South African Journal for Research in Sport, Physical Education and Recreation, 2011, 33(3): 113-128.
Suid-Afrikaanse Tydskrif vir Navorsing in Sport, Liggaamlike Opvoedkunde en Ontspanning, 2011, 33(3): 113-128.
ISBN: 0379-9069

EFFECT OF A KINDERKINETICS PROGRAMME ON COMPONENTS OF CHILDREN'S PERCEPTUAL-MOTOR AND COGNITIVE FUNCTIONING

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ABSTRACT

The aim of this research was to determine the effect of a Kinderkinetics programme on components of children's perceptual-motor and cognitive development. A pre-test- /post-test design with an intervention group and a control group was used. A sample of 40, 4-6-year-old pre-school children was selected and allocated to the two groups. The intervention group participated in a perceptual-motor programme while the control group received no intervention. The programme involved an hour session once per week, over a period of seven months and consisted of different activities to improve body awareness, gross and fine motor skills, coordination, balance, bilateral integration, locomotor skills and spatial awareness. Both groups were evaluated with the Peabody Developmental Motor Scales-2 (PDMS-2) and the Junior South African Individual Scale (JSAIS). Co-variance of analysis adjusted for pre-test differences showed that the programme contributed significantly to improvement in the fine motor, gross motor and total motor quotients, while two of the subscales of the JSAIS also showed significant improvement. The Kinderkinetics programme was effective in the improvement of perceptual-motor abilities of these pre-school children, while also contributing to their school readiness on an attentive and cognitive level.

Key words: Pre-school; Kinderkinetics; Perceptual-motor development; Cognitive function.

INTRODUCTION

It is important for young children to obtain a proper motor foundation as basic fundamental motor skills (FMS) are regarded as building blocks of more advanced movement (Goodway & Robinson, 2006). Furthermore, these skills offer children the basic motor abilities to function fully in the environment on a cognitive, social and motor level and contribute to their physical growth and development (Clarke, 2007). Research findings (Diamand, 2004) indicate that motor development and cognitive development are more interrelated than initially thought and that these processes are probably fundamentally interwoven. In this regard there is an indication that the brain is more receptive to movement stimulation at certain times, which is regarded as sensitive periods or windows of opportunity for motor development (Gabbard, 1998), and the early childhood years are considered as the period when fundamental motor skills should be developed (Robinson & Goodway, 2009). The optimum developmental period for perceptual-motor skills are considered to be between 3.5 and seven years (Gabbard, 1998).

According to Gallahue and Ozman (2006), perceptual and motor development is interrelated as all voluntary movement involves an element of perceptual awareness resulting from sensory stimulation while perceptual skills are influenced in part by movement. These researchers define perception as ‘to know’ or ‘to interpret’ information and the process whereby incoming information is organised together with stored information. They describe perceptual-motor development as the assimilation of more skills and functional abilities by making use of sensory input, sensory integration, motor interpretation, movement activation and feedback. Gabbard (1998) indicates that good perceptual-motor development contributes to school readiness skills such as listening skills, reading skills, writing and language skills and self-confidence, which are required by the child when they enter the formal school system. Kokot and Krog (2006) state that movement is essential to learning and can be regarded as the door to learning. Basic learning skills associated with normal educational development in mathematics, reading and writing is also related to perceptual-motor processes (Van Zyl, 2004).

Although the importance of motor development programmes are emphasised by various researchers, Goddard-Blythe (1998) stress the fact that there are links between successful learning and the adequate mastery of motor skills, yet there are some who are still sceptical about the effects of movement on academic performance. In this regard, Fredericks *et al*. (2006) emphasise the importance of considering the content of movement programmes in relation to the purpose, highlighting that movement programmes should be meaningful for development in order to ensure that these skills develop. Valentini and Radisill (2004) also indicate that fundamental motor skills must be learnt, practised and maintained, as is the case with many other skills that young children should acquire. Gallahue and Ozmun (2006) highlight that perceptual skills have to be learned and depend on movement as a medium for this learning to occur, therefore these skills develop in harmony. The findings by Robinson and Goodway (2009) emphasise the importance of regular, planned and well-compiled movement programmes in centres for early childhood development.

PURPOSE OF THE STUDY

This study had a dual purpose, firstly to determine whether participating for seven months in a scientifically based, age and developmentally appropriate Kinderkinetics programme, based on perceptual-motor development, had an effect on the motor development of four to six year-old children; and secondly whether the cognitive development of these children could also benefit from their participation.

RESEARCH METHOD

Research design

A two group pre-test and post-test design was followed, where one group received an intervention by means of a perceptual-motor programme.

