

Impact of a motor activity program with executive functions to strengthen the integral development of the child

Impacto de un programa de actividad motriz con funciones ejecutivas para el fortalecimiento del desarrollo integral del niño

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Abstract

The present investigation consisted in analyzing the impact of the application of a program of motor activity linked to executive functions, in order to contribute to the development of cognition, executive functions, motor skills, reading, writing and mathematics. The sample consisted of 66 children (35 experimental group and 31 control group) with normal development and ages ranging from 5.2 to 6.9 years, the average was 6.2 ± 0.54 , who attended third kindergarten and first grade of a public school of the city of León, Spain. To carry out the program, the children made their materials and their parents supported them in the design of the most difficult materials. The program was completed in 45 sessions 2 per week, with a duration of 60 minutes each, during 6 months, being transcendental that a week a month the parents of the family participated in the class. The instruments used were: Merrill Palmer Revised Developmental Scale, NEPSY Test II, Infant Neuropsychological Maturity Questionnaire, Movement Assessment Battery for Children-2 and Mathematical Competence Test Basic. The most relevant results indicate that in the pre-test and post-test experimental group there are significant differences in: motor cognition, executive functions, writing and reading with a $p < 0.05$. Among the control groups and experimental post-test, significant differences were found $p < 0.05$ in: motor cognition, executive functions, writing and reading. In conclusion: the importance of creating motor programs linked to the executive functions is emphasized in order to strengthen the integral formation of the child.

Keywords

Executive functions; cognition; reading; Mathematics and early childhood education.

Resumen

La presente investigación, consistió en analizar el impacto de la aplicación de un programa de actividad motriz vinculado con funciones ejecutivas, con la finalidad de contribuir al desarrollo de la cognición, funciones ejecutivas, motricidad, lectura, escritura y matemáticas. La muestra se conformó por 66 niños (35 grupo experimental y 31 grupo control) con un desarrollo normal y edades comprendidas entre 5.2 a 6.9 años, la media fue 6.2 ± 0.54 , que cursaban tercero de educación infantil y primero de primaria de una escuela pública de la ciudad de León, España. Para desarrollar el programa, los niños elaboraron sus materiales y sus padres los apoyaron en el diseño de los materiales complejos. El programa se implementó en 45 sesiones 2 por semana, con una duración de 60 minutos cada una, durante 6 meses, siendo trascendental que una semana al mes los padres de familia participaban en la clase. Los instrumentos utilizados fueron: Escala de Desarrollo Merrill Palmer Revisada, Test NEPSY II, Cuestionario de Madurez Neuropsicológica Infantil, Batería de evaluación del movimiento para niños-2 y la prueba de Competencia Matemática Básica. Los resultados más relevantes indican, que en el grupo experimental pre-test y pos-test existen diferencias significativas en: cognición motricidad, funciones ejecutivas, escritura y lectura con una $p < 0.05$. Entre los grupos control y experimental pos-test se encontraron diferencias significativas $p < 0.05$ en: cognición motricidad, funciones ejecutivas, escritura y lectura. En conclusión: enfatizando la importancia de crear programas motrices vinculados con las funciones ejecutivas con la finalidad de fortalecer la formación integral del niño.

Palabras Clave

Funciones ejecutivas; cognición; lectura; matemáticas y educación infantil.

I. Introduction

The evolutive phase from 3 to 8 years it's a critic stage for the child development (Jones, et al., 2011; Livesey, Keen Rouse & White, 2006; Nelson, 2014). This stage is composed of wide period of knowledge and evolution inside the vital cycle, this is when scholar age begins, and this it's important because it's decisive for motor, cognitive, individual, emotional and social development (Meza, 2000). In some neuroimaging studies like the ones of Moriguchi & Hiraki (2013), showed that between 4 and 8 years it starts to increment the activity of the frontal lobe,

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just as the cognitive and motor development follows the same trait, having an accelerated development between the 5 and 10 years (Ahnert Schneider, & Bos 2009; Roebbers, et al., 2014; Westendorp, Hartman Houwen, Smith & Visscher, 2011). It is considered by Portellano, Mateos & Martínez (2009) that the child's education is an important period in the neurodevelopment, this is the most significant stage because in this stage a lot of neuronal connections establish that are the basis of the knowledge and behavior. The cognitive functions refer to the use or management of the knowledge, this integrates the processes that give meaning to the sensory signals and the motor actions, as they are encoded by the nervous system. The cognitive process, involves a variety of mental functions like the attentiveness, memory, learning, perception, language and problem-solving ability. It should be noticed that each of the functions mentioned above continues a developmental sequence that correlates with the maturation of the central nervous system (Rosselli, Matute & Ardila, 2010). It's important to consider that the motor development is reflected through the ability to move, depending especially on two basic factors: the maturation of the nervous system and the evolution of tone (Durivage, 2007). Alterations in the motor skills of a child may reflect cerebral immaturity associated with a developmental problem or may be the manifestations of a brain injury. Usually the first ones are being reflected as minor or soft neurological signs, for example the inability to jump on one foot or the difficulty to perform alternating movements with the fingers. These soft signs indicate an injury (Rosselli et al. 2010). Simultaneously, the motor development in early childhood is one of the most important factors to evaluate. Experts such as Videmšek, Klopčič, Štihec & Karpljuk (2006) have established that everything that is not acquired in early childhood is difficult to compensate for in later stages of life. Some researches such as that of Hardy et al. (2012) and Jess & Collins (2003), conclude that boys and girls who do not have motor skills according to their development, are often relegated from organized games. The lack of integration to play with other boys and girls can influence a life of physical inactivity, due to the frustrating experiences they had as children. Physical education classes is a program that helps to strengthen motor skills. In a study by Flores et al. (2017), which consisted in measuring the effective time of physical education class and its impact on caloric expenditure, showed that the 35.1% of the students remain standing and 28% didn't

