South African Journal for Research in Sport, Physical Education and Recreation, 2011, 33(3): 73-87.
Suid-Afrikaanse Tydskrif vir Navorsing in Sport, Liggaamlike Opvoedkunde en Ontspanning, 2011, 33(3): 73-87.
ISBN: 0379-9069

MOVEMENT PROGRAMMES AS A MEANS TO LEARNING READINESS

Soezin KROG & Deirdré KRÜGER
Department of Further Teacher Education, University of South Africa, Pretoria, Republic of South Africa

ABSTRACT

Movement is a prerequisite for learning readiness. There continues to be growing research that movement and bodywork improve brain function and learning. Learning readiness requires the effective functioning of lower level systems in order for the higher level systems to perform adequately. The aim of this study was to determine whether a specifically designed movement programme, which includes activities for developing the sensory-motor system, can help the educator to improve the child's learning readiness. The systems specified in this study include the vestibular, proprioceptive, tactile, visual and auditory systems. A one-group pre-test/post-test design was selected to obtain data before the implementation of a movement programme regarding Grade 2 learners (N=14) who experienced barriers to learning, as well as to determine the impact of the movement programme. After applying the t-test in the different subtests, no significant differences between the pre-test and post-test were found. However, the significant results that were obtained must be considered with caution because of the size of the sample.

Key words: Movement intervention programme; Learning readiness; Sensory motor system development; Movement and scholastic achievement; Far senses; Near senses.

INTRODUCTION

Early childhood educators need to focus on skills that enable a child to enter into a classroom ready to learn (Diamant-Cohen, 2007). School success seems largely to depend on the child being 'ready to learn'. Movement is also a prerequisite for learning readiness – it provides the basis to help the brain integrate in preparation for academic work (Pheloung, 1997). Movement refers to all human movement, which is affected through the reflexes and by the purposeful use of the muscles. Movement plays a vital role in activating many mental capacities for the reason that it integrates and anchors new information and experiences into the brain's neural networks. The notion of a link between movement and successful learning stems from the work of earlier theorists, such as Delacato (1959, 1974), Cratty (1972, 1973), Kephart (1975) and Ayres (1979). These scholars believed that movement reflects neural organisation and provides the stimulation to neurological systems that are necessary for optimal development and functioning. Learning readiness, therefore, requires the effective functioning of lower level systems in order for the higher level systems to perform adequately (National Scientific Council on the Developing Child, 2007). A weakness in motor development has an effect on perceptual adequacy and conceptual development (e.g., body awareness) and can interfere with a larger area of subsequent and more complex learning (Espenschade & Eckert, 1980).

The neurons in the brain have the ability to make new connections with other neurons and to create new pathways. Plasticity allows a child to form new neurological pathways, for example, changing the way a child holds a pencil. With the help of the educator and repetition, a new way of holding the pencil is practised. Repetition creates additional connections between the neurons and a more secure pathway is established (Leppo *et al*., 2000) which is superimposed over the old pathway (Cheatum & Hammond, 2000).

Movement is seen as the gateway to sensing, acting upon and being affected by the world around us (Goddard, 2002; Clark-Brack, 2004). During the sensory-motor process the far senses (touch, smell, taste, sight, and hearing) and the near senses (vestibular, proprioceptive and tactile systems) are developed through movement. Since Jean Ayres's early findings regarding the role of the sensory-motor system on learning, research that movement and bodywork improve brain function and learning continues to grow (Pheloung, 2006). The body's senses feed the brain environmental information with which an understanding of the world is formed and from which is drawn when learning takes place (Hannaford, 2005).

According to Reber and Reber (2001:602) readiness is defined as the *"state of a person is such that they are in a position to profit from some experience. The type of experience determines the conceptualisation e.g. reading readiness, school readiness or learning readiness".* Learning readiness is thus viewed in this article as the state in which children profit from teaching by learning optimally. The systems specified in this study include the vestibular (balance system – the main coach of the sensory system), proprioceptive (body in space), tactile (touch), visual (seeing) and auditory (hearing) systems. Each has a sensory organ through which information is gained and primary actions are initiated. They depend on each other for interpretation of information and movement. For example, when a child is sitting at the desk and writing, the fixation and movement of the eyes across the paper involves the visual, vestibular and proprioceptive systems. Holding the pencil involves the tactile and proprioceptive systems. Ignoring background noise relies on the auditory system (Cheatum & Hammond 2000). Therefore, the sensory systems have to be in sync to enhance quality learning.

