1. Using a developmental movement programme to enhance academic skills in Grade 1 learners

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Abstract

The effects of movement on academic performance and cognitive development is often underrated. Many theorists argue for the importance of movement to be recognized because there appears to be an elaborate interplay of brain and body.

Brain research has shown that the brain is "plastic" in that it can adapt continuously, and its structure can be changed by certain kinds of stimulation, including movement.

The body is a sensory-motor response system that causes the brain to organize itself. Movement is essential to learning and can be regarded as the door to learning. This article reports on a developmental movement programme which was established to determine whether movement would enhance the academic skills of Grade 1 learners.

Four groups of learners were used in this research project.Learners were randomly selected for one of the following groups: the experimental, control, free-play or educational toys group.The results of the pre-testing and post-testing indicate that the learners of the experimental group showed a significant improvement in spatial development as well as in reading and mathematical skills, compared to the learners in the control group, free-play group and educational toys group.

Key words: Movement programme; Academic skills; Cognitive learning; Physical activities; Development.

Introduction

The benefits of physical exercise for fitness and health are seldom questioned. More controversial is the debate around the impact of movement on the academic performance and mental development of young children. Research does not consistently show that movement programmes have a positive effect on learning, so the schools do not have a clear mandate in this regard.

The result is that physical education is often seen as a frill, and has been discontinued in many South African schools, which might be a misguided kind of thinking (Summerford, 2001: 6). This research is an exploratory investigation into the efficacy of a movement programme on the academic skills of Grade 1 learners.

BRAIN DEVELOPMENT AND LEARNING: THE ROLE OF MOVEMENT

The link between movement and successful learning stems from earlier theorists such as Kephart (1975), Ayres (1979), Cratty (1972; 1973) and Delacato (1959; 1974). They believed that movement reflects neural organisation and provides the stimulation to neurological systems that is necessary for their development and optimal functioning. In more recent years, many theorists reflect these views.

Pica (1998: 18) and De Jager (2001: 8) agree that we consider the brain and body as a united whole.The more closely we consider the elaborate interplay of brain and body, the more clearly we see that movement is an integral part of all mental processing.Every movement is a sensory-motor event, linked to our understanding of our physical world, from which all learning derives (Hannaford, 1995).

The explosion of brain research supports these theories. Examples include the work on nerve growth factor for which Rita Levi-Montcalcini won the Nobel prize in 1986; Changeux and Conic (1987), whose work provided evidence that movement is necessary for neural growth, and Ito (1984; 1987), who found that stimulation of the vestibule-ocular reflex arc resulted in changes to the structure of the cerebellum.

Further brain research has shown quite conclusively that the brain is “plastic” in that it can adapt continuously, and its structure can be changed by certain kinds of stimulation, including movement (Thompson, 1996; Gold, 1997; Robertson, 2000; Berthoz, 2000; Stiles, 2001 and Le Poncin cited in Kokot, 2003a: 45).

These findings mean, in effect, that the body, as a sensory-motor response system, causes the brain to learn and thus to organise itself, rather than the other way around (Kokot 2003a: 45).

Piaget (1952) called the first stage of intellectual development the sensorimotor stage, when children experience the world primarily through their senses and motor abilities. This forms the bedrock on which the subsequent hierarchy of all intelligence is built.

Randolph and Heiniger (1994: 21) explain that children learn from the inside out – first through experiencing their own bodies and then from their own bodies in relation to the rest of the world. Hannaford (1995: 12) states that movement activates the neural wiring throughout the body, making the whole body the instrument of learning.

Black (1995: 33) reports that good physical education programmes can boost academic achievement and feels that children may be learning more in physical education classes than anyone ever imagined. Black (1995: 34) concludes that schools that insist that children sit still for most of the day deny the connection between movement and learning.Maude (2001: 49) found indications that early movement served as the springboard for learning language.

Summerford (2001), who also studied the impact of movement on learning, based her initial conclusions on a research study with mice. These findings built on earlier work showing that exercise boosts the number of brain connections in the hippocampus, the part of the brain known to be centrally important to learning and memory. Associated work suggests that similar mechanisms may operate in humans (Summerford, 2001: 7).

While these studies report positive findings, it is necessary to consider the content of movement programmes or the type of movement programme that is used to stimulate brain function. A study by Longhurst (2002) found that a regular physical education programme made no significant difference to the motor proficiency or academic performance of learning-disabled children, while significant improvements in both areas were noted in groups of children engaged in sensory-and perceptual-motor programmes.

With this in mind, the nature and quality of movement programmes in early childhood education should be evaluated. Consideration has to be given to what is being done, because (at present) there is no single recipe for best practice in early childhood physical education (Campbell, 1997: 37) or other movement programmes.

A LACK OF MOVEMENT: THE KEY TO UNDERSTANDING LEARNING RESTRAINTS

Learning restraints have been the subject of much research in many disciplines, but no single cause has as yet been found.There is some evidence that a lack or insufficient degree of movement during a child's developmental stages may contribute to or underlie most learning restraints (Pheloung, 2003: 53). This includes the view of Goddard-Blythe (2000: 156), who believe that attention (A), balance (B) and coordination (C) constitute the primary ABC upon which all later learning depends.

If these skills are not developed at the time that children enter school, children run the risk of later developing specific learning difficulties, not because they lack intelligence, but because the basic systems fundamental to learning are not fully in place at the time they start school. Movement that is meaningful for development will ensure that these skills develop.

Spatial awareness, which is needed for school readiness, is reliant on healthy gross motor development (Corso 1993). Until children have had experience orienting their bodies in space by moving up, on, under, beside, and in front of things, it is possible that they will have difficulty dealing with letter identification and the orientation of symbols on a page (Olds 1994: 33). Olds' research revealed that 98% of 500 children who had been identified as being learning disabled were also characterised as being physically clumsy.

Difficulties with eye convergence leading to reading problems are possibly the result of neurological disorganisation particularly related to vision, and arise because of underlying movement problems (Hager, 2000). Hager (2000) concludes that movement is necessary to stimulate the brain's ability to take in, process and store information well. Movement is seen as essential to strengthening short-term memory, long-term memory, as well as cortical hemispheric dominance.

MOVEMENT AS A REMEDIAL MEASURE

Studies using movement to remediate learning difficulties have been few and show conflicting results. Bass (1985: 160) found that running or jogging is an effective treatment for children's behavioural and learning difficulties.

Bass (1985: 160) cites other studies documenting the effects of exercise on learning, including Young (1978), who correlated physical activity with improvement in test scores of intelligence, brain function, speed of performance, memory, and learning; Elsom (1981), who found that jogging improved the visual and auditory attention span and decreased the hyper behaviour of hyperactive boys and Evans (1981), who noted that adolescents decreased their talking-out behaviour in class and completed more written assignments after running treatments.

Goddard-Blythe and Hyland (1998) demonstrated the positive effect of movement in addressing specific learning difficulties that have their origin in neurological dysfunction. Hotveldt (2001) also found movement to be an effective remedial measure and the more movement she included in daily lessons, the more attentive the learners were.

Jensen (1998: 87) writes: "Give a school daily dance, music, drama and visual art instruction where there is considerable movement and you might get a miracle".

On the other hand, Corrie and Barratt-Pugh (1997: 30) report on studies showing that certain perceptual-motor training was not an effective intervention technique for academic, cognitive or perceptual-motor variables. The results show little effect in any developmental domain, even on children's gross motor skills.

Furthermore, the programmes made little difference to the reading, arithmetic, language or spelling of children with learning difficulties or of normally developing children.However, even though it may initially seem that Corrie and Barratt-Pugh (1997) do not accept the theory that movement leads to learning, they do state that it is not the importance of perceptual-motor development that is disputed, but the way of supporting and facilitating that development that is critical.

This gives rise to the question: "What should a movement programme contain?" It seems that physical education programmes need to be far more than mere physical fitness activities (Feigley, 1990: 20) or preparation for sporting proficiency.

MOVEMENT TO ADDRESS THE ROOT CAUSE OF LEARNING DIFFICULTIES

The design of a movement programme should be guided by knowledge of the root cause of a learning problem. This reduces the "shotgun" approach to symptomatic behaviours or difficulties with learning, and characterises the approach followed by the HANDLE® Institute, based in Seattle in the United States of America.

HANDLE practitioners focus on the underlying causes of learning and other neurodevelopmental problems, rather than the behavioural symptoms. For example, it may be necessary to understand why a child with attention problems blocks certain types of stimulation (such as the voice of an adult) and seeks others (such as constant movement) and why he or she has difficulty adjusting attention flexibly enough to meet certain demands of the environment and not others (such as being able to fixate on a computer screen, but not on an academic task).

For a child to experience success in learning areas, a number of underlying sensory-motor systems have to be functioning well.

If the vestibular, proprioceptive, tactile, visual and/or auditory systems are malfunctioning, they will fail to support the child's attempts to learn academic work, sit still, pay attention, complete tasks and learn appropriate social behaviours (Kokot, 2003b: 15).

These sensory systems develop according to a hierarchy.Success on one level is necessary for success on the next. Therefore, if any of these developmental steps have been interrupted or skipped, it is likely to affect the degree to which the child experiences academic success.

An assessment is done to determine which sensory systems are "faulty". Once these systems have been identified, an individualised programme of both active and passive activities is designed for the learner in order to rehabilitate the "weak" systems (Kokot, 2003a: 47). This is a holistic approach and while other factors are also taken into account, movement forms an integral part of the support given to the learner.

Tony Hager, a trained neurodevelopmental specialist and founder of CAN LEARN, agrees that movement is the key to overcoming learning disabilities and foresees a bright future for learning-impaired children if the core problem is treated, rather than the symptoms (Hager, 2000).

Movement as a means of adjusting the underlying systems that support learning is also the premise of Brain Gym (Dennison & Dennison, 1989). The Brain Gym activities were created to either stimulate (lateral dimension), release (focusing dimension), or relax (centring dimension) individuals involved in particular types of learning situations. Brain Gym does not attempt to diagnose any ailment or impairment, but some of the movement activities are similar to those used in the HANDLE approach and those proposed by Hager (2000).

The Movement Programme

In accordance with the literature and the experience of the researchers that certain therapeutic movement programmes bring about rapid and lasting improvements in children's ability to concentrate and learn, it was decided to design and implement a specific movement programme, and evaluate its effect on a class of Grade 1 learners as an exploratory study in a single school.

METHOD

A detailed 10-week programme comprising 20 minutes per weekday of highly specific, developmental movements was designed by Professor Kokot of the University of South Africa (Unisa). The activities were drawn from those included some used by the HANDLE approach, others used by Hager (2000), and yet others drawn from perceptual-motor and sensory-motor programmes.

The exercises were designed to focus on the following: the developmental sequence of movements through infancy, midline crossing, balance, proprioception, laterality, interhemispheric integration, vestibular work, convergence, divergence, visual accommodation, integrating reflexes, listening ability, muscle tone and tactility.

The nature of the exercises ensured that more than one of the preceding aspects would be addressed during the duration of the particular activity.

PROGRAMME DESIGN

The following is an example of a single day's programme used during weeks 1-5:

<u>Tuesday (Week 4)</u>

1. Warm-up activity
2. Flip-flops
3. Beanie back-roll
4. Side-to-side tips
5. Quarter-turn roll
6. Ball throw and tap (modification of the clapping game)
7. Accentuation hop (left, left, right)
8. Animal-walk exit

Each day's programme began with a warm-up activity. (Discretion could be used in the choice of the warm-up activity from a given list of activities).