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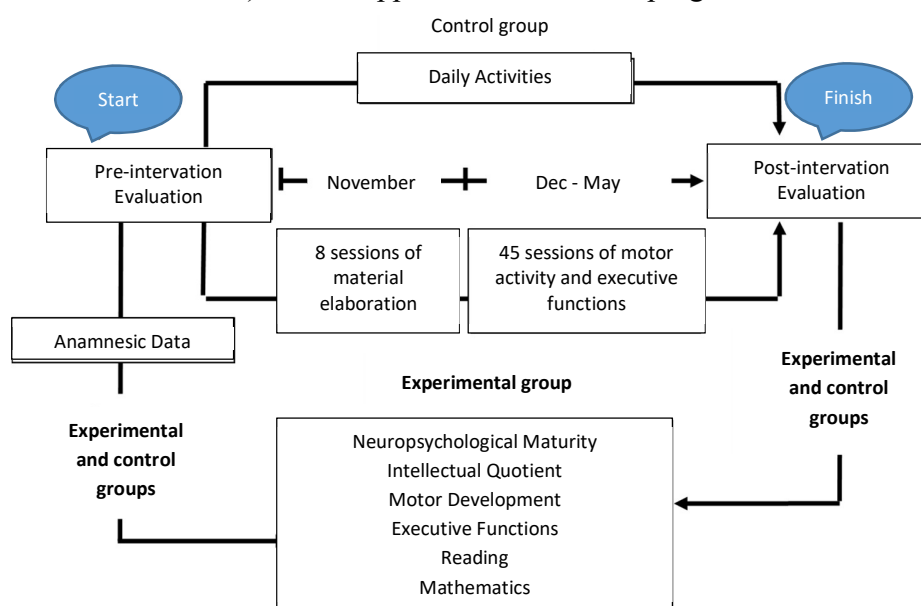
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perform any activity. Regarding the teacher's role, 27.8% of the time they spent observing the class and 26.4% were outside of the work area. Therefore, we see the need to carry out additional programs to physical education classes such as psychomotricity, which influences the motor and cognitive development of the children. Silva, Nevarez & Moreira mention (2016) that it's important to include it in the preschool curriculum. Solís, Prieto, Nístal & Vázquez (2017) consider that the psychomotricity is fundamental for the integral development of the children in the infantile stage. This is why the main objective of this research was to apply a program of motor activities to stimulate the different functions, in order to see the changes that occur in the children and especially the impact on the main learning which is necessary in its stage of development.

II. Material and Method

2.1 Design

The research was developed with an experimental methodology. An intra- and inter-subject design was used and the results obtained were compared, control and experimental group of children were compared in two different moments, before (pre-intervention evaluation) and after (post-intervention evaluation) and the application of a motor program with executive functions.



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Figure 1. Design of the study

2.2 Sample

The sample consisted of 66 boys and girls who attended third year of kinder garden and first year of elementary school of a public school of Leon, Spain; which had a typical development with a mean of 6.2 ± 0.54 (min = 5.2, max = 6.9) (35 experimental group and 31 control group).