Subjects

All the 4 to 6-year-old pre-school children who enrolled in the beginning of 2006 for participation in the 4 to 5 year-old and 5 to 6 year-old perceptual-motor development programmes of the Clinic for Kinderkinetics at the North-West University (Potchefstroom Campus) were asked to participate in the study. A convenient sample of 20 pre-schoolers was selected on the basis of availability (a maximum of 10 children are allowed in one programme). A control group of 20 children was also selected on the basis of availability from nursery schools in Potchefstroom. Seven of the 20 children in the intervention group had incomplete data due to poor attendance of the programme or withdrawal during the study for different reasons. The final group (N=13) consisted of 7 boys (two 4-year-olds, four 5-year-olds and one 6-year-old) and 6 girls (two 4-year-olds, three 5-year-olds and one 6-year old).

The intervention group consisted of children from 6 different pre-primary schools and playgroups in Potchefstroom. The control group was selected from 2 pre-primary schools (N=19 - 1 child withdrew) and consisted of 7 boys (five 4-year-olds, two 5-year-olds) and 12 girls (seven 4-year-olds, four 5-year-olds). All the children were white and Afrikaans-speaking to ensure that the measuring instruments could be administered in their mother tongue and in so doing ensure that the reliability of the tests was kept as high as possible.

Measuring instruments

The participant's motor development (to determine whether the perceptual-motor development programme improved motor functioning) was assessed by means of the Peabody Development Motor Scales 2 (PDMS-2) (Folio & Fewell, 2000). This test determines the motor development of children between the ages of 0 and 72 months, and is a valid test used worldwide to assess the motor development of young children. The 6 subtests of this test measures reflexes, balance, locomotor skills, object manipulation, grip and visual motor integration. As reflexes are usually integrated when a child is 12 months old, this subtest is only administered to children from birth to the age of 11 months, and was therefore not applied for the purpose of this study.

The standard scores of the 5 subtests used (balance, locomotor skills, object manipulation, grip and visual-motor) were added together to determine the gross motor, fine motor and total motor standard scores. These standard scores were then converted to gross motor, fine motor and total motor quotient scores to determine the motor development of a child. It was therefore possible to determine in which category of the measuring instrument the child showed progress.

The cognitive development of the participants was measured by the means of the Junior South African Individual Scale (JSAIS) measuring instrument (Madge, 1981). The Global Scale value of the JSAIS consists of 12 subtests, namely (1) Form board; (2) Vocabulary; (3) Ready knowledge; (4) Numeracy and quantity concepts; (5) Memory of digits; (6) Block patterns; (7) Story memory; (8) Picture riddles; (9) Word association; (10) Absurdities A - Missing parts; (11) Absurdities B- Absurd situations; and (12) Form discrimination, which is converted into an IQ value. This Global Scale value is subdivided into 3 subscale values: the

Verbal Scale value (subtests 2, 3, 7, 8, 9); Visual-spatial Scale value (subtests 1, 6, 10, 11, 12); and the Numerical Scale value (subtests 4 and 5).
An independent Memory scale value was also calculated (using sub items 5, 7, 10). From these scale values a Verbal IQ, Action IQ, Numerical norm and Memory norm was calculated using the applicable norm tables. The reliability quotient for the test was calculated using the Kuder-Richardson formula of >0.8, which showed a satisfactory mean positive correlation of more than 0.8. The only subtest that exhibited a smaller correlation than 0.8 was the Absurdities B: Absurd situations, with a reliability quotient of 0.77. A psychologist was responsible for these assessments.

For the purpose of this study, the reliability of the PDMS-2 and JSAIS were firstly analysed by means of Cronbach alpha values, where a Cronbach alpha value of ≥0.5 is considered an indication of reliability. If, however, there are only 2 subtests involved, a Cronbach alpha value cannot be determined and the internal coherence with regard to a correlation value is reflected, where this correlation is an indication of reliability if ≥0.3. According to Nunally (1978), the reliability of measuring instruments depends on the internal coherence between the subtests that form part of the various subscales. These values therefore indicate to what degree the various subtests that are part of each subscale measure the same constructs.

Research procedure

Parents who reported to the Clinic for Kinderkinetics at the North-West University (NWU) and who gave permission for their children to be part of the research group were asked to complete consent forms. Principals of 2 nursery schools in Potchefstroom were asked permission to allow children from their nursery schools to form part of the control group, and the parents had to provide consent for their children to participate in the study.

Following this, the children from the intervention and the control group were tested using the 2 measuring instruments, after which the intervention group participated in the intervention programme for approximately 7 months, once per week. During this period the control group only attended their nursery schools. Both groups were re-evaluated after the 7 month period. To adhere to the ethical standards of the study, a motor stimulation programme was offered to the control group on completion of the intervention.

The Cronbach alpha values of the correlated subscales of the 2 measuring instruments are displayed in Table 1 and the values that show reliability (#) are indicated therein. The PDMS-2 and the JSAIS can be considered as reliable in total as a strong individual internal coherence was indicated between the totals of the 2 subtests. With regard to the subscales, it appears that memory norm (JSAIS) and the gross motor scale (PDMS-2) exhibit a weaker internal coherence in the various subtests.