The format of the programmes for weeks 6-9 was different. During this time the group was divided into three smaller groups each day and each group would, after the warm-up activity, work at a different workstation. The groups would rotate, so that each group spent approximately 5 minutes at each workstation. Different activities were prescribed for each day of the week.

The following is an example taken from week 7:

(Tuesday)

Station 1: Low walking boards

Equipment: Place a low board (balance-beam, plank, two strips of tape, or two lines of chalk, about 10 cm apart) on the floor.

(A) Children walk across, with eyes focused on teacher's hand (held at a comfortable distance in front of the eyes).

(B) On the second time around, those children who manage this easily, may be given an obstacle to step over halfway along the walk (e.g. another child may hold a stick, broom handle, etc. in the way at a height of about 15 cm).

(C) On the third time around, able children may balance a beanbag on their head, as they walk – and step over the obstacle.

Station 2: Obstacle course

Equipment: Mats, two cross-bars and hula hoop

(A) Children jump over cross-bar from a stationary position. (Bar may be supported by small chairs.)

(B) Crawl under low cross-bar. (Child should be close to the ground.)

(C) Crawl through the hula hoop without touching any part of it with body.

On subsequent turns, the child may be challenged to find a different way of moving through the obstacles. The teacher may also hold the hula hoop in different positions.

Station 3: Ball-bouncing with hoops

Equipment: Ball and 5 hula hoops.

(A) The child bounces and catches the ball once in each of the five hoops, followed by a jump into each of the hoops.

(B) The child hops through the hoops on one foot and bounces the ball into each hoop. (The bouncing of the ball into the hoop precedes the hop.)

Emphasise: The child bounces the ball into the hoop, followed by a jump into the same hoop. Both feet leave the ground at the same time on each jump. Eyes focus on the ball with hands and fingers forming a pocket to properly catch the ball. Exit hall with cross-patterned walk, touching each knee with the opposite hand.

The activities prescribed for week 10 were similar in format to those used in weeks 1-5.

PARTICIPANTS

The school at which the programme was tested had four Grade 1 classes. The division into experimental group, control group, free-play group and educational toys group was done randomly. There were 58 learners in total in the four classes, but not all 58 were included in the results.

Some learners were absent on the day of the pre-testing so, although they participated in the programme, they were not included in the findings. The following frequency table gives the biographical information of the participants in this study:

Table 1: Frequency table of biographical information

Gender	Boy Girl	23 30
Group	Experimental Control Educ. toys Free-play	13 13 14 13
Language	English Afrikaans Other	42 6 5
Age/month	Up to 5.5 years >5.5 to 6.5 years >6.5 years	16 20 17

Procedure

Step one

A seminar was held with the teachers to introduce the project, clarify their involvement in the project and ensure that the staff members responsible for the programme (an occupational therapist and Grade 1 teacher) were knowledgeable about the significance and specific aspects of the different movements/activities.

The exercises were taught to and practised by these two staff members. The four groups were identified as well, namely

- a free-play group (play), where the children were allowed to run and use playground equipment such as jungle gyms, etc.
- an educational toys group (toy), where the children were contained in their classroom, but allowed to use table-top educational games.
- a control group (cont), which followed the normal school curriculum
- an experimental group (exp), which followed the movement programme

Step two

Pre-testing of each of the learners in the four groups was performed. The learners were assessed on the following:

- the Aptitude Test for School Beginners (ASB). This test comprises 8 sub-tests, namely perception, spatial, reasoning, numerical, Gestalt, co-ordination, memory and verbal comprehension
- reading age
- maths age
- draw-a-person (DAP) (for emotional indicators)

The teacher of each class also performed qualitative observation.

Step three

The programme had to be done on a daily basis and one of the researchers involved in the project was assigned the task of overseeing the correct implementation of all the prescribed movement activities.

