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## Development of the body scheme in children in primary education: a systematic narrative review of the influence of an intervention plan on this psychomotor component

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### Abstract

*Aim:* The purpose of this review is to summarize the scientific literature that examined the importance of physical activity programs in the development of body scheme in primary school students by identifying methods and tests used to test body scheme on motor development, spatial-temporal orientation and coordination.

*Method:* Using the electronic databases Research Gate and Web of Science, we searched for articles using key words, including terms related to methods, intervention plan, children's age and body schemes. We selected only those that followed the influences of an intervention plan on children.

*Results:* We selected 30 articles regarding the development of the body scheme, the spatial-temporal orientation and the coordination through an activity plan. The study results in the three categories show a significant influence on body scheme, spatial orientation and coordination. Following the tests applied and the results obtained, we can say that a well-structured program of physical activity influences the child's development in terms of body scheme. If it is correctly integrated, one can avoid the existence of body diagram disorders that are quite common for children.

*Conclusion:* The harmonious physical development of the child is influenced by a program of physical activity. Early participation in these programs is recommended in order to avoid disorders of body scheme.

*Key words:* body scheme, physical education, intervention plan.

### Rezumat

*Scop:* Scopul acestei revizuirii este de a sintetiza literatura științifică care a examinat importanța programelor de activitate fizică în dezvoltarea schemei corporale la elevii din școala primară identificând metodele și testele utilizate pentru testarea schemei corporale privind dezvoltarea motorie, orientarea spațio-temporală și coordonarea.

*Metodă:* Folosind bazele de date electronice Research Gate și Web of Science au fost căutate articole, cu criterii de căutare, inclusiv termeni legați de metode, plan de intervenție, vârsta copiilor și schema corporală. Am selectat doar care au urmărit influențele unui plan de intervenție asupra copiilor.

*Rezultate:* Am selectat 30 de articole, care vizează dezvoltarea schemei corporale, orientarea spațio-temporală și coordonarea prin intermediul unui plan de activitate. Rezultatele studiilor din cele trei categorii arată o influență semnificativă asupra schemei corporale, orientării spațiