while the therapist appraises and prompts the learner step by step as the skill to copy develops.

Motivation and interest in the activity is very important for optimal learning[5,25]. The learner will perceive success through his own evaluation of successful performances, feedback, task completion and good outcome. When applying the IVPF it is important to hear the voice of the learner giving his/her evaluation of accomplished success so that the motivation to participate in activities can be internalised.

In selecting cognitive strategies to perform the daily tasks of a learner, the therapist should use the top down approach as presented in Luna's five stage problem-solving structure, as suggested in Case-Smith[24]. These steps include task analysis, anticipation of the difficulties, exploration and selection of task specific strategies, and the application of these, and finally, evaluation of the effectiveness of the activity participation. Such evaluation can be done using cues, prompting, verbal questions (according to Reven, Feuerstein and Haywood as cited in Missiuna et al.[13]) and modelling behaviour. These strategies should not to be used with children younger than 5 years. With them, exploration and modelling behaviour is preferred. Additional cognitive strategies suggested for use in the IVPF are in line with the global execution strategy[13] of "goal, plan, do and check" with the following questions guiding behaviour:

- What must I do (What is the problem)? Do I think I can do it?
- How do I do it?

When you are ready go over into action and "do it".

- The last two questions to be asked: Has the task been completed? If yes, was the task completed correctly?

Check for correctness and ask: Is the end product satisfactory?

The learner might experience stress as a result of the challenge of participating in a learning activity. Successful performance will lead to feelings of mastery but in the process of participation the child may respond with flight or fight reactions that are typical of a stressful situation. These reactions might be mistaken, because of the similarities between these reactions and the behaviour it can be mistaken for. For example when there is a binocularity problem the learner may look out of the window or ask to go to the toilet, or alternatively reveal fight reactions, which can be identified when the child is hyper- focused on information, because he/she is struggling to cope with divergence or with figure ground perceptual problems. The therapist will need to differentiate between the two reactions to be able to adapt activity requirements that enable the right fit for participation of the learner.

Development takes place through maturation and learning, which can be based on observation of role models and from active engagement in the environment. Motor learning theory suggests that children learn more effectively when engaged in the whole activity (dynamic system theory) than with the use of the "bottom up" approach[19], where you start with the underlying components and then work towards function. In support of the dynamic system theory the researcher found that the experimental group, presented with the IVPP that started with warm-up eye exercises, was able to attend to the activity quicker; they scanned more thoroughly for information and focused for longer on the activity to obtain detail information than the control group (where no "eye warm-up exercises" were included). This is in accordance with the opinion of O'Brien & Williams[19] that action and perception is linked and that the rapid accurate perception of a visual component of the environment enables effective planning and execution of associated actions. It seems that the inclusion of "eye warm-up activities", involving similar eye movements to those required in an activity, enabled the learner to engage quicker and to meet the challenge and demands required from two-dimensional tasks simulating the skills that the learner uses in school tasks.

Visual perception is used to create meaning from the observations of the environment made during motion and in stable positions. Sensory integration therapists use the experience from engagement in activities during motion to develop visual perceptual skills. The focus of IVPP that was used in the clinical study was on the development and refinement of visual perceptual skills. The researcher placed learners in the sitting posture at a table as a stable position, because this is the position in which learners typically engage in learning tasks where they are required to write, read, and copy from the board. The learners were not required to sit completely motionless because learners will normally engage in movements on the chair or mat during participation in activity. However, the authors do not suggest that the programme can only be used in a sitting posture. The programme should be used in collaboration with other approaches to intervention.

In the learning process the learner will make sense of the clues in the environment by attributing meaning to the observed clues. This involves an integration of information obtained from the focus on the objects, shapes, orientation and judgement of distance into visual perception that creates meaning of the objects in totality and utilises the information to do tasks that form part of the occupation like reading, writing and copying from the board.

The learner and visual perception

Tasks typically associated with occupations of learners will have a strong focus on the use of different visual abilities to recognise forms, shapes and objects in different orientations and in relation to space thus giving meaning to the visual images before making interpretations and using these in a problem solving manner[8,10,21]. According to Warren[10] these abilities develop in a hierarchy, starting with visual acuity using the visual fields and ocular-motor control to attend and maintain attention before focussing on a stimulus. Scanning for information will enable pattern recognition. These patterns will be memorised for use and stored for further use to enable the learner to understand information and utilise it in every day activity problems to find effective solutions, referred to as visual cognition. Adaptations to activity participation will be guided by vision. This hierarchy is seen during visual motor learning which follows a developmental pattern as shown in *Table II*.