Step four

Owing to interruptions at the beginning and end of the 10-week term, it was only possible to run the programme over eight weeks. After the eight weeks each learner was reassessed (post-testing) on the eleven quantitative aspects referred to under step two.

Step five

The results of the pre-tests and post-tests were compiled in order to be able to conduct different statistical analyses.

Statistical analysis and findings

The statistical analysis sought to answer the following questions:

- Would there be any significant difference in the “before” and “after” performance scores of the learners after participating in their respective groups (i.e. the free-play, educational toys, control or experimental groups)?
- Would there be an improvement in their scores after having participated in their respective groups?
- If any improvement was evident, was the improvement meaningful?
- Did age, language, group and/or gender influence any meaningful improvement that may exist?

In order to answer the above-mentioned questions, it was necessary to start by converting all the scores obtained with the pre-testing and post-testing for the different tests, to a percentage. Creating such a uniform scale allowed for comparisons to be made between the different test measurements.

The next step entailed calculating means, standard deviations and means according to the biographical factors for each of the 11 test measurements. This was done with the pre-test and post-test scores.

At this point a possible tendency was noted, but at this early stage no conclusion could be drawn in respect of meaningful differences. These observations (listed in Table 2) were merely descriptive and informative.

Table 2: Pre-test and post-test: Means, standard deviations and mean differences

	Pre-test MEAN	Post-test MEAN	Paired-diff t-test: Mean difference	SD	Significance
Apt 1	97.74	98.30	0.57		
Apt 2	76.42 a	83.40 b	6.98	18.25	**
Apt 3	91.13 a	95.28 b	4.15	9.29	**
Apt 4	80.94 a	87.55 b	6.60	16.75	**
Apt 5	87.92	86.13	-1.79	11.15	
Apt 6	75.35	77.67	2.33	16.14	
Apt 7	93.02 a	96.79 b	3.77	19.67	*
Apt 8	72.17 a	83.54 b	11.41	10.02	***
Draw	69.51	66.87	-2.64	11.71	
Read	82.04 a	86.25 b	4.21	2.68	***
Maths	85.96 a	91.87 b	5.91	3.43	***

Apt = Aptitude test
Significance associated with test:
0.0001 or 0.1%: ***
0.05 or 5%: **
0.1 or 10%: *

In Table 2, for each of the seven performance tests where a significant difference in the means was observed, the performance measurement is indicated as an improvement.

In order to confirm these noticeable tendencies seen in Table 2, the next step entailed calculating the difference between the "before" and "after" testing for each learner. These differences were tested by means of a parametric and non-parametric test. The tests that were used were the paired-difference t-test and the Wilcoxon Signed Rank Test.

When making use of a paired-difference t-test, a normal distribution of observations is a prerequisite and this requirement was met. The two tests would test the null and alternate hypotheses:

- *Null hypothesis:* The mean difference between the "before" and "after" scores for each of the eleven performance tests does not differ significantly from zero.
- *Alternate hypothesis:* The mean difference between the "before" and "after" scores for each of the eleven performance tests differs significantly from zero.

Only the significant findings for the two tests are given in Table 3.

Table 3: Paired-difference T-Test (Parametric) and Wilcoxon signed rank test to test

Ho:µd = 0 against Ha:µd * 0

	Student's t	P(t) > ltl & Significance	Conclusion	Wilcoxon (S) Signed Rank Test	Pt(s) > lSl & Significance	Conclusion
aptdiff	2.79	0.007	Average mean diff is	191.5	0.003	Average mean