Goddard Blythe (2000) is of the opinion that one has to consider the "ABC" of learning in order to gain optimal learning readiness. The "ABC" stands for Attention, Balance and Coordination, which also vest in the five systems included in this study. Attention depends on the ability to reject irrelevant sensory stimuli such as: background noise; movement within the visual field (someone walking past the open door); and sensations from the muscles and skin (the irritation of the chair or someone standing close to them). Coordination requires the brain to gain control over balance, posture and involuntary movement such as abnormal reflexes. Muscle tone is key to coordination and the result of vestibular functions (Bluestone, 2004). In order for a child to sit or stand still and pay attention, entire muscle groups must work together in co-operation with balance and postural systems (Leppo *et al*., 2000).

Other requirements for learning readiness that flows from the systems included in this study are general spatial orientation (Bluestone, 2004), laterality and directionality (Pheloung, 2006), and midline crossing (Pheloung, 2006). The intricate sensory-motor functioning depends ultimately on inter-hemispheric integration (communication between the left and right cerebral hemispheres of the brain) (Bluestone, 2004).

PURPOSE OF THE STUDY

The general aim of this study was to determine whether a specifically designed movement programme, which includes activities for developing the sensory-motor system, could help the educator to improve the child's learning readiness. The following research questions were formulated:

- What was the motor proficiency level of a chosen group of learners with regards to vestibular, proprioception, tactile, visual and auditory functioning prior to the implementation of the movement programme?
- What were the learners' states of learning readiness according to their academic level prior to the implementation of the movement programme?
- Did a specifically designed movement programme improve motor proficiency, as well as the level of learning readiness as reflected by their academic level?

METHODOLOGY

Research design

This research consisted of a quantitative approach. An experimental design was selected to obtain data before the implementation of the movement programme as well as to determine the impact of the movement programme. A one-group pre-test/post-test design was chosen, which allowed for intensive descriptions and analyses, as well as for an in-depth understanding of the researched phenomenon. The quasi-experimental mode of inquiry was used. This mode is used as it can determine cause and effect if there is direct manipulation of conditions. This means that there was no random assignment of participants. In this study, the Grade 2 class with participants was 'intact' and already organised as a special class. Different teachers were not assigned to this group of learners (McMillan & Schumacher, 2001).

Selection of the sample

This study took place at a selected primary school in the Gauteng Province in South Africa. The participants were selected through convenience sampling on grounds of being accessible as well as being particularly informative about the topic (McMillan & Schumacher, 2001).

From the literature presented, it is noted that children need certain requirements in order to be learning ready. For this reason a specific pre-selected group of children who were experiencing barriers to learning were included in this research. The specific Grade 2 class had a combination of eight boys and six girls (N=14). The group of learners were pre-assigned to the special class on grounds of their academic performance during the first year of school. Some of the barriers which the learners were experiencing were lack of spatial awareness and coordination, problems with laterality and directionality, midline crossing problems, short attention span, and reading and spelling problems (communication with class teacher). The learners were between the ages of 7 to 9.5 years. None of the participants received occupational therapy that could have influenced the results of the research. Their language of teaching and learning was English.

Research hypothesis

There is a significant difference between the pre- and post-test results of a group of learners who participated in a movement programme. The rationale for the hypothesis, already earlier expounded, is that movement is required for the development of lower level functions (vestibular, tactile, proprioception) in order for higher level cognitive functions (i.e., ability to read, spell and calculate) to function effectively.

Ethical measures

Marczyk *et al.* (2005:233) states that virtually all studies with human participants involve some degree of risk. To ensure the protection of the participant's rights, interests and sensitivities, ethical considerations were employed for the duration of the research after ethical clearance was granted. For confidentiality reasons each learner was allocated a number according to the alphabetical class list in ascending order, from one to 14.

Consent to undertake the proposed research study

After permission of the school principal was obtained, we approached the class teacher and the parents or primary caregivers respectively to obtain informed signed consent to proceed with the proposed study. The children were too young to sign assent (agreement to participate); therefore only the consent of parents was considered necessary.

Measuring instruments

The following measuring instruments were included at the pre- and post-intervention stages of the movement programme.

Group Test for 7/8-year-olds to determine intellectual abilities

The test (see Appendix) was selected on grounds of its ability to indicate the general level of a learner's intelligence (IQ) as it relates to learning readiness. The means and K-R 8 reliability coefficients for the proportional sample were all an acceptable 0.85 or higher, for the non-environmentally disadvantaged an acceptable 0.82 or higher and for the environmentally disadvantaged an acceptable 0.72 or higher.

Bender-Gestalt II to determine motor and perceptual development

The Bender® Visual-Motor Gestalt Test (Bender-Gestalt II) measures visual-motor integration skills in children and adults from four to 85+ years of age. The Bender-Gestalt II draws from research developments over the past 60 years and includes a global scoring system. The overall reliability is 0.91 with an average standard error of 4.55 (Brannigan & Decker, 2003). In addition a motor test and perception test was included in the Bender-Gestalt II, which in essence is used to provide the examiner with an additional opportunity for observation of an examinee's performance. It detects deficits in motor or perception skills or both that would adversely affect a subject's performance.

Basic scholastic assessment to determine academic level

The *one-minute tests* were selected on grounds of their ability to test the participant's academic levels in reading of sight words and mathematics (addition and subtraction). These tests were used and re-standardised during the standardisation of the ISGSA (Individual Scale for General Scholastic Aptitude), which was released in 1996. The *UCT spelling test* was used to determine the participants spelling ability. A summary of the scholastic tests used in this study: One-minute reading test; One-minute mathematics addition test; One-minute mathematics subtraction test; and the UCT spelling test.

Movement proficiency assessment

A combination of tests was set up in order to evaluate certain neurological aspects. As this was a motor skills assessment, it required us to rely on our own qualitative observation. To simplify the scoring either "0" (indicating not being able to do the activity) or "1" (able to perform the activity) was used. Learners were afforded three opportunities to execute the task except where otherwise indicated. Other researchers have used the tests (Cheatum & Hammond, 2000). The scale used for the presence of retained reflexes was adopted from the Institute for Neuro-Physiological Psychology (Goddard Blythe, 2006). Knowledge regarding the reflex behaviour is vital as together with the normal development of the child, insight is gained into the motor abilities of the child, which could have an impact on learning (Goddard, 2002).

The tests used to determine neurological functioning were:

(a) Vestibular system - *Manns test, One-leg test, Post rotary nystagmus test (PRN test)*;
(b) Muscle tone;
(c) Proprioceptive system - *Angel in the snow test, Rhomberg test, Reciprocal limitations, Index finger-nose test, Shoulder-level arm raise test*;
(d) Tactile system or tactility - *Skin touch tactile awareness, Object identification test, Traced number identification test*;
(e) Visual system - *Visual fixation test, Binocular fusion test, Visual tracking assessment;*
(f) Reflexes - *Asymmetrical tonic reflex (Schilder test), Symmetrical tonic neck reflex (STNR), Tonic labyrinth reflex (TLR), Head righting reflex (HRR), Moro reflex* (Goddard, 1995; Goddard, 2002);
(f) Auditory system; and
(g) Body awareness - *Body concept test.*

Data collection

Procedure

The procedure followed in order to prepare, conduct pre-tests, provide intervention and final collection of data included the following: (1) initial contact with the school principal and permission; (2) discussion with the teacher and obtaining permission from the teacher; (3) permission letters to parents; (4) pre-testing conducted at school in an individual setting; (5) training of the teacher of the class in the movement programme; (6) 10-week movement programme; and (7) post-testing conducted at school in an individual setting.

Movement programme

The movement programme was designed to incorporate as many activities to develop the sensory-motor systems, which form the basis of numerous neurologically based movement programmes, which are currently offered worldwide: HANDLE (Holistic Approach to Neurodevelopment and Learning Efficiency), the Institute for Neuro-Physiological Psychology (INPP) reflex programme, the Move to Learn programme and the CAN LEARN programme.

The movement programme for this study (see Appendix) was designed for a 10-week implementation period and was offered for 30 minutes a day. The activities were compiled to suit the needs of the group, which were determined after pre-testing. It was based on the developmental sequence of movements through infancy (such as rolling, crawling, kneeling), vestibular functioning, proprioception, crossing the midline, laterality, directionality, inter-hemispheric integration, integrating reflexes, muscle tone, tactility, visual activities (divergence, convergence and accommodation) and auditory development. It was necessary to start on a broad neurological development of movement that included the preceding mentioned aspects. The teacher of the class was present with all the lessons while one researcher attended the lessons twice weekly.

The teacher also concentrated on a variety of visual activities (5 minutes daily) in the class separate to the 30-minute movement programme. The programme was set up in a station format with five stations offered during the 30 minutes. The class first did a warm up activity, after which they were divided into groups. They rotated from station to station on the signal of the teacher. The learners spent an average of five minutes at each station before being signalled to move to the next station. At the end of the lesson the group did one or two activities as a cool down.

The movement programme was divided into various sections. Weeks 1 to 3 were kept more or less the same in order for the children to build a good basis. Thereafter, the programme was made a bit more difficult (weeks 4 to 6). Weeks 7 to 8 built on the previous 2 weeks while weeks 9 to 10 saw a further degree of difficulty. Additional class activities were added to supply children with a break between academic activities.

Scoring

All tests were hand scored. The manuals for the Group Test for 7/8-year-olds, the Bender-Gestalt II and the scholastic tests were used to score each specific test. The movement proficiency assessment was scored according to a self-designed score sheet. The data were scored for both pre- and post-tests respectively. The data were coded specifically to include the raw scores of the above-mentioned tests as well as biographical detail. The raw scores were then transferred to the specially designed data collection forms, which were completed by hand. These forms were scrutinised three times for any possible errors.

Statistical analysis

Parametric and non-parametric paired difference tests were performed on the score-differences of the respondents. The Statistical Analysis System (SAS), version 9.3.1, statistical package was used to this end. The Proc Univariate procedure calculated the required paired difference t-test statistic and associated t-probability for the parametric approach and the Wilcoxon Signed Rank test statistic and associated probability for the non-parametric approach. The probabilities obtained in this way were compared against the general 1 and 5% levels of significance to decide whether pre- and post-treatment levels differed significantly.

RESULTS

The Council of Learning Disabilities (CLD) Research Committee (1993) states that in order to achieve external validity for other researchers to replicate the study, a description of the participants who took part in the research study should be provided (Table 1).

TABLE 1: **DESCRIPTION OF PARTICIPANTS**

Gender:		
Boys		8
Girls		6
Age: Mean		8.07
Race/ethnicity:		
White		10
Black		3
Coloured		1
Social-economic status:		
Middle		10
Low		4
Grade level:	Participants were placed in a special class (January 2010)	
Grade 2		
Location:	All participants were resident in an urban area	
Urban		

Testing the hypothesis

In order to test the null hypothesis the scores of the 14 learners for the pre-test were compared with that of the post-test scores. The data were analysed using the t-test (McMillan & Schumacher, 2001). When a sample is large enough (N>30) the t-test can be used to analyse data, irrespective of the distribution of the population (Ferguson, 1981). Since the sample is only 14 in this instance, the distribution of the population must be taken into account. One cannot be absolutely sure whether the population has a normal distribution with regard to all the variables measured in the present design. According to Mulder (1993), non-parametric tests are used when the researcher is not sure whether the distribution of the population is normal or not. It was, therefore, decided to use a parametric test (t-test) and a non-parametric test (Wilcoxon Signed Rank test) to analyse the data. However, the same results were obtained in both analyses. Consequently only the t-test analysis will be discussed.

The results of the pre-test of the learners before the movement programme was implemented are given in Table 2 and of the post-test, after participation in the programme, are given in Table 3.

TABLE 2: **PRE-TEST MEAN AND STANDARD DEVIATION OF VARIABLES**

Variable	Mean (N=14)	SD
IQ: Group Test for 7/8 year-olds	84.71	10.43
Supplement motor test	11.14	0.86
Supplement perception test	9.86	0.36
One-minute Mathematics Addition Test	7.05	0.33
One-minute Mathematics Subtraction Test	6.96	2.05
UCT Spelling Test	8.08	0.62
One-minute Reading Test	7.35	0.62
Vestibular	1.07	1.33
Muscle Tone	0.64	0.50
Proprioception	9.64	3.03
Tactility	11.07	1.38
Visual	2.29	1.68
Reflexes	10.14	2.26
Auditory	0.21	0.42
Body Awareness	10.07	0.83

TABLE 3: **POST-TEST MEAN AND STANDARD DEVIATION OF THE VARIABLES**

Variable	Mean (N=14)	SD
IQ: Group Test for 7/8 year-olds	83.86	10.45
Supplement motor test	10.43	1.87
Supplement perception test	9.93	0.27
One-minute Mathematics Addition Test	7.72	0.73
One-minute Mathematics Subtraction Test	8.00	0.71
UCT Spelling Test	8.72	0.91
One-minute Reading Test	8.28	0.97
Vestibular	3.71	1.07
Muscle Tone	0.86	0.36
Proprioception	14.93	2.09
Tactility	10.14	0.53
Visual	4.14	1.29
Reflexes	4.79	2.26
Auditory	1.93	0.27
Body Awareness	10.43	1.16

The t-test for dependent groups was then applied to the data in order to determine if the differences between the pre- and post-test results were statistically significant. These t-values, the probability of rejection or acceptance at the 0.01 or 0.05 levels, as well as the difference in means, are given in Table 4.