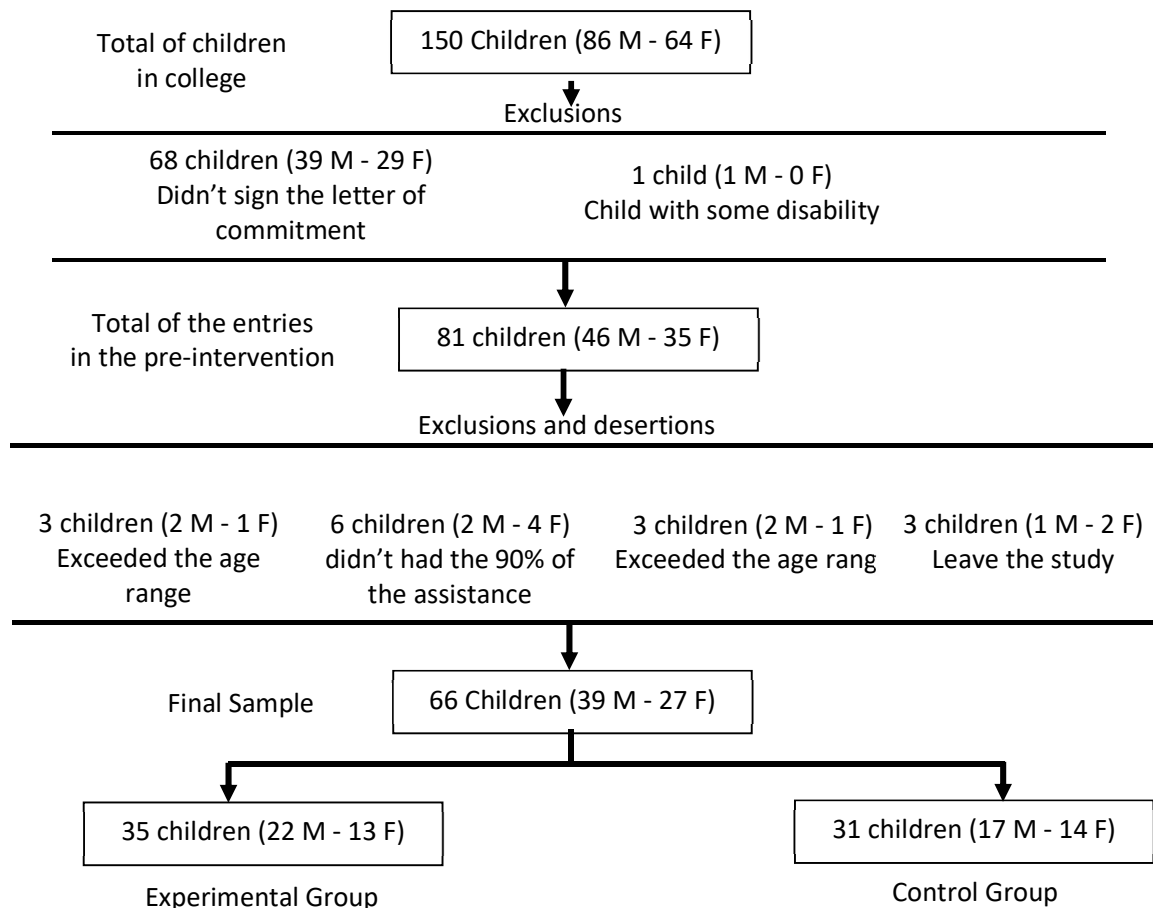


Figure 2. Sample Flowchart (M: Masculine, F: Feminine)

2.3 Selection criteria

Inclusion criteria were: have had between 4 and 6.9 years old, have had enrolled in a public school in León, Spain, not having any disability (cognitive, motor or sensory), or any type of disorder diagnosed up to the moment of the initial evaluation (ADHD, dyslexia, dyscalculia, autism, etc.), having answered all tests by the parents (anamnesic data and expressive language test for parents), having completed at least 90% attendance in the program (experimental group) and have accepted, by parents and children, participation was free and voluntary through written informed consent.

2.4 Variables

The dependent variables are cognitive area, reading, writing, mathematics, motor and executive functions and the independent variable is a motor program with executive functions.

2.5 Procedure

As part of the structure of the program, didactic materials (see Annex 6.1) were designed and implemented by the children, with their parents' help when the materials were more complex, for 1 month, in two sessions per week. The program entitled "Motor area Activity with Executive Functions" was applied consecutively, being carried out during 45 sessions, distributed in 6 months (2 sessions per week). At the beginning and end of the session the children had to say a tongue twister as a key to entering and leaving the class. Each session was divided as follows: in the initial part the children were activated through a children's song (for 8 minutes), in the core part through the game children were stimulated, taking into account the specific aspects of Durivage (2007) (for 37 minutes), and in the final part activities were carried out to stimulate executive functions (for 15 minutes). The last week of each month the boys and girls performed the same activities with the support of their parents.

2.6 Instruments

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2.6.1 Revised Merrill Palmer Development Scale (MP-R) (Gale & Jackie, 2004), adapted to Spanish by Sánchez, Santamaría Fernández & Arribas (2011).

The MP-R is the first of a new generation of instruments to assess child development, according to US regulations for the early identification of children with developmental delays or learning disabilities. From this battery, we used only the evaluation that measures the development of cognitive abilities, which includes the Cattell–Horn–Carroll (CHC) factors of fluid reasoning and crystallized intelligence, that is understanding and knowledge directed at children, consisting of 1 to 78 months, which consists of 111 items, in which it was applied card matching activities, mathematical activities, sequence follow-up exercises, pattern recognition and identification of differences were applied. In terms of reliability for the Spanish adaptation, the internal consistency α of Cronbach obtained by the authors of the instrument fluctuated between 0.97 and 0.78.