2		**	sign different from zero (Pre-post differ)		**	difference is sign different from zero (Pre-post differ)
aptdiff 3	3.25	0.002 **	Average mean diff is sign different from zero (Pre-post differ)	129	0.001 ***	Average mean difference is sign different from zero (Pre-post differ)
aptdiff 4	2.87	0.006 **	Average mean diff is sign different from zero (Pre-post differ)	176	0.007 **	Average mean difference is sign different from zero (Pre-post differ)
aptdiff 8	8.30	<0.0001 ***	Average mean difference differ sign from zero =>Pre-post test differ sign	543.5	<0.0001 ***	Average mean difference differs sign from zero =>Pre-post test differ sign
diff draw	-1.64	0.106 *	Average mean difference differ sign from zero =>Pre-post test differ sign	-244.5	0.024 **	Average mean difference differs sign from zero =>Pre-post test differ sign
diff read	11.44	<0.0001 ***	Average mean difference differ sign from zero =>Pre-post test differ sign	669.5	0.024 ***	Average mean difference differs sign from zero =>Pre-post test differ sign
diff maths	12.53	<0.0001 ***	Average mean difference differ sign from zero =>Pre-post test differ sign	663	<0.0001 ***	Average mean difference differs sign from zero =>Pre-post test differ sign

Probability & Significance associated with test:
<0.01 0.0001 or 0.1%: ***
<0.05 0.05 or 5%: **
<0.001 0.1 or 10%: *

From the results of the paired t-test given in Table 3, it is evident that the following means differed significantly from zero: spatial, reasoning, numerical, verbal comprehension, reading age and maths age. According to the results of the Wilcoxon Signed Rank Test, the following differed significantly from zero: spatial, reasoning, numerical, verbal comprehension, draw-a-person, reading age and maths age.

The findings listed in Table 3 indicated a difference in the means between the "before" and "after" scores. In the light of these findings, the null hypothesis is rejected and the alternate hypothesis accepted for the following: spatial, reasoning, numerical, verbal comprehension, draw-a-person, reading age and maths age.

To establish the effect of the biographical factors on the significant mean difference in performance, an analysis of variance was done for each test. This analysis of variance would indicate the possible effect of the biographical variables on the improvement in the performance of the learners. The four variables of gender, group, language and age were therefore included in the model.

The ANOVAS were done on the differences between the pre-test and post-test scores (presented as a percentage) for the eight aptitude tests, the DAP, reading age and maths age. The significance associated with each ANOVA (F probability) and with the biographical variables entered in the ANOVA (F probability as well) to determine their possible effect on the relevant test score differences, are supplied in Table 4. Once again only the significant findings are reported in Table 4.

Table 4: Summary – Analyses of Variance Results

Test-score difference	Significance f-probability	Biographical variables included:					
		Gender	Group	Language	Age		
Apt diff 2	0.0018 ** 0.002	0.20	0.014 *	0.01 **	0.13	53	Sign differences established between pre-test and post-test can to some extent be explained by sign effect of group and language
Diff read	0.01 **	0.21	0.001 ***	0.74	0.31	53	Effect of group explains part of the sign difference established between pre-test and post-test results
Diff math	0.05 **	0.10 *	0.10 *	0.54	0.07 *	53	Effects of gender and group explain some of the sign difference established between pre-test and post-test results

Probability & Significance associated with test:
<0.01 0.0001 or 0.1%: ***
<0.05 0.05 or 5%: **
<0.001 0.1 or 10%: *

The findings reported in Table 4 indicate that spatial (apt 2), reading age and maths age are meaningfully influenced by the biographical variables.This can be explained as follows:

1. With spatial, some extent of the significance can be attributed to the group and the language.
2. The effects of the group explain part of the significant difference established between pre-test and post-test results with regard to reading age.
3. The effects of the group and the gender of the learner explain some of the significant difference established between the pre-test and post-test results in respect of mathematical age.

To interpret these findings, the means and standard deviations for the biographical effects included in the ANOVAS are given in Table 5 where it shows "how" and "where" the four groups differed from one another.