TABLE 4: **DIFFERENCE BETWEEN MEANS OF VARIABLES, t-VALUES AND PROBABILITY**

Variable	**Mean Diff. (N=14)**	**t-Value**	**Probability**
IQ: Group Test for 7/8 year-olds	-0.86	0.45	p>0.05
Supplement motor test	-0.71	1.33	p>0.05
Supplement perception test	0.07	0.56	p>0.05
One-minute Mathematics Addition Test	0.67	3.85	p<0.01
One-minute Mathematics Subtraction Test	1.05	1.91	p>0.05
UCT Spelling Test	0.64	3.30	p<0.01
One-minute Reading Test	0.93	4.39	p<0.01
Vestibular	2.64	7.74	p<0.01
Muscle Tone	0.21	1.38	p>0.05
Proprioception	5.29	4.61	p<0.01
Tactility	-0.93	2.51	p<0.05
Visual	1.86	4.19	p<0.01
Reflexes	-5.36	6.68	p<0.01
Auditory	1.71	13.68	p<0.01
Body Awareness	0.36	1.44	p>0.05

Analysis of test results

When comparing the mean scores of the two sets of test results, it is noted that in general the averages were higher in post- than in the pre-test. The scoring of the tests would be that the higher the degree of learning readiness, the higher the scores. A higher mean in the post-test could thus mean an increase in the level of learning readiness. However, the exception would be with the scores for reflexes and muscle tone. It must be noted that the means for *Reflexes* for post-testing (Table 3) was lower than the pre-test score (Table 2). This does not mean the learners did not improve after the implementation of the programme. The tests used for reflexes are such that a higher score represents reflexes not yet inhibited and a lower score represents reflexes that have been inhibited. The expectation was to have a lower score, which was the case in the post-test data.

When examining the t-values (Table 4), the null hypothesis is rejected for the following variables:

- One-minute Mathematics Addition Test (t-value=3.85 with p<0.01);
- UCT Spelling Test (t-value=3.30 with p<0.01);
- One-minute Reading Test (t-value=4.39 with p<0,01);
- Vestibular functioning (t-value=7.74 with p<0.01);
- Proprioception (t-value=4.61 with p<0.01);

- Tactility (t-value=2.51 with $p<0.05$);
- Visual functioning (t-value=4.19 with $p<0.01$);
- Reflexes (t-value=6.68 with $p<0.01$); and
- Auditory (t-value=13.68 with $p<0.01$).

In the following instances the null hypothesis is accepted:

- IQ: Group Test for 7/8-year-olds (t-value=0.45 with $p>0.05$);
- Bender-Gestalt II Supplement Motor Test (t-value=1.33 with $p>0.05$);
- Bender-Gestalt II Supplement Perception Test (t-value=0.56 with $p>0.05$);
- One Minute Mathematics Subtraction Test (t-value=1.91 with $p>0.05$);
- Muscle Tone (t-value=1.38 with $p>0.05$); and
- Body Awareness (t-value=1.44 with $p>0.05$).

The adequate functioning of a lower level system, namely the vestibular system has the most influence on the daily functioning of the child (Seaman *et al*., 2003; Kokot, 2006). This could subsequently be the effect of the movement programme on significant results with regards to the difference between the means: vestibular (t-value=7.74); proprioception (t-value=4.61); and reflexes (t-value=6.68). It is noted that no significant difference was indicated in the Bender-Gestalt II (Supplement Motor & Perception Tests) with t-values 1.33 and 0.56 respectively. These particular tests focus mainly on the fine motor and visual perceptual development respectively. Coordination develops through three basic levels, namely reflexes, gross motor and fine motor. Looking at the mentioned results the learners still had to develop considerably more in gross motor before the fine motor would improve. Muscle tone on the other hand depends on the vestibular system generating adequate muscle tone (Van der Westhuizen, 2007). It is thus possible that the amount of vestibular activities included in the programme might not have been enough and the 10-week movement programme should have been extended with a few weeks to improve the muscle tone.

Influence of variables

It is necessary to mention variables, which could possibly have influenced the results of the study.

- Neurological development in each child does not take place at the same time. Each child reaches milestones at his or her own pace.
- The sensory systems also develop according to a hierarchical order. According to Kokot (2003), for a child to experience success in learning, a number of sensory-motor systems need to be functioning well. The results, which do not show a significant difference, could be a result of the aforementioned aspect. It could also relate to disorganisation before reorganisation, which is common in sensory integration interventions (Van der Westhuizen, 2007).
- Maturation may threaten the internal validity of a study (Salkind, 2003) and could have influenced the results.
- Other possibilities, which could have influenced the results, are the effect of the programme over a short time and the absence of a control group.

- Another aspect which could also have had an influence on the findings is the Individual Support Plan (ISP) each child was following in the special class. The class teacher indicated that each learner received additional assistance with certain aspects with which they experienced difficulty in smaller groups of three to four (communication with class teacher).