2.6.2 NEPSY II test (Korkman, Kirk & Kemp, 2007), adapted to Spanish by the Center of Neurological Rehabilitation-FIVAN and the Laboratory of Diversity, Cognition and Language, of the Department of Psychology of Evolutionary and of the Education of the University of Seville; in collaboration with the R & D Department of Pearson Clinical & Talent Assessment (2014).

NEPSY II is designed so that examiners can select relevant evidence for clinical research, aimed at children and adolescents from 3 to 16 years and 11 months. From this test only the tests that measure attention and executive functions are selected, which are 1) Design Fluency (DF), in this test there are shown several boxes with points that have to be joined with two or more points, using lines making a drawing in the box which must be different from each other, in a time of 60 seconds. 2) Executive Function Denomination (IND), in this test the child is shown a series of geometric figures or arrows in black or white and must say the name of the geometric figure or the direction of the arrow or an alternative answer, taking the time from start until the end of the test. 3) Inhibitory executive function (INI), in this mode the child must change his behavior, as appropriate responding the opposite to the figure established for example when observing a circle should verbalize that it is a square and if you observe a square should verbalize that it is a circle

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depending on the drawing. Likewise, if the child looks an arrow upwards, he / she should verbalize down and if he / she observes an arrow downwards he / she must verbalize up depending on the drawing, taking the time since the beginning until the end of the test.

2.6.3 Movement evaluation battery for children-2, (Henderson, Sugden, & Barnett, 2007) adapted to Spanish by Ruiz & Graupera (2012).

The MABC-2 battery was designed specifically to identify children with movement difficulties and allows changes in motor competence over time; this battery was applied to all participants using the MABC-2 "number 1" manual, which covers ages between 4-6 years. In this battery 3 areas are valued: manual dexterity, aim and capture and balance, being carried by 8 exercises. This 8 exercises are to insert coins in a piggy bank, to thread beads in a string, to draw a path following a path, throwing a bag of seeds to a target, maintenance of balance on a foot supported by a structure, tiptoe on a line and jumps on mats. The values obtained in each test are compared with the reference values for each different group, acquiring a score in the form of standard score whose value oscillates between 1-19, and an equivalent percentile depending on how high the score was in the standard score. From the sum of the 3 areas it was obtained a score as a global T-score. A normal result is a T-score > 67 or a percentile > 15, in risk a T-score of 57-67 or a percentile between 6-15, and pathological a T-score \leq 56 or a percentile \leq 5. The interpretation of the percentiles is similar for each of the 3 areas.

2.6.4 Test of Early Mathematics Ability (TEMA-3) by Ginsburg & Baroody (2007).

The study with TEMA-3 by Salgado & Salinas (2012), considered that it is the ideal instrument to assess the level of basic mathematical competence of students in this stage, which can predict the success of future mathematical learning.

This test is aimed to students between 3 and 8 years old, it's composed of 72 items, which assess skills and concepts of informal character with 41 items and formal with 31 items. Within the informal and formal aspects, four components are evaluated. Informal components refer to

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numbering, quantity comparison, informal calculation and basic concepts; the formal ones, to conventions of reading-writing of quantities, mastery of numerical facts, formal calculation and basic concepts of the decimal numerical system. The values of the Cronbach's α coefficient obtained by the authors of the instrument fluctuated between 0.84 and 0.95, with an average of 0.92.

2.6.5 Infant Neuropsychological Maturity Questionnaire (CUMANIN) (Portellano, Mateos & Martinez, 2000). The CUMANIN is a Spanish instrument which evaluates neuropsychological maturity in children between 36 and 78 months, consisting of 132 items grouped into 13 sub-scale, with a Cronbach's α between 0.71 and 0.92. For this study only the reading and writing subscales were used, where the child has to read 10 words and 2 sentences and must write 10 words and 2 sentences dictated by the examiner, in both tests the degree of difficulty increases.

2.7 Data analysis

The Statistical Package for the Social Sciences package (SPSS) version 21.0 was used. The analysis was performed with ANOVA of repeated measures, the student t test and the λ Wilks to measure the effect size of the motor program with executive functions. The significance level is $p \leq 0.05$.

2.8 Bioethical considerations

This study was reviewed and authorized by the General Directorate of Educational Innovation and Teacher Training, of la Junta de Castilla y León. In addition parents were given an informative talk and had to sign a letter of informed consent to approve the participation in the investigation process which also stipulated the confidentiality of personal data.

III. Results

Table n° 1 shows the results obtained from all the tests applied to the boys and girls of the research, which shows that there is a significant difference in the experimental group between the



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pre-test and post-test in cognition, reading, writing, attention and executive function of design, executive function of naming and inhibition. It also shows significant differences between the control and experimental group in the post-test in cognition, motor, reading, writing, mathematics attention and executive function of design and executive function of naming.

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Table nº1. Descriptive statistics of the area of cognition, motor, reading, writing, mathematical competence index (BMI), attention and

Test	Evaluated Areas	Control Group				Experimental Group				Control-Experimental			
		Pre-test	Post-test	(F)	(p)	Pre-Test	Post-test	(F)	(p)	Pre-Test	Post-Test (F)		
		<i>M ± DE</i>	<i>M ± DE</i>			<i>M ± DE</i>	<i>M ± DE</i>			(t)	(p)	(t)	(p)
MP-R	Cognition	101 ± 10.9	103 ± 9.6	0.591	0.448	106 ± 10.8	110 ± 9.8	4.453	0.042*	1.711	0.092	2.753	0.008*
MABC-2	Motor Activity	36.13 ± 28.93	35.09 ± 28.24	0.039	0.845	44.97 ± 30.4	51.94 ± 28.01	2.477	0.125	1.206	0.232	2.429	0.018*
CUMANIN	Reading	61.8 ± 25.4	79.8 ± 19.7	15.816	0.001*	68.6 ± 24.3	90.7 ± 8.8	28.231	0.000*	0.984	0.330	2.847	0.006*
	Writing	65.3 ± 24.6	75.0 ± 26.2	3.726	0.065	68.4 ± 20.2	89.0 ± 12.5	32.231*	0.000*	0.501	0.619	2.719	0.009*
TEMA-3	ICM	97.1 ± 13.9	95.7 ± 15.4	0.751	0.303	106.2 ± 16.6	108.1 ± 15.3	3.314	0.078	2.395	0.020*	3.263	0.002*
	Attention and Executive Function FD	10.6 ± 2.0	9.9 ± 2.3	3.485	0.072	10.2 ± 2.8	11.6 ± 2.9	5.593	0.024*	0.687	0.494	2.520	0.014*
NEPSY	Executive Function IND	9.9 ± 2.8	10.2 ± 3.7	0.352	0.558	10.2 ± 2.7	12.3 ± 3.1	24.460	0.000*	0.505	0.616	2.424	0.018*
	Executive Function INI	9.8 ± 2.2	10.8 ± 3.4	3.321	0.078	10.4 ± 3.1	12.1 ± 3.7	14.215	0.001*	0.864	0.391	1.406	0.165

* Significant Differences ($p \leq 0.05$)

executive functions design flow (DF), executive function denomination (IND) and executive function inhibition (INI). As well as the results of the test F and t for the contrast of means and the level of significance.

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The results obtained in the present investigation showed that in the areas of cognitive, reading, writing, executive functions, motor and mathematics, no significant differences were found between the control group and the experimental group when applying the pre-test.

However, in the post-test, significant differences were found between the control group and the experimental group in the cognitive area ($t = -2.753$ $p = 0.008$). In the control group there were no significant differences between the pre-test and post-test, where there were significant differences in the experimental group ($F = 4,453$ $p = 0.042$) (Table nº 2).

Table nº 2. Descriptive statistics of the cognition area, as a function of the control group and experimental group and results of the test F and t for the contrast of means. MP-R Test.

Evaluated Area	Control Group n=31			Experimental Group n=35		
	Pre-Test	Post-Test	Δ CG	Pre-Test	Post-Test	Δ EG
	$M \pm DE$	$M \pm DE$		$M \pm DE$	$M \pm DE$	
Cognition	101 \pm 10.9	103 \pm 9.6	-1.8 \pm 13.0	106 \pm 10.8	110 \pm 9.8 * F	-3.8 \pm 10.7

* Significant Differences ($p \leq 0.05$) intra group before and after of the intervention in the experimental group

F Significant Differences ($p \leq 0.05$) inter group before and after of the intervention in the control group and the experimental group.

Δ Differences between the pre-test and the post-test.

CG (Control Group), EG (Experimental Group), M (), DE ()

In the motor area, when analyzing the post-test, significant differences were found between the control group and the experimental group ($t = -2.429$ $p = 0.018$). In the control and experimental group, there were no significant differences between the pre-test and post-test (Table nº 3).

Table nº 3. Descriptive statistics of the motor area, as a function of the control group and experimental group and results of the test F and t for the contrast of means. MABC-2 Test.

Evaluated Area	Control Group n=31			Experimental Group n=35		
	Pre-Test	Post-Test	Δ CG	Pre-Test	Post-Test	Δ EG
	$M \pm DE$	$M \pm DE$		$M \pm DE$	$M \pm DE$	
Motor Area	36.13 \pm 28.93	35.09 \pm 28.24	1.03 \pm 29.21	44.97 \pm 30.4	51.94 \pm 28.01 F	-6.97 \pm 26.20

F Significant Differences ($p \leq 0.05$) inter group before the intervention in the control group and the experimental group

Δ Differences between the pre-test and the post-test.

CG (Control Group), EG (Experimental Group), M (), DE ()

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In reading, significant differences were found in the post-test between the control group and the experimental group ($t = -2.609$ $p = 0.012$). In the control group, there were significant differences between the pre-test and post-test ($F = 15,816$ $p = 0.001$), and in the experimental group there were also significant differences ($F = 28.231$ $p = 0.000$).