Table 5: Means (and SD) for the biographical effects included in the Anova Models

Apt diff		Gender	Group	Language	Age
2	Spatial	7.3a girl girl 6.5a boy boy	exp 17.69a toy 10.71ab cont 5.39bc play -6.15c	Afr 28.33a Other 10.06b Eng 3.57b	<5.5 1 1.25a >6.5 5.88a 5.5 - 6.5 4.50a
10	Read diff	boy 4.61a girl 3.90a	exp 5.92a toy 5.07ab play 3.38bc cont 2.38c	Other 4.60a Eng 4.17a Afr 4.17a	
11	Maths diff	boy 6.52a (5,02) girl 5.43a (2,88)	exp 7.3a cont 6.8a play 5.7ab toy 4.06		

In Table 5 the improvement in the performance of the experimental group on the spatial test is given as 17.96 percentage points, which is significant compared to the -6.15 percentage point difference of the free-play group.

This significant difference is also greater than that of the educational toys group (10.71) and that of the control group (5.39). Similarly, with the significant difference in respect of reading age and maths age the experimental group showed a greater significant difference than the other groups.

For the reading age, the experimental group showed a 5.92 percentage point difference, compared to the 5.07 of the educational toys group, the 3.38 of the free-play group and the 2.38 of the control group.

As far as the significant difference in respect of the maths age is concerned, the experimental group showed a 7.3 percentage point improvement compared to the 6.8 of the control group, the 5.7 of the free-play group and the 4.06 of the educational toys group.

The teachers were asked to record any observations that they thought could be meaningful when interpreting the results. When all four groups were assessed at the end of the term, the teaching staff noticed that not a single learner in the experimental group showed problems with midline crossing, whereas this was a common problem experienced by children in each of the other three groups. Midline crossing was dealt with in the first five weeks of the movement programme.

Conclusion

The calculations of the means for the pre-tests and post-tests showed a significant difference in respect of seven of the 11 performance tests: spatial, reasoning, numerical, memory, verbal comprehension, reading age and maths age.

The mean difference between these scores showed an improvement in performance upon post-testing. However, at that stage no decision could be made as to the significance of the difference in means. Therefore these differences were tested by means of a parametric and a non-parametric test.

The results of the paired t-test and the Wilcoxon Signed Rank Test that were used for this purpose indicated significant differences in the following: spatial, reasoning, numerical, verbal comprehension, draw-a-person, reading age and maths age.

An analysis of variance was then done to determine the effect of the biographical factors on the improvement in the performance of the learners. The ANOVAS that were calculated indicated the following as being significant: spatial, reading age and maths age. Further analysis showed that the experimental group had the most significant difference with regard to spatial, reading and mathematical skills.

Based on the findings we conclude that a developmental movement programme did have a positive impact on the learners over a remarkably short period of eight consecutive weeks. As seen from the results, these learners improved where spatial factors were involved in learning. From the literature survey, the indication is that spatial awareness is necessary for success in reading and mathematics.

It is therefore not surprising that the learners in the experimental group also showed a greater improvement in their reading and mathematical skills compared to the learners in the other three groups. In addition the learners in the experimental group were reported to be more alert and quicker in their responses in the classroom after the exercise period. It can thus be concluded that when movement targets those systems that are crucial to a child's ability to learn, certain learning experiences of the Grade 1 learner will be enhanced.

The results of this exploratory study suggest that further research is warranted to confirm the strong possibility that carefully designed, developmental movement programmes during early childhood may make a difference to those learners who are at risk when it comes to learning problems. This implies that educators should reconsider the value of such programmes in the school curriculum.

The possibility exists that other variables may have influenced this improvement and further research may have to control such variables. One shortcoming in this study was that the emotional indicators obtained with the draw-a-person test were not included in the results.

The effect of emotional factors should be considered in future research and the effects of a programme sustained over a longer period of time must also be investigated. In this instance the ten-week programme had to be reduced to eight weeks due to interruptions in the academic programme. This could have had an influence on the results.

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