As a result the data of these subscales must be interpreted with care as it appears that the subtests that make up the subscales concerned, possibly do not measure the same constructs. To overcome this problem, all data with regard to each subtest was discussed separately. After the individual interpretations, the subscales were incorporated in a summary.

TABLE 1: **RELIABILITY OF PDMS-2 AND JSAIS AS INDICATED BY CRONBACH ALPHA VALUES**

Sub Scale	Cronbach Alpha-Value	Correlation	Sub-tests from which subscales originate
PDMS-2			
Total motor scale	0.59 #		All subscales
Fine motor scale	-	0.48 #	1, 2 & 3
Gross motor scale	0.32		4 & 5
JSAIS			
Global scale	0.88 #		All subscales
Verbal scale	0.83 #		2, 3, 7, 8 & 9
Action scale	0.74 #		1, 6, 10, 11 & 12
Numerical norm	-	0.33 #	4 & 5
Memory norm	0.47		5, 7 & 10

=Reliable

Statistical methods

Statistica for windows (Statsoft, 2008) was used to perform the various statistical analyses in the study. The Cronbach alpha-quotient was firstly used to determine the reliability of the measuring instruments. Descriptive statistics were then performed on the variables for descriptive purposes. Independent t-tests were used to determine whether the control and intervention groups were comparable beforehand with regard to the measurements, while paired t-tests were used to determine whether any improvements within the group itself had occurred. Covariance of analysis was used to adjust for pre-test differences to determine whether the intervention groups' post-test results was better than that of the control groups' post-test. Effect sizes were used to determine the practical significance of differences within groups, as well as between the intervention and control groups for the pre- and post-tests. Cohen (1988) and Ellis and Steyn (2003) indicate that p-values are considered significant at ≤ 0.05 and these statistical significant values are indicated with an asterisk (*). If the values were higher than D = 0.8, practical significance is indicated and these values are marked with a (#).

INTERVENTION PROGRAMME

The perceptual-motor development programme within the Clinic for Kinderkinetics (NWU, Potchefstroom) was used as the intervention programme for this study. This programme is scientifically based, developmentally appropriate and claims to improve the perceptual-motor development and school readiness of pre-school children. Trained professionals in the field of motor development, namely Kinderkineticists (with a degree in Human Movement Science, with postgraduate specialisation in motor development) conducted the programme.

The intervention group underwent the perceptual-motor development programme over a period of 7 months. The 4 to 5 year-olds and 5 to 6 year-olds participated in separate programmes although the content of the programmes are the same and conducted by the same person, but adjusted for age and developmental differences. The programme consisted of an hour lesson, once a week and a lesson comprised 40 minutes of structured activity and 20 minutes of free play using apparatus and equipment available in the Clinic for Kinderkinetics. Each 40-minute lesson was based on playing and enjoyment and was made up of age appropriate and developmentally appropriate motor development and perceptual-motor activities.

The core of the programmes for different aged children are the same, the only difference is that the content of the programme is designed according to the age appropriate developmental needs of the children. An important philosophy of the programme is that the child's natural need to play is respected and encouraged. Each lesson began with warm-up activities, which mainly addressed fundamental locomotor skills, stability, manipulation and bilateral integration activities. Body awareness, spatial orientation, balance, general-, hand-eye and foot-eye coordination, fundamental skills and activities for vestibular stimulation were then addressed after which the lesson was ended with an enjoyable activity. All these skills and abilities are considered important perceptual and motor requirements for the development of basic learning skills in the school. Following are examples of activities done under the various main components.

Locomotor skills at the beginning of each lesson comprised of basic locomotor activities such as one-leg jumps, skipping, two-leg jumps with a bean bag between the legs, running forward and backward between buckets and running towards a bean bag and stopping when the music stops.

Body awareness was addressed by activities where instructions were used in which participants had to identify body parts as well as the movement possibilities of these specific body parts. For example: "Touch your shoulder with your hand"; "Who can show me where your knee is?"; placing a beanbag on various body parts; shaking various body parts as identified by the Kinderkineticist; as well as identifying another participants body parts.

Activities to improve *balance* included standing on one leg with hands on the head, walking over a bench and through hoops with a beanbag on the head, walking backwards, walking heal to toe, walking sideways and standing on a bench with both legs and then separately.

General *body coordination*, motor planning and sequencing and spatial orientation were addressed by the following activities: climbing a ladder and sliding down; walking like a crab; hanging on a bar and lifting legs; doing forward logrolls and rolls with a beanbag held under the chin; and climbing through hoops and ropes without touching it. These activities provided basic concepts for better understanding of basic maths.

Hand-eye and foot-eye coordination (also known as manipulation) activities involved the following activities: throwing and catching a ball; pushing a ball with a mini-golf stick against the side of a hoop; kick a ball after it has been dropped; catching a tennis ball with a catching net; and pushing a ball softly through various obstacles.