In writing, significant differences were found in the post-test between the control group and the experimental group ($t = -2.481$ $p = 0.016$). In the control group there were no significant differences between the pre-test and post-test, where there were significant differences in the experimental group ($F = 32,231$ $p = 0.000$) (Table n° 4).

Table n° 4. Descriptive statistics in the area of reading and writing in function of the control group and experimental group and results of the test F and t for the contrast of means. CUMANIN Test

Evaluated Area	Control Group n=31			Experimental Group n=35		
	Pre-Test	Post-Test	Δ CG	Pre-Test	Post-Test	Δ EG
	$M \pm DE$	$M \pm DE$		$M \pm DE$	$M \pm DE$	
Reading	61.8 \pm 25.4	79.8 \pm 19.7 \forall	-17.9 \pm 22.5	68.6 \pm 24.3	90.7 \pm 8.8 * \forall	-21.0 \pm 21.2
Writing	65.3 \pm 24.6	75.0 \pm 26.2	-9.6 \pm 25.0	68.4 \pm 20.2	89.0 \pm 12.5 * \forall	-21.4 \pm 19.6

\forall Significant Differences ($p \leq 0.05$) intra group before and after of the intervention in the control group
* Significant Differences ($p \leq 0.05$) intra group before and after of the intervention in the experimental group
 \forall Significant Differences ($p \leq 0.05$) inter group before the intervention in the control group and the experimental group
 Δ Differences between the pre-test and the post-test.
CG (Control Group), EG (Experimental Group), M (), DE ()

Mathematics found significant differences in the post-test between the control group and the experimental group ($t = -2.395$ $p = 0.020$) in the pre-test and post-test ($t = -3.263$ $p = 0.002$). In the control group there was no significant difference between the pre-test and post-test, however, between the pre-test and post-test in the experimental group, a trend of improvement was found in the experimental group ($F = 3,314$ $p = 0.078$) (Table n° 5).

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Table n° 5. Descriptive statistics in the area of mathematics in function of the control group and experimental group and results of the test F and t for the contrast of means. TEMA-3 Test.

Evaluated Area	Control Group n=31			Experimental Group n=35		
	Pre-Test	Post-Test	Δ CG	Pre-Test	Post-Test	Δ EG
	$M \pm DE$	$M \pm DE$		$M \pm DE$	$M \pm DE$	
Mathematics	97.1 \pm 13.9	95.7 \pm 15.4 #	1.3 \pm 14.2	106.2 \pm 16.6	108.1 \pm 15.3 #	-1.91 \pm 13.8

Significant Differences ($p \leq 0.05$) inter group before the intervention in the control group and the experimental group
 Δ Differences between the pre-test and the post-test.
CG (Control Group), EG (Experimental Group), M (), DE ()

Executive functions (FD) found significant differences in the post-test between the control group and the experimental group ($t = -2.520$ $p = 0.14$). In the control group there were no significant differences between the pre-test and post-test, where there were significant differences in the experimental group ($F = 5,593$ $p = 0.024$).

Executive functions (IND) found significant differences in the post-test between the control group and the experimental group ($t = -2,424$ $p = 0.018$). In the control group there were no significant differences between the pre-test and post-test, where there were significant differences in the experimental group ($F = 24,460$ $p = 0.000$).

Executive functions (INI) did not find significant differences in the post-test between the control group and the experimental group. In the control group there were no significant differences between the pre-test and post-test, where there were significant differences in the experimental group ($F = 14,215$ $p = 0.001$) (Table n° 6).

Table n° 6. Descriptive statistics in the areas of attention and executive function FD, IND, INI, as a function of the control group and experimental group and results of the test F and t for the contrast of means. NEPSY-II tests.

Evaluated Area	Control Group n=31			Experimental Group n=35		
	Pre-Test	Post-Test	Δ CG	Pre-Test	Post-Test	Δ EG
	$M \pm DE$	$M \pm DE$		$M \pm DE$	$M \pm DE$	
Attention and Executive Functions FD	10.6 \pm 2.0	9.9 \pm 2.3	0.7 \pm 2.1	10.2 \pm 2.8	11.6 \pm 2.9* F	-1.3 \pm 3.4

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Attention and Executive Functions IND	9.9 ± 2.8	10.2 ± 3.7	-0.3 ± 3.3	10.2 ± 2.7	12.3 ± 3.1* F	-2.0 ± 2.4
Attention and Executive Functions INI	9.8 ± 2.2	10.8 ± 3.4	-1.0 ± 3.0	10.4 ± 3.1	12.1 ± 3.7*	-1.6 ± 2.6

* Significant Differences ($p \leq 0.05$) intra group before and after of the intervention in the experimental group

F Significant Differences ($p \leq 0.05$) inter group before the intervention in the control group and the experimental group

Δ Differences between the pre-test and the post-test.

CG (Control Group), EG (Experimental Group), M (), DE ()

IV. Discussion

The main objective of this research was to highlight the application of a program of motor activities related to executive functions in early childhood education, as well as to identify the impact of the program on cognition, motor skills, executive functions and the main academic processes such as reading, writing and mathematics (DSM-5, 2014).