Table II: Developmental age for Visual skills in motor learning

Visual skill	Development age
Vision is important for learning new skills	
Infants begin to move their hands under visual control as they reach for an object	About 4 months
Visio-motor development for accurate reach	Matures by approximately 6 months
Visual-motor coordination continues to refine and the infant guides hand movements using visual-somatosensory integration	Up to the age of 9 months
Horizontal tracking of faster moving targets	Takes longer into adolescence to develop
Ability to track a ball through space and judge its speed and direction	Develops after 12 years of age
Visual acuity is optimally developed and regresses again	18 years

Source: Adapted from Exner[22:276] and Schneck[23:388 -389].

The abilities of visual perception vary in terminology[8,23]. Schneck[23] suggested that the abilities can be broadly referred to as perception of form or space. This differentiation works well because it enables the occupational therapist to decide where the focus for visual perception should be. The learner can have an overall perceptual problem or struggle with either form or space perception. Schneck[7,23] is of opinion that perception of form can include form constancy, visual closure and figure ground perception. Perception of space includes position in space, spatial orientation, in-depth perception and topographic perception. Visual discrimination is seen as the ability to recognise characteristics of shapes to enable recognition, fit (match similarities and differences) and categorising, and is a combination of form and space perception. The skill to discriminate will develop with the ability to attend to information and to memorise the information. In the process of discriminating

between differences and similarities the learner will use recognition, matching and sorting skills[8] and then categorise the information[10]. Naming is a more integrated level of skill that involves language development and integration. Some learners will still experience difficulty in verbally expressing their visual perceptual skills when they are able to non-verbally show evidence of mastering the skills. During the learning process the ability to discriminate between shapes and objects develops in line with cognitive development and is indicated as developing from general to specific, whole to parts, concrete to abstract and from familiar to unfamiliar objects and forms. This trend in developmental grading should be used for each visual-perceptual ability that the occupational therapist develops during intervention.

Very little attention is normally given to the visualisation of people, ideas and objects, but should be seen as the last visual perceptual skill to be reached and used for abstract thinking and memorising information[23]. Visualisation was encouraged in the IVPP developed for use in the clinical trial by asking the learners to close their eyes and to think about the object or task that had to be copied and try to imagine it before attempting to do it.

The optimal time for refinement of visual perception as shown in Table I should be taken into account when developing an integrated visual perception programme. The learner that enters school at the age of six years may experience difficulties in spontaneously reproducing letters and numbers in relation to each other, because of the developmental age of refinement and the critical period of learning for spatial relations that is indicated to be at a later age.

The learner's preference for teaching methods should also indicate the level at which perceptual activities should be presented. The young learner may prefer tactile and kinaesthetic experiences to visual and auditory learning[8,23]. The six to seven year old learner tends to enjoy kinaesthetic, tactile, visual and auditory learning. It can thus be understood why a young learner still wants to play when introduced to pen and pencil activities. Grade 3 learners are visual learners and by Grade 5 between 75% and 90% of learning will take place through the visual system[26].

Table III: Developmental age for Eye Movement Control

Eye movement	Development age
Tracking /Pursuit	
Smooth pursuit of predictable targets	Rapid development in the first 3 months after birth
Tracking occurs with predominant head movement	To the age of 5 years and then refined through early childhood
Tracking slow moving targets	Up to the age of 7 years
Horizontal tracking of faster moving targets	Takes longer into adolescence to develop
Ability to track a ball through space and judge its speed and direction A child in the early school years should be able to move the eyes smoothly in all directions. Horizontal vertical, diagonal and circular.	Develops after 12 years of age
Fixation/Search Movements	
Infants develop the ability to fixate on stationary objects with some degree of control	4-5 Days after birth and during first two postnatal years
Refinement takes place in terms of the search process to determine the nature of the object or figure being viewed. Young children spend as much time on fixating on a target than on off target Older children are more systematic and tend to use more rapid fixations of short duration directed on salient parts of the stimuli to be viewed	3 years and then 6-7 years

Source: Adapted from O, Brien & Williams[19:258-260] and Schneck[23:388].