Activities used to improve the participant's *fine motor skills* were cutting out shapes, making figures with clay, pinching washing pegs around the edge of a frizbee, flicking fingers in the air and placing shapes in the correct holes on a board. Only 3-5 minutes of the movement lesson was spent on fine motor skills. These activities are especially important to improve visual motor integration and visual perception, which are required in reading and writing.

The content of this programme compares well to the perceptual-motor development programmes of Bossenmeyer (1988) and Capon (1994, 1997, 1998) as it is aimed at improving essential aspects of perceptual-motor development at a young age.

RESULTS

The aim of this study was to determine the influence of a Kinderkinetics programme on the perceptual-motor development and cognitive development of pre-school children between the ages of 4 to 6 years. Subtest scales and the totals derived in the PDMS-2 and JSAIS, where a statistical and practical difference occurred, were used as indicators. The results are displayed as means (M), standard deviations (SD), p-values (p) and effect sizes (d), which were found in the subscales of the PDMS-2 and JSAIS. The t-test was firstly used to analyse possible pre-test differences between the groups to eventually determine whether the intervention and control groups were comparable beforehand with regard to the PDMS-2 and JSAIS measurements (Table 2.1 & 2.2). Huysamen (1986) identifies this step as a prerequisite in designs of this nature to ensure that the intervention and control groups are comparable beforehand.

TABLE 2.1: **PRE-TEST RESULTS OF PDMS-2 SCALES OF INTERVENTION AND CONTROL GROUPS**

PDMS-2 scales	Intervention group		Control group		t-test p-value	Mann-Whitney value	Effect size
	M	SD	M	SD	p-value	p-value	d-value
Balance	8.85	2.61	8.82	2.43	0.981	0.802	0.011
Locomotor	10.62	1.50	9.29	2.59	0.113	0.132	0.514
Object manipulation	8.00	1.29	7.29	1.49	0.185	0.132	0.477
Grip	9.92	1.71	9.06	3.21	0.387	0.818	0.268
Visual motor	10.23	3.59	10.47	3.16	0.847	0.630	0.067
Gross motor	27.46	3.36	25.41	4.49	0.180	0.209	0.457
GMQ	94.46	7.16	90.29	9.63	0.202	0.209	0.433
Fine motor	20.15	4.86	19.53	5.47	0.748	0.738	0.113
FMQ	100.46	14.59	98.59	16.40	0.748	0.738	0.114
Total Motor	47.62	6.56	44.94	8.48	0.355	0.325	0.316
TMQ	96.61	8.99	92.94	11.51	0.351	0.325	0.319

* = Statistically significant; # =Practically significant; GMQ = Gross motor quotient; FMQ = Fine motor quotient; TMQ = Total Motor Quotient; d = practical effect size as criterion for practical significance

Table 2.2: **PRE-TEST RESULTS OF JSAIS SCALES OF INTERVENTION AND CONTROL GROUPS**

JSAIS scales	Intervention group		Control group		t-test p-value	Mann-Whitney value	Effect size
	M	SD	M	SD	p-value	p-value	d-value
Form board	12.12	2.66	10.95	2.67	0.189	0.131	0.438
Vocabulary	11.00	3.95	10.30	3.95	0.562	0.594	0.177
Ready knowledge	12.35	2.39	10.6	2.39	0.100	0.059	0.732
Number and quantity	11.12	2.74	9.45	2.74	0.121	0.322	0.639
Memory for digits	10.82	2.03	9.65	2.03	0.298	0.532	0.576
Block designs	8.29	4.26	7.80	4.26	0.748	0.761	0.115
Story memory	10.71	2.89	10.30	2.89	0.699	0.615	0.142
Picture riddles	10.94	2.40	9.90	2.40	0.279	0.223	0.433
Word association	11.24	3.03	10.05	3.03	0.307	0.329	0.452
Absurdity A	11.76	2.67	10.05	2.67	0.103	0.135	0.640
Absurdity B	9.88	2.32	7.85	2.32	0.026*	0.049*	0.875#
Form discrimination	11.29	2.37	8.95	2.37	0.018*	0.043*	0.987#
Global	131.53	29.75	115.85	20.79	0.068	0.211	0.527
Verbal	56.24	14.46	51.15	10.62	0.227	0.201	0.352
Actions	53.35	12.10	45.60	10.30	0.043*	0.077	0.640
Numerical	21.94	6.82	19.10	3.48	0.112	0.217	0.416
Memory	33.29	7.70	30.00	5.55	0.141	0.266	0.427

* = Statistically significant; # =Practically significant; d = practical effect size as criterion for practical significance

Although a tendency is seen of higher mean values during the pre-testing in the intervention group, the results obtained from the analysis of possible pre-test differences between the groups (Table 2.1 & 2.2), indicated that the intervention and control group were comparable with regard to the subtests as well as in the gross motor, fine motor and total motor quotients of the PDMS-2, as no significant differences were found between the groups. Thus, if significant differences are found between the groups in the post-test, these differences could possibly be ascribed to the exposure to the intervention programme or to normal maturity. In the JSAIS, none of the global scale values exhibited practical significant differences, except for 2 of the 12 subscales (absurdity B and form discrimination), where the intervention group fared better. As a result the supposition can be made that the 2 groups (also with regard to the JSAIS) differed very little from each other during the pre-test. The pre-test-post-test differences within each groups was further analysed to determine if motor and cognitive improvement occurred within each group respectively (Table 3 & 4).