In the meta-analysis by Pless & Carlsson (2000), based on the effectiveness of developmental skills programs in children, they concluded that the most effective interventions had occurred under the following conditions 1) With children over 5 years; 2) Using an approach based on the learning of specific skills; 3) In small groups or intervention at home and 4) With a frequency of 3 to 5 times a week. In this study the first three aspects of the mentioned authors were worked in the same way, however, in relation to the number 4, where it affirms that the sessions must be carried out of 3 to 5 times per week. In this investigation it is verified that with 2 weekly sessions organized and systematized are sufficient. Significant differences were found in the motor, cognitive and executive functions, as well as in reading, writing and mathematics, therefore it is important to point out that the application of the motor skills program and the linking the executive functions, the sessions were effective as evidenced by the statistical analysis.

Figure 3 shows the relationship between the different investigations, since they conclude that motor activity and executive functions have an impact on cognitive ability (López, Santos, Pereira, & López, 2013; Roebbers et al., And in the executive functions (Miller, et al., 2013, Piek, Dawson, Smith & Gasson, 2008), Sheikh, Safania & Afshari, 2011) for the benefit of

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learning (Blakey & Carroll, 2015, Nolan, 2004, Westendorp et al., 2011). Consequently, in relation to the results of this research, they are similar since they demonstrate that implementing motor activities programs related to executive functions have a great benefit in different areas of child development. As well as, having structured the gross motor capacities, facilitating the cognitive functioning in the children (Kin, Carlson, Curby & Winsler, 2016; Westendorp et al., 2011), improving the executive functions, have been seen to have greater advantage in terms of letter acquisition and math skills, which are precursors to reading, writing and mathematics achievement (Cragg, & Gilmore, 2014; Carlson, White, & Davis-Unger, 2014; Miller, et al., 2013; Thibodeau, Gilpin, Brown & Meyer, 2016). Other studies show that changes in the behavior of executive functions are shown in early childhood education (Moriguchi & Hiraki, 2013).

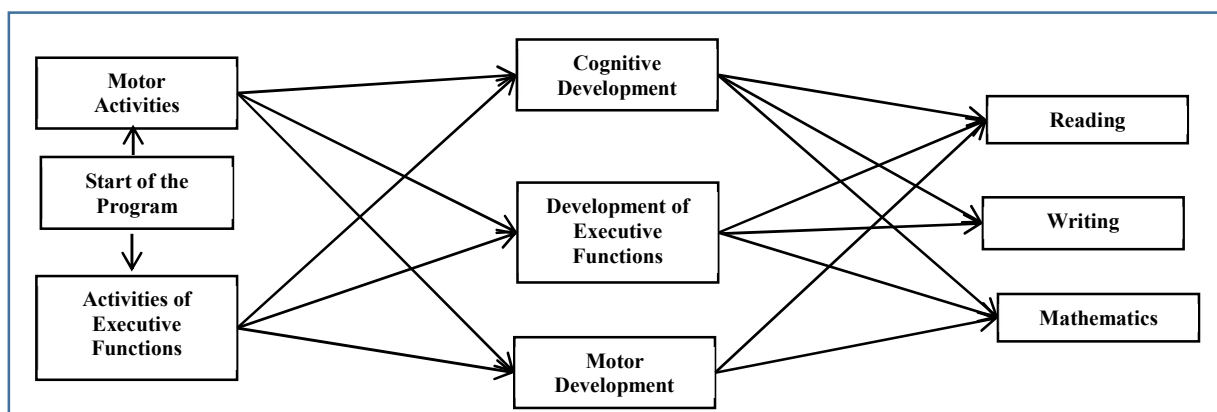


Figure nº 3. Process of the functionality of the motor activities program linked to the executive functions. Source: direct.

In this investigation the most significant result was the effect size of the motor activity program with executive functions, which is described as follows λ Wilks = 0.783 F (18) = 1744 p = 0.031, whereas λ Wilks the closer the program is to 1, which highlights the effectiveness of the program. Sustaining it Silva, et al. (2016) found that by stimulating motor development, motor skills were improved, such as increased motivation for better academic performance. Thus, during childhood and early years of elementary school, it is important to promote physical activity through the development of motor skills (Bornstein, Beets, Byun, & McIver, 2011). Other studies have found that young children are more encouraged with structured and unstructured games to develop motor skills, considering these factors in the applied program (Riethmuller et al., 2009). It has also been shown that children who develop good movement

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skills tend to be more confident, more independent and more likely to succeed academically (Utley, Nasr & Astill, 2010). When the elements of motor development are strengthened at an early age, they are associated with an increase in density relative to gray matter in the premotor cortex when it has reached adulthood (Roebbers et al., 2014). The above is consistent with the results obtained from this research since the boys and girls improved in motor development, cognitive processes and executive functions.