Vision and the learner

Vision is the ability to see over short and far distances and is referred to as acuity and clarity of sight[5,27]. The ocular motor system enables observation of the environment by aligning the muscles in the eyes to enable a clear image to be observed. Acuity[8,23,26] is measured using a Snellen chart and is indicated according to the distance measured, which is normally six meters. It does not indicate the learner's ability to have a clear image of objects further, nearer, horizontal or in a diagonal plane. In the classroom the learner is expected to do observations from any distance and in several planes. Activities included in an integrated visual perception programme should therefore include observations from any distance and plane.

Vision is a learnt skill, as such it can be developed (according to a trend as indicated in *Table III*) and practiced. Optimal vision is made possible by the ocular-motor system and is referred to as fixations, eye following, saccadic movement, accommodation and binocularity for convergence, divergence and stereopsis[7,8,12,23,26]. There are two types of eye movements that are used to extract information from the environment namely eye following and saccadic eye movement to scan. Eye following is the maintaining of focus on a moving object to obtain a clear image[8,23,26]. These movements are very important to enable the learner to read and maintain the position on the page. Convergence and divergence is used to adapt from far to near and from near to far. All eye movements are done by the six eye muscles thus indicating that these can be practiced and strengthened in the same manner. Should the eyes tire, deep pressure or proprioceptive input by 'palming'[16,26] the closed eyes can release pressure; this is done by pressing the palms of the hands on the closed eyes.

The eyes should be exercised individually and also both eyes together, for all the eye movements and in the different planes[29].

In the process of planning an integrated visual perceptual programme, the following should be considered sequentially:

- The best method that should be used to enable the learners to learn,
- Aspects that will improve visual perception e.g. position in space (the 'what' of visual perception),
- Choice of eye-movement exercises. These should be planned according to a task analysis indicating the type of eye-movements that will be needed for the task. For example, should the task require figure ground perception, the eye movements should include more focus and scanning abilities. When copying from a board, the focus on an object, divergence and convergence should be included.

Because visual perception implies the inclusion of vision, visual perceptual abilities and cognitive abilities all these components should be included in a visual perceptual programme. Therefore, the IVPF proposes the inclusion of developmental principles and trends of development; cognitive development and learning; vision and visual perceptual abilities into the development of a programme (*Table IV*).

Recommendations/summary

Occupational therapists should include eye exercises as integral to activity participation by adapting activities to facilitate optimal visual development of the learner. Developing and enhancing cognitive strategies will further encourage active learning, including the skills needed to generalise into occupational performance – specifically the learner's academic performance.

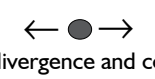
Measurement of outcomes should be supported by the voices of the learners[28]; to include their perception of achievement and performance linked to their school tasks. Perceived Efficacy and Goal Setting (Pegs) and/or an informal interview with open-ended questions could be used to elicit the child's opinion[15]. Field notes can be used to capture the child's experiences and will also give a good indication of when success or failure was experienced.

Table IV: Framework for a visual perceptual integrated programme

1. OCULAR MOTOR EXERCISES TO INCLUDE IN THE WARM-UP EXERCISES

Exercises must be done: First mono-ocular and then bi-ocular

1. Begin with focus on stimuli (use the distance of the child's arm and his thumbs). The focus should be on the thumbs. Start in the midline and the height of the lines and move the thumb slowly towards the eyes / nose and slowly back. Repeat maximum 5 times. A finger puppet or pencil with a target on works well.
2. Do eye following in a linear and circular movements. Use the thumb and the stretched arm from the midline to the shoulder and back. To the left and to the right. ● = midline


divergence and convergence horizontal and vertical


diagonal


circular

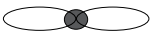


figure 8:

3. Scanning for information at 1 meter distance. Pictures can be put on a poster with a focus in the middle and a picture in each corner. The learner focuses on the middle picture, listens to a question about a certain picture and then finds the information.
4. A pipe with a moving target, or pathways connecting animals, or using a flashlight that the eyes can follow for eye following.