TABLE 3: **PDMS-2 AND JSAIS - INTERVENTION GROUP: INTRAGROUP DIFFERENCES FROM PRE- TO POST TESTING**

Variables	**Mean difference**	**SD difference**	**t-Test p-value**	**Wilcoxon P-value**	**d-value**
PDMS-2					
Balance	2.08	2.78	0.0200*	0.011*	0.748
Locomotor	1.39	1.66	0.0110*	0.017*	0.837#
Object manipulation	0.85	1.14	0.0200*	0.030*	0.746
Grip	0.46	1.39	0.2550	0.214	0.331
Visual motor	2.15	2.64	0.0120*	0.023*	0.814#
Gross motor	4.31	3.50	0.0010*	0.002*	1.231#
GMQuotient	9.54	7.49	0.0010*	0.002*	1.274#
Fine motor	2.62	2.82	0.0060*	0.014*	0.929#
FMQuotient	7.85	8.44	0.0060*	0.014*	0.930#
Total Motor	6.92	4.15	0.0001*	0.001*	1.667#
TMQuotient	9.15	5.61	0.0001*	0.001*	1.631#
JSAIS					
Form board	-0.46	3.07	0.598	0.838	0.150
Vocabulary	-0.23	1.74	0.641	0.657	0.132
Ready knowledge	0.31	2.63	0.680	0.969	0.118
Number and quantity	-1.54	2.37	0.037*	0.037*	0.650
Memory for digits	-0.62	2.57	0.404	0.388	0.241
Block designs	3.85	3.48	0.002*	0.008*	1.106#
Story memory	-0.31	3.25	0.739	0.838	0.095
Picture riddles	0.46	3.64	0.656	0.722	0.126
Word association	-0.15	2.03	0.790	0.790	0.074
Absurdity A	0.38	3.86	0.726	0.824	0.168
Absurdity B	-0.62	3.70	0.586	0.625	0.168
Form discrimination	-0.85	2.85	0.306	0.213	0.298
Global	0.23	15.35	0.958	0.279	0.015
Verbal	0.08	9.86	0.978	0.576	0.008
Actions	2.31	7.89	0.312	0.308	0.293
Numerical	-2.15	3.36	0.040*	0.050	0.640
Memory	0.23	2.62	0.756	0.814	0.088

$p < 0.05$; $d > 0.8$; # practical significant difference; Q = quotient;

TABLE 4: **PDMS-2 AND JSAIS - CONTROL GROUP: INTRAGROUP DIFFERENCES FROM PRE- TO POST-TESTING**

Variables	Mean difference	SD difference	t-Test p-value	Wilcoxon P-value	d-value
PDMS-2					
Balance	0.47	2.48	0.445	0.490	0.190
Locomotor	0.47	1.81	0.299	0.262	0.260
Object manipulation	0.18	2.13	0.737	0.451	0.085
Grip	-0.24	3.33	0.774	0.845	0.072
Visual motor	0.12	3.50	0.891	0.570	0.034
Gross motor	1.12	3.37	0.190	0.193	0.332
GMQuotient	2.24	7.13	0.214	0.201	0.314
Fine motor	-0.12	6.19	0.939	0.959	0.019
FMQuotient	-0.35	18.58	0.939	0.959	0.019
Total Motor	1.00	7.87	0.607	0.463	0.127
TMQuotient	1.29	10.78	0.627	0.463	0.120
JSAIS					
Form board	0.89	2.49	0.135	0.140	0.357
Vocabulary	0.05	2.90	0.938	0.831	0.017
Ready knowledge	0.42	2.19	0.414	0.605	0.192
Number and quantity	-0.79	2.74	0.225	0.244	0.288
Memory for digits	0.21	2.25	0.688	0.842	0.093
Block designs	2.00	2.77	0.006*	0.004*	0.722
Story memory	1.47	2.52	0.020*	0.024*	0.583
Picture riddles	-0.74	2.75	0.257	0.113	0.269
Word association	0.11	2.18	0.836	0.906	0.050
Absurdity A	-0.05	2.76	0.935	0.932	0.018
Absurdity B	0.63	2.19	0.225	0.332	0.288
Form discrimination	0.68	2.52	0.252	0.328	0.302
Global	0.23	15.35	0.013*	0.021*	0.015
Verbal	0.08	9.86	0.285	0.332	0.008
Actions	2.31	7.89	0.013*	0.014*	0.293
Numerical	-2.15	3.36	0.373	0.485	0.640
Memory	-0.54	6.10	0.054	0.067	0.089