CONCLUSION

According to the results of the t-test in the different subtests the hypothesis is rejected. It is likely that the movement programme was the variable that contributed to the higher mean scores and the significant t-values. However, the significant results that were obtained must be considered with caution because of the small size of the sample.

Caution should also be applied because movement and learning readiness comprise a number of factors. The battery of tests did not include all these factors that are at play. In addition, movement is a difficult construct to evaluate using objective standardised measuring instruments. The teacher in the classroom, however, found significant improvements. The learners showed improvements in various areas such as crossing the midline, laterality, directionality, spatial awareness, concentration, handwriting ability and language ability. Some of these aspects are considered to be abilities which will only improve once the functioning of the lower systems has taken place, for example, spatial awareness and body awareness are reliant on the effective functioning of the vestibular system.

The results of this research correlate with that of other studies conducted on the effect of movement on learning. Fredericks *et al*. (2006) found similar significant differences in the pre- and post-test results in the academic skills in Grade 1 learners after the implementation of a movement programme. Likewise, in a study conducted by Van der Westhuizen (2007), a significant difference in the levels of concentration of children after the implementation of a movement programme was also found.

REFERENCES

AYRES, A.J. (1979). *Sensory integration and the child*. California, CA: Western Psychological Services.

BLUESTONE, J. (2004). *HANDLE. Intervention in the holistic approach to neuro-development and learning efficiency*. (Second Experimental Edition). Seattle, WA: HANDLE Institute.

BRANNIGAN, G.G. & DECKER, S.L. (2003). *Bender Gestalt II Examiner's Manual.* Itasca, IL: Riverside.

CHEATUM, B.A. & HAMMOND, A.A. (2000). *Physical activities for improving children's learning and behaviour*. Champaign, IL: Human Kinetics.

CLAASSEN, N.C.W. (1993). *Revised norms for the Group Test for 7/8-year-olds*. Pretoria: Human Sciences Research Council.

CLARK-BRACK, J. (2004). *Learn to move, move to learn! Sensorimotor early childhood activity themes*. Shawnee Mission, KA: Austism Asperger Publishing Company.

COUNCIL OF LEARNING DISABILITIES (CLD) RESEARCH COMMITTEE (1993). Minimum standards for the description of participants in learning disabilities research. *Journal of Learning Disabilities,* 6(4): 210-212.

CRATTY, B.J. (1972). *Physical expressions of intelligence*. Englewood Cliffs, NJ: Prentice-Hall.

CRATTY, B.J. (1973). *Movement, behaviour and motor learning*. London: Henry Kimpton.

DELACATO, C.H. (1959). *Treatment and prevention of reading problems: The neuro-psychological approach*. Springfield, IL: Charles C. Thomas.

DELACATO, C.H. (1974). *The diagnosis and treatment of speech and reading problems*. Springfield, IL: Charles C. Thomas.

DIAMANT-COHEN, B. (2007). First day of class. The public library's role in "School Readiness". *Children and Libraries,* Spring Issue: 40-48.

ESPENCHADE, A.S. & ECKERT, H.M. (1980). *Motor development*. London: Merrill.

FERGUSON, G.A. (1981). *Statistical analysis in psychology and education*. London: McGraw-Hill.

FREDERICKS, C.R.; KOKOT, S.J. & KROG, S. (2006). Using a development movement programme to enhance academic skills in grade 1 learners. *South African Journal for Research in Sport, Physical Education and Recreation*, 28(1): 29-42.

GODDARD, S.A. (1995). The role of reflexes in the development of the visual system. *Journal of Behavioural Optometry,* 6(2): 31-35.

GODDARD, S.A. (2002). *Reflexes, learning and behaviour: A window into the child's mind*. Eugene, OR: Fern Ridge Press.

GODDARD BLYTHE, S.A. (2000). Early learning in balance - Priming the first ABC. *Support for Learning*, 15(4): 154-158.

GODDARD BLYTHE, S.A. (2006). "The INPP school programme." *The Institute for Neuro-Physiological Psychology*. [http://www.inpp.org.uk]. Retrieved on 02 May 2006.

HANNAFORD, C. (2005). *Smart moves: Why learning is not all in your head*. Salt Lake City, UT: Great River Books.

KEPHART, N.C. (1975). *The slow learner in the classroom*. Columbus, OH: Merrill.

KOKOT, S.J. (2003). A neurodevelopmental approach to learning disabilities. In D. Montgomery (Ed.), *Gifted and talented children with special educational needs: Double exceptionality* (11-24). London: David Fulton.