2. ACTIVITIES OR GAMES USING THE SAME MOVEMENT AS THE WARM-UPS AND IN LINE WITH THE TASK THAT THE LEARNER NEEDS TO FOCUS ON

E.g. Should the task be reading, the 3 D activity could be copying beads positioned in a horizontal manner and then vertical plane. Using the direction of work from top to bottom and left to right. Or copying 3 D blocks on a grid.
Analyse the eye movements needed for the tasks and simulate it in your activity requirements.
This enables the learner to practice the skill in an activity through repetition.

3. VISUAL PERCEPTUAL TASKS FOCUS ON A SPECIFIC VISUAL PERCEPTUAL ABILITY

Choose your activity according to the visual perceptual developmental age tasks and the optimal or critical learning period for the specific visual ability.

Grade: kinesthetic experience – 3D to2 D to 2D to 3D and 3D to 2D.
Recognise and identify – match – sort- categorise and name and representation
Simple to complex; from general to specific; whole to parts; concrete to abstract and from familiar to new and unfamiliar objects and forms.

Example of a framework for a 12 week visual perceptual programme for the age 7-9 years.

Session	Visual perceptual ability	Grading
Session 1&2	Form constancy	3D to 2 D Identify. Match and Sort and group
Session 3&4	Figure ground	3D to 2 D Identify. Match and Sort and group
Session 5&6	Position in space	3D to 2 D Identify.
Session 7&8&9	Position in space and visualisation	3D to 2 D Identify.
Session 9&10	Position in space and spatial relations	3D to 2 D Identify. Include part whole perception
Session 11&12	Visual discrimination	3 D and 2D Identify

Cognitive strategies to be included: preferred learning method- Kinesthetic, Tactile, Visual or Auditory; repetition; cues and feedback, questions, verbalisation, visualisation, scaffolding, shaping, modeling of behavior and self evaluation. Top-down approach or a bottom-up approach.

Source: Vlok[16].

The IVPF proposed in this article emphasised that an integrated visual perception programme can contribute to a learner's development and refinement of his/her visual system if it includes components for development of eye movements, visual perceptual abilities and cognitive components. The programme should consider developmental trends to enable the 'just right' fit for the learner and enable mastering of visual perceptual skills through graded activities that provide a challenge for participation. The IVPF is offered as a guideline for clinical reasoning in developing programmes for individuals or groups of learners. The most important principles are that the learner should perceive success in participation in activities and be actively involved to ensure optimal learning for the form and spatial orientated academic task. Seeing will become more meaningful and useful in dealing with every day academic tasks.

References

1. Tiemensma L. The literacy Environment in Support of Voluntary Reading: A Case Study in Gauteng East and the Highveld Ridge Area. 2009: 13. http://uir.unisa.ac.za/bitstream/handle/10500/1738/disertation.pdf?sequence=1 (28 March 2011).
2. Report; Western Cape Education Department: WCED Literacy and Numeracy strategy 2006-2016. 2006: 13-36 http://wced.school.za/documents/literacy_numeracy_strategy/e-LitNumStrat.pdf (28 March 2011).
3. Education for all (EFA): Country Report: South Africa 2009. The Department of Basic Education, Pretoria. 2010: 60. http://www.into.gov.za/view/DownloadFileAction?id=124570 (28 March 2011).
4. Minister of Education. Western Cape Government Announces Steps to Strengthen Numeracy and Literacy Strategy. http://www.capegateway.gove.za/eng/your_gov/3572/news/2010/oct/206230 (28 March 2011).
5. Wait J. Die Middelkinderjare. In Wait J, Meyer JC, and Loxton HS. Menslike Ontwikkeling – 'n Psigososiale Perspektief. Parow-Oos: Ebony Books, 2004: 131-149.
6. Niland B. Improving Literacy and Numeracy. http://www.teacher.org.za/index.php?option=com_content&view+article&catid+7:get-ed. (26 September 2011).
7. Cheatum BA and Hammond HH. Physical Activities for Improving Children's Learning and Behaviour: A Guide to Sensory Motor Development. USA: Human kinetic, 2000.
8. Schneck CM. Visual Perception. In Case-Smith J. Occupational Therapy for Children. Toronto: Mosby, 2001: 382-412.
9. Glutten SY. The Development of a Visual Perception Test for learners in the Foundation Phase. University of South Africa; Thesis, 2009.
10. Todd VR. Visual Perceptual Frame of Reference: An Information Processing Approach. In Kramer P and Hinosja J. Frames of References for Paediatric Occupational Therapy. USA: Williams and Wilkins, 1993: 177-232.
11. Warren M. A hierarchical Model for Evaluation and Treatment of Visual Perceptual Dysfunction in Adult Acquired Brain Injury. American Journal of Occupational Therapy, 1993; 47(1): 42-54.
12. Fishman-Hellerstein L and Fishman B. Collaboration between Occupational Therapists and Optometrists. Journal of Behavioural optometry, 1999; 10(6): 147 – 151.
13. Missiuna C. Malloy-Miller T. and Mandich A. Cognitive or "Top-down", Approach to Intervention. http://canchild.interlunx http://canchild.interlunx.net/KC1997-1.html (II December 2003).
14. Beery K. Beery-Buktenica Developmental Test of Visual-Motor integration. 4th edition of Beery (1997) for Visio-motor integration. Parsipanny, New Jersey: USA: Modern Curriculum Press.