* p< 0.05; d>0.8; # practical significant difference

The results of the intervention group's pre- and post-test results obtained for the PDMS-2 and JSAIS (Table 3) are presented. Two of the 5 tests of the PDMS-2 exhibited a statistical and practical significant difference between the pre- and post-test means in the intervention group (locomotor and visual motor skills), while 4 of the 5 subscales exhibited a statistical significant difference (excluding grip). It is important to take cognisance of the fact that part of the method of the PDMS-2 is to convert the raw scores to scale scores by means of age appropriate norm tables. These scale scores which are corrected for age, were used in the statistical analysis to calculate the mean differences between pre- and post-tests. No practical significant differences occurred between the pre- and post-test performances of the intervention group's verbal, action, numerical and memory skills and the group's global scale performance. There was a practical significant difference in 1 subtest of the JSAIS, namely block patterns, between the pre- and post-tests in the intervention group.

Table 4 displays the same results for the control group. The control group showed a statistically significant difference in 2 of the global subtests' pre- and post-tests, although these differences had no practical significance. The gross motor, fine motor and total motor standard scores of the PDMS-2 and the gross motor, fine motor and total motor quotient scores exhibited statistical and practical significant differences. When the pre- and post-test means derived for the PDMS-2 of the control group were compared no practical significant differences were found in any of the subtests or total scores. The control group exhibited statistically significant differences in the JSAIS, but these differences were not practically significant in block patterns and story memory.

Maturation can also be observed in the results. In the number and quantity subtests where both the intervention and control groups exhibited decreases which were statistically significant within the intervention group. Although these differences were not practically significant, it could be an indication that natural maturation did not sufficiently take place, according to the test's age appropriate norm**.** The control group also showed a negative difference in this subtest and although not statistically or practically significant, the assumption of natural maturation according to the JSAIS norms can also not be made.

The results of the post-tests of both groups were analysed by means of co-variance of analysis to determine whether the Kinderkinetics programme improved the motor and cognitive skills of the participants in a practical significant manner (Steyn *et al*., 1998). Adjustments were made for pre-test differences to determine whether the intervention group's post-test means obtained in the PDMS-2 and JSAIS were better compared to that of the control group. Both the intervention and control groups were exposed to natural development and maturation over the same 7 month period, but only the intervention group was exposed to the perceptual-motor kinderkinetics programme, therefore any significant differences between the intervention and control group's means could be regarded as a result of the intervention programme. The analysis of the co-variance is displayed in Table 5.

The intervention programme exhibited a statistical and practical significant improvement in 2 of the 5, PDMS-2 subtests (balance, locomotor). The difference found in the object manipulation and visual motor sub-items were statistically but not practically significant, (slightly below the cut-off point for practical significance).

TABLE 5: **CO-VARIANCE OF ANALYSIS OF POST-TEST DIFFERENCES**

Variables	**Means**	**df**	**ANCOVA**	**Mann**	**d-value**

	Int. Gr.	**Con. Gr.**		**p-value**	**Whitney p-value**	
PDMS-2						
Balance	10.92	9.30	2.45	0.009*	0.010*	1.035#
Locomotor	11.55	10.21	2.64	0.042*	0.014*	0.825#
Object manipulation	8.73	7.59	2.36	0.062	0.038*	0.742
Grip Strength	10.25	8.96	3.92	0.092	0.045*	0.652
Visual-motor	12.44	10.53	6.93	0.060	0.086	0.726
Gross motor	31.19	27.11	8.97	0.001*	0.001*	1.362#
GM quotient	102.82	93.71	40.55	0.001*	0.001*	1.431#
Fine motor	22.66	19.52	14.25	0.033*	0.027*	0.832#
FM quotient	107.98	98.56	128.58	0.033*	0.027*	0.831#
Total Motor	53.77	46.71	33.14	0.003*	0.003*	1.226#
TM quotient	104.71	95.29	62.14	0.004*	0.003**	1.199#
JSAIS						
Form board	11.35	12.00	5.11	0.443	0.744	0.288
Vocabulary	10.75	10.62	3.71	0.858	0.420	0.067
Ready knowledge	11.56	11.36	5.08	0.811	0.788	0.089
Number & quantity	9.45	9.33	5.44	0.891	0.443	0.051
Memory for digits	10.91	10.44	4.80	0.759	0.454	0.215
Block designs	12.45	9.95	4.96	0.004*	0.013*	1.123#
Story memory	9.97	11.66	4.39	0.033	0.088	0.807#
Picture riddles	10.90	9.41	8.92	0.179	0.135	0.499
Word association	10.63	10.65	4.11	0.977	0.632	0.010
Absurdity A	11.95	10.00	4.51	0.021*	0.008*	0.918#
Absurdity B	9.10	8.54	5.27	0.542	0.300	0.244
Form discrimination	9.79	10.33	6.35	0.600	0.388	0.214
Global	125.73	126.82	108.55	0.786	0.199	0.105
Verbal	53.66	54.01	49.15	0.893	0.591	0.050
Actions	53.84	51.98	38.54	0.544	0.044*	0.300
Numerical	19.47	19.95	9.40	0.691	0.466	0.157
Memory	31.92	32.29	13.08	0.783	0.578	0.102