KOKOT, S.J. (2006). Movement and learning. Manual 1. Integrated learning therapy training. Unpublished manual. Cape Town: Integrated Learning Therapy Centre.

LEPPO, M.L.; DAVIS, D. & CRIM, B. (2000). The basic of exercising the mind and body. *Childhood Education,* 76(3): 142-147.

MARCZYK, G.; DEMATTEO, D. & FESTINGER, D. (2005). *Essentials of research design and methodology*. Hoboken, NJ: Wiley & Sons.

MCMILLAN, J.H. & SCHUMACHER, S. (2001). *Research in education - A conceptual introduction.* (5th ed.). New York, NY: Longman.

MULDER, J.C. (1993). S*tatistical techniques in education*. Pretoria: HAUM Tertiary Publishers.

NATIONAL SCIENTIFIC COUNCIL ON THE DEVELOPING CHILD (2007). "The timing and quality of early experiences combine to shape brain structure." Working Paper 5. Hyperlink [http://www.developingchild.net]. Retrieved on 18 February 2009.

PHELOUNG, B. (1997). *Help your class to learn: Effective perceptual movement programs for your classroom*. Sydney (Australia): Griffiths Press.

PHELOUNG, B. (2006). *School Floors: Effective perceptual movement programs for your classroom.* Sydney (Australia): Iceform.

REBER, A.S. & REBER, E.S. (2001). *The Penguin dictionary of psychology*. London: Penguin Books.

SALKIND, N.J. (2003). *Exploring research.* Engelwood Cliffs, NJ: Prentice Hall.

SEAMAN, J.A.; DEPAUW, K.P.; MORTON, K.B. & OMOTO, K. (2003). *Making connections: From theory to practice in adapted physical education.* Scottsdale, AZ: Holcomb Hathaway Publishers.

VAN DER WESTHUIZEN, B. (2007). An ecosystemic approach to addressing attentional difficulties and heightened motor activity. Unpublished D.Ed. Dissertation. Pretoria: University of South Africa.

APPENDIX

Tests

Group Test for 7/8-year-olds to determine intellectual abilities

The test consists of six subtests (comparison, mazes, verbal comprehension, figure classification, number comprehension and pattern completion) and a maximum raw score of 50 is attainable. Guessing can probably influence the score to an appreciable extent in only 16 of the items (Claasen, 1993). The norms were revised in 1993. Norms are given for English- and Afrikaans-speaking learners, the non-environmentally disadvantaged and the environmentally disadvantaged.

Bender-Gestalt II to determine motor and perceptual development

It utilises 16 stimulus designs which examinee's have to first copy and then recall from memory. The aim of the test is to obtain more refined measurements of simple motor and perceptual abilities in order to provide the examiner with information of the performance of controlled motor and perceptual tasks.

<u>Vestibular system</u>

Manns test: This test requires the child to stand on a straight line with the heel of one foot against the toe of the other foot. This test is conducted with eyes open and then eyes closed.

One-leg test: The child has to stand on his or her preferred foot, with the opposite leg bent at the knee and his or her eyes opened then closed. Repeat this on the non-preferred foot, eyes open and eyes closed.

Post rotary nystagmus test (PRN test): This test measures the length of time nystagmus lasts following rotation of the child. The child sits in a chair with the head slightly bent toward the chest. He or she is then rotated 10 complete turns in one direction for 20 seconds. Once the rotation has stopped the child's eyes are checked for movement. After a 2 minute rest the child is rotated in the opposite direction. The examiner must take note of the following: after the rotation, if the vestibular system is functioning normally the nystagmus will last for 7 to 14 seconds. Anything below is considered hypo vestibular (below normal = 0) and anything above is hyper vestibular (which also obtained 1). This exercise was executed once.

<u>Muscle tone</u>

In order to assess this aspect the child needs to lie down on the back and lift the legs for 10 seconds. If the legs bob up and down it is an indication of poor phasic muscle control and if the legs do not bob up and down, the child has good phasic motor control.

<u>Proprioceptive system</u>

Angel in the snow test: The child is placed on the back on the floor with the midline along a straight line. The examiner must then give the child an indication of which limbs to move (e.g., both arms and legs, both arms, both legs, left arm). The examiner observes if the learner can follow the instructions (scores 1) or cannot follow the instruction (scores 0).

Rhomberg test: This test requires the child to assume a standing position, with both feet together, the arms relaxed at his or her side, and the eyes closed. The examiner has to observe if the participant can maintain balance (scores 1) or if there is weaving back and forth, lifting or moving of feet, and lifting or moving one or both arms (scores 0).