15. Hamill DD, Pearson NA and Voress JK. The Developmental Test of Visual Perception, 2nd edition. Austin, Texas: VSA: Pro-Ed.1993.
16. Vlok ED. 'n Ondersoek na die effek van okulomotoriese oefeninge in kombinasie met 'n visuelepersepsieprogram op die visuele persepsie by sewejarige leerders met visueel-perseptuele Probleme. Werkstuk: Universiteit Stellenbosch: 2005.
17. Case-Smith J. An Overview of Occupational Therapy for Children. In Case-Smith J. and O' Brian JC. Editors. Occupational Therapy for Children. Sixth Edition. USA: MOSBY, Elsevier, 2010: 1-21.
18. Law M, Cooper B, Strong S, Stewart D, Rigby P, and Letts L. The person-environment-occupation model: A trans-active approach to occupational performance. Canadian Journal of Occupational Therapy. 1996; 63(1): 9-23.
19. O'Brien J. and Williams. Application of Motor Control/Motor learning to Practice. In Case-Smith J and O' Brian JC. Editors. Occupational Therapy for Children. Sixth Edition. USA: MOSBY, Elsevier, 2010: 245 – 274.
20. Wait J, Meyer JC, and Loxton HS. Menslike Ontwikkeling – 'n Psigososiale Perspektief. Parow-Oos: Ebony Books, 2004: 1-43.
21. Witthaus S. Enhancing your child's development: You can make a difference. Pretoria: Nassou, 2002.
22. Exner CE. Evaluation and Interventions to Develop Hand Skills. . In Case-Smith J and O' Brian JC. Editors. Occupational Therapy for Children. Sixth Edition. USA: MOSBY, Elsevier, 2010: 276 – 277.
23. Schneck CM. Visual perception. In Case-Smith J and O' Brian JC. Editors. Occupational Therapy for Children. Sixth Edition. USA: MOSBY, Elsevier, 2010: 373 – 403.
24. Case-Smith J, Law M, Missiuna C, Pollock, N. and Stewart D. Foundations for Occupational Therapy Practice with Children. In Case-Smith J. and O' Brian JC. Editors. Occupational Therapy for Children. Sixth Edition. USA: MOSBY, Elsevier, 2010: 22-55.
25. Sullivan KJ, Kantak SS and Burtner PA. Motor learning in children. Feedback effects on skill acquisition. Physical Therapy, 2008; 88: 720 -732.
26. Optometrists Network. Vision and Learning Disabilities. http://www.chirldren-special-needs.org/parenting/learning disabilities.html (7 October 2004).
27. Pelz JB. and Canosa RL. Ocular motor Behaviour and Perceptual Strategies in Complex Tasks. Vision Research. 2001: 42: 3587 – 3596. Optometrist Network. Vision and Reading. http://.children-special-needs.org/vision/esophoria_reading.html (10 December 2003).
28. Kokot S. What's wrong with my child/ Getting to the Root Causes of Learning Difficulties? http://www.ilt.co.za/content.html (24 June 2003).
29. Portwood M. Movement Disorders in early childhood – an epidemic. Dyspraxia Foundation Professional Journal 3:2004. http://www.dyspraxiafoundation.org.uk/downloads/Professional_Journal_Issue_3.pdf (24March 2011).

Based on work completed as part of an M OT at the University of Stellenbosch

❑

Corresponding Author
Elizabeth Daphne Vlok
edv@sun.ac.za