The results obtained in this research are similar to those obtained by Madrigal, Lizano and Vargas (2008), where they conclude that stimulation through movement helps reinforce in children the basic knowledge of mathematics, to stimulate cognitive development and reading processes (Miller et al., 2013; Noguera, Herazo & Vidarte, 2013).

IV. Conclusions

The applied program of motor activities linked to executive functions, showed a significant change in the study population in the cognitive area, motor development, executive functions, in the process of reading and writing, therefore, it is important to consider that this type of programs have a greater emphasis on the educational process, contributing especially in the early years of early childhood education and in the early years of elementary school. In order to be more efficient in solving the problem, they should be considered as a fundamental part of their processes for improving the application of their treatments (Portellano, 1997).

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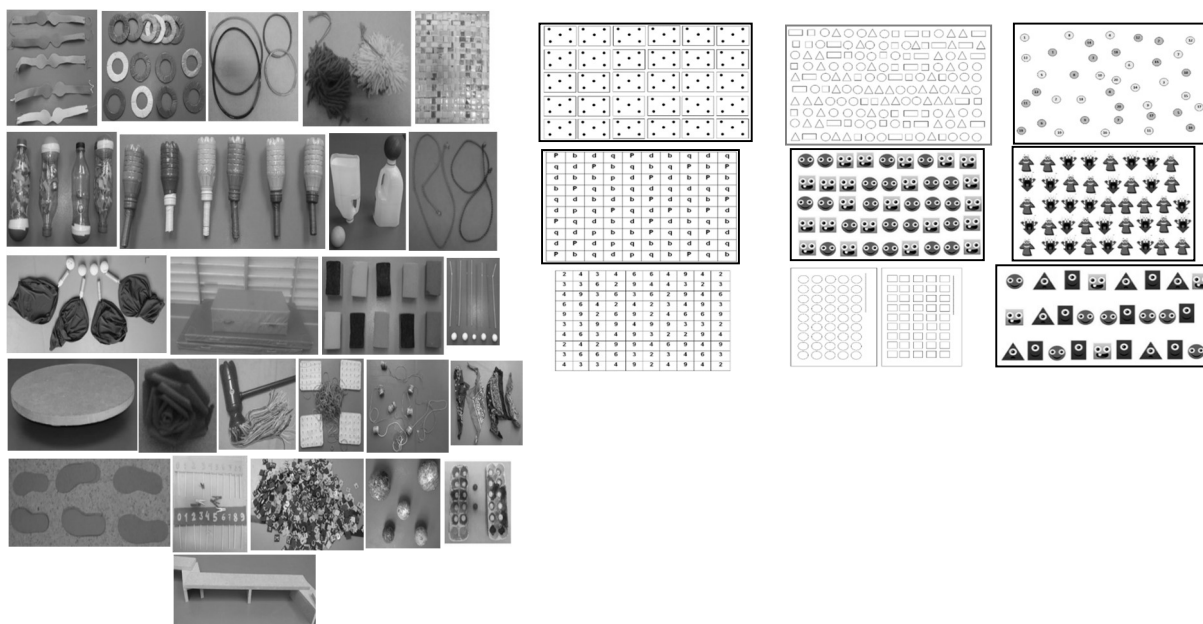
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VI Annexes

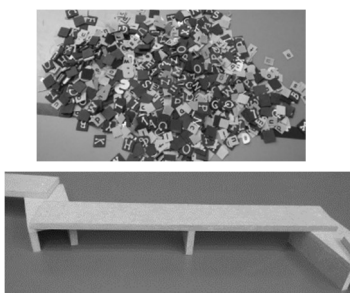
6.1 Material for motor activity



6.2 Files to stimulate attention and executive functions

6.3 Model of the activity planning sheet

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Professor's name: David Arnaldo García Fernández		Scholar Center: León, Spain		
Class time: 70 minutes		Sessions: 1	Date: 09/12/2014 y 12/12/2014	
Purpose of the session: Stimulate the equilibrium through the motor activities and the recognition of some letters.				
Grade	First Grade of Kinder ()	Methodology Global (x) Exploration and solution of problems () Task assignments () learning through experiences ()		
	Second Grade of Kinder ()			
	Third Grade of Kinder (x)			
	First Grade elementary school (x)			
	Second Grade elementary school ()			
General and Specific Aspects	Motor Area	() Locomotive Movements (x) Dynamic Coordination (x) Dissociation (x) Visual motor Coordination () Fine Motor	Materials Leton's balance girder	Values Respect Auto control Discipline
	Perceptions	() Auditive () Tactile (x) Visual		
	Body layout	() Imitation () Exploration () Body notion () Utilization () Creation		
	Laterality	() Laterality differentiation (x) body orientation () Projected body orientation		
	Spatial Location	() Spatial Adaptation () Spatial notion () Spatial orientation () Spatial structure () Graphic space	Photo of the Material 	
	Equilibrium	() Static () Dynamic		
	Temporal Location	() Temporal notions () Temporal orientation () Temporal structuration		
	Rhythm	() Rhythm regulation () Adaptation to a rhythm () Repetition of a rhythm		