Reciprocal limitations: The child is requested to imitate the examiner's movements for example, open one hand while closing the other hand, turn the palm of the hand down while the other one is up, raise the one while lowering the other. Observation was made if the child could or could not do the skill using the same side as the examiner. Confusion with regards to left and right (diagonal laterality) is prevalent in this activity.

Index finger-nose test: This is completed standing with both arms raised to shoulder level and extended to straight out to the side. Using the index finger of the preferred hand the child touches the nose then returns the arms to starting position. This is alternated to the non-preferred side as well.

Shoulder-level arm raise test: The test requires the child to close the eyes and raise the preferred arm to shoulder level, placing it there 4 times in a row. The child has to repeat it with the non-preferred arm as well (1 for raising both arms to shoulder level). Varying heights of the arm indicate a problem with body schema or body awareness. Hannaford (2005) states that proprioception contributes to the development of a physical sense of self or body awareness – the internal awareness of the body parts, which we also assessed separately.

<u>Tactile system or tactility</u>

The child is blind folded. The examiner applies light pressure with a pen to different parts of the body. The child has to indicate where the examiner has touched (1 for indicating all the body parts correctly). This exercise was executed once.

The *Object identification test* enables the examiner to test the child's ability to identify an object by feeling it. The child is blind folded and familiar items are placed on the table which the child has to identify.

The *Traced number identification test* is used to determine if the child can identify numbers between 0 and 9 which are traced on various parts of the body, also referred to as graphesthesia. The child is blind folded.

<u>Visual system</u>

The *Visual fixation test* is used to check fixation by holding a pencil about 20cm in front of the child's nose. The child is required to look at it for 10 seconds without blinking the eyes or changing the position of the head.

The *Binocular fusion test* consists of asking a child how many pencils are seen when 1 is held in front of the eyes. The eyes are supposed to fuse the images received from both eyes into a single image.

The *Visual tracking assessment* consists of the examiner holding a pencil in front of the child's nose and moving it horizontally in front of the nose to the other side of the face. The child has to follow the pencil with the eyes only. This activity is repeated back and forth 15 times horizontally as well as vertically.

Reflexes

The assessment of possible retained reflexes was conducted according to selected battery tests with regards to the asymmetrical tonic reflex (Schilder test), the symmetrical tonic neck reflex (STNR), the tonic labyrinth reflex (TLR), the head righting reflex (HRR) and the moro reflex (Goddard, 2002; Goddard, 1995). The scoring of each reflex varied from 0 to 4 depending on body movements.

Auditory system

One simple screening procedure was used to evaluate the child for possible auditory problems as rhythm can provide an indication of auditory processing. The child is required to tap a sequence with both hands on the table, which the examiner demonstrates while the child watches. Sequences of 1,2; 2,3,2; and 3,2,3 are used. The child has to close the eyes while performing the activity.

Body awareness

A simple test (the *Body concept test*) was chosen to determine if the child was knowledgeable about the various body parts. It requires the child to point to the body part that has been called out.

Detailed movement programme for weeks 1–10

Weeks 1–3 (Stations) Heel-toe walking forward & backward on rope; Stepping over rope crossing midline; Rolling; Climb through a series of hoops; Clapping game ***Cooling down all in one group*** Clapping game; Rhythm skipping ***Class activity*** Eye activities; Crumple papers	**Weeks 4–6 (Stations)** Walk on balance beam; Rolling & gliding; Stepping onto and off chair; Roll back & sit up; Clapping game (integrate left & right) ***Cooling down all in one group*** Rhythm skipping; Speed stacking relays ***Class activity*** Eye activities; Speed stacking
Weeks 7-8 (Stations) Rolling, gliding, leopard crawl, flip flops; Hoop series; Beanbag throws; Speed stacking (4x3); Walk on low beam and step over bean bag carry on walking ***Cooling down all in one group*** Clapping game; Rhythm skipping ***Class activity*** Eye activities; Tactile activities	**Weeks 9–10 (Stations)** Rolling, gliding, leopard crawl, flips flops, crawling, rocking, cross pattern walking; Beanbag throws; Speed stacking (4x3); Walking on low beam forward & backward; Climbing over a low pole ***Cooling down all in one group*** Rhythm skipping; Speed stacking relays ***Class activity*** Eye activities; Tactile activities

Prof. Deirdré KRÜGER: Department of Further Teacher Education, University of South Africa, PO Box 392, Pretoria 0003, Republic of South Africa. Tel.: +27 (0)12 4294520, Fax.: +27 (0)12 3453568, E-mail: kruged@mweb.co.za or kruged@unisa.ac.za

(Subject Editor: Dr. K.J. van Deventer)