$p < 0.05$; $D > 0.8$; # practical significant difference

The intervention programme therefore did not succeed in improving the intervention group's ability to manipulate balls in a practically significant manner. These findings are contradictory to the findings of a study by O'Keeffe (Smyth & O'Keeffe, 1998), which showed that a ball throwing intervention programme did significantly improve the ball throwing skills of these children. A possible explanation for this could be that it takes longer to master these skills because it demands more complex coordination of the child.

The intervention programme also did not succeed in improving, with practical significance, the group’s ability to use their visual perceptual skills in performing complex hand-eye coordination tasks. Gabbard (1998) indicates that visual perception plays an important role in the development of most of the perceptual-motor skills, as 75% of information received from the environment is received by means of visual stimulation. A possible reason for this could be ascribed to the relative short period of time spent on this aspect within the programme.

The grip subtest was the only test that did not exhibit any statistically significant difference. A possible reason for this could be that although activities to improve this skill were included in the intervention programme, it was not sufficient to bring about a practical significant improvement as only 5 minutes of the 40 minutes programme was spent on fine motor skills. It can also be that the motor control that is required for the fine motor control needed in these tests is not sufficiently in place yet. Hand grip, however, plays an important role in the child’s writing skills that, according to Gabbard (1998), is considered an important aspect of school readiness. As a result, this aspect needs to receive more attention.

DISCUSSION

It appears that the intervention programme exhibited a statistical and practical significant improvement in two of the five PDMS-2 subtests (balance, locomotor skills), while the group only showed a statistical significant improvement in four of the five subtests (balance, locomotor skills, visual motor, object manipulation). The results in Table 5 also shows that the total motor standard scores of the intervention group exhibited a practical significant improvement with regard to both the gross and fine motor quotients, as well as the total motor quotient. It can therefore be concluded that the intervention programme succeeded in improving the overall motor abilities of the intervention group, of which the five subtests forms the foundation.

The significantly better performance of the intervention group in the block pattern subscale of the JSAIS is an indication that the intervention programme was also successful in practically significantly improving the group’s ability to analyse, compile and reproduce two dimensional abstract designs. These types of skills are needed for reading and mathematics (Magde, 1981). A statistical and practical significant difference also occurred for the missing parts subtest between the two groups. This is an indication that the intervention group succeeded in practically significantly improving the group’s ability to visually understand objects and to identify and isolate the absence of essential, rather than non-essential details. The most important clinical value of this test is that the naming of irrelevant details is an indication of poor observation skills, a disturbed sense of reality or an apractic attitude (Magde, 1981).

De Wit and Booysen (1994) state that school readiness relies to a large extent on perceptual-motor readiness, however, children must also have developed a high level of cognitive functioning by then. There are also certain basic steps that must take place before perception can occur and which may obviate future perceptual problems. Reading, writing and arithmetic require a great deal of sensory integration for the child to be able to experience success at school, and the integration of the senses with motor experiences or moving in particular is important in this regard (De Witt & Booysen, 1994). Van Zyl (2004) also indicates that the child's sensory integration must be developed first, before perceptual modalities will be in place and that the modalities of perception important for school readiness and school success are visual (spatial, memory), auditory, reasoning, verbal related abilities, numerical and tactile perception. The child’s powers of observation must also already have developed to a reasonably high level as attention span forms a very important part of school readiness, and the length of time the child can pay attention is a determining factor for learning.

The Kinderkinetics movement development programme in which the children participated in this study is marketed as a programme, which contributes to perceptual readiness and addresses concepts that make understanding aspects such as mathematics and reading easier. Although the normal maturation process also contributed to the intervention group’s motor development, it appears that the programme had a positive effect on the pre-schoolers’ motor development from the practical significant improvement of the group’s gross- and fine motor quotient, as well as the total motor quotient in comparison to that of the control group where none of these differences were found. From the cognitive analysis of the intervention group’s results, certain concepts dealing with cognition, namely the ability to analyse, comprise and reproduce an abstract two dimensional design, as well as their observation abilities and sense of reality further underwent a significant improvement, which was not found in the control group.

The only aspect that did exhibit a significant improvement in the control group and not in the intervention group was their story memory. This result can possibly be ascribed to the control group being composed of children from two pre-primary schools who offered formal programmes, in comparison to the intervention group which was made up of playgroups and pre-primary schools on the basis of their registration within the Kinderkinetics programme, and where the programme was possibly less formal in some cases.

CONCLUSION

This research has shown that the Kinderkinetics programme was effective in significantly improving the pre-schooler’s fine motor, gross motor, perceptual-motor and overall motor abilities, as well as significantly improving selected cognitive concepts and attentive and observation skills. These findings are important as research indicates that a well-planned, regular and well compiled movement programme is important in the early years of childhood to lay the foundation for good motor development, but also to improve sensory integration and eventually perceptual development (Valentini & Rudisill, 2004; Robinson & Goodway, 2009) which is important for the learning process when they enter the formal school system (Van Zyl, 2004).

The research did, however, have certain shortcomings, which limit the generalisation thereof. The test sample was based on an available sample and not a random sample, and was relatively small, which make the generalisation of the results difficult. No provision was made for a longitudinal follow-up, which means that the effectiveness of the perceptual-motor development programme could not be determined over a long period of time. It is therefore recommended that in similar studies use should be made of a bigger and random sample of subjects with follow-up testing to determine the lasting effects of the programme. Limiting the age range of the group to either four to five-year-olds or five to six-year-olds is also recommended to control for the possible influences of age/maturation differences at this young age. It is also recommended that the intervention programme should take place either over a longer period of time, or more frequent contact sessions per week or make provision for a longer structured lesson time to provide especially for improvement of more complex manipulation skills and grip related activities.

REFERENCES

BOSSENMEYER, M. (1988). *Perceptual-motor development guide: Skill development movement programme for preschool and elementary teachers*. Byron, CA: Front Row Experience.

CAPON, J. (1994). *Perceptual-motor development series, book 1: Basic movement activities.* Byron, CA: Front Row Experience

CAPON, J. (1997). *Perceptual-motor lesson plans: Level 1.* Byron, CA: Front Row Experience

CAPON, J. (1998). *Perceptual-motor lesson plans: Level 2.* Byron, CA: Front Row Experience

CLARK, J.E. (2007). On the problem of motor skill development. *Journal of Physical Education Recreation & Dance,* 78(5): 39-44.

COHEN, J. (1988). *Statistical power analysis for behavioural sciences*. Hillsdale, MI: Erlbaum.

ELLIS, S.M. & STEYN, H.S. (2003). Practical significance (effect sizes) versus or in combination with statistical significance (p-values). *Management Dynamics,* 12(4): 51-53.

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

FOLIO, M.R. & FEWELL, R.R. (2000). *Peabody Developmental Motor Scales*. Austin, TX: Pro-Ed, Inc.

GABBARD, N. (1998). Motor skills in extremely low birth weight children at the age of 6 years. *Archives of Disease in Childhood,* 68: 286-290.

GODDARD-BLYTHE, S. & HYLAND, D. (1998). Screening for neurological dysfunction in the specific learning difficulty child. *British Journal of Occupational Therapy*, 61(10): 459-464.

GALLAHUE, D.L. & OZMUN, J.C. (2006). *Understanding motor development: Infants, children, adolescents, adults* (6th ed.). New York, NY: McGraw-Hill.

GOODWAY, J.D. & ROBINSON, L.E. (2006). Skipping toward an active start: Promoting physical activity in pre-schoolers. *Beyond the Journal: Young Children,* 61: 1-6.

HUYSAMEN, G.K. (1986). *Inferensiële statistiek en navorsingsontwerp: 'n Inleiding.* Pretoria: Academica.

MADGE, E.M. (1981). *Junior Suid-Afrikaanse Individuele Skaal (trans.* Junior South African Individual Scale). Pretoria: Human Sciences Research Council.

NUNNALLY, J. (1978). *Psychometric theory*. New York, NY: McGraw-Hill.

ROBINSON, L.E. & GOODWAY, J.D. (2009). Instructional climates in preschool children who are at-risk. Part 1: Object-control skill development. *Research Quarterly for Exercise and Sport*, 80(3): 533-542.

STATSOFT (2008). Statistica for windows release 6.0: General conversions & statistics. Tulsa, OK: StatSoft.

SMYTH, P.J. & O'KEEFFE, S.L. (1998). Fundamental motor skills: The effects of teaching intervention programmes. *Irish Journal of Psychology*, 19(4): 532-539.

STEYN, A.G.W.; SMIT, C.F. & DU TOIT, S.H.C. (1998). *Moderne statistiek vir die praktyk*. Pretoria: J.L. van Schaik.

VALENTINI, N.C. & RUDISILL, M.E. (2004). Motivational climate, motor skills development, and perceived competence: Two studies of developmental delayed kindergarden children. *Journal of Teaching in Physical Education*, 23*:* 216-234.

VAN ZYL. E. (2004). The relation between perceptual development (as part of school readiness) and school success of Grade I learners. *Africa Education Review*, 1(1): 147-159.

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(Subject Editor: Dr. M. van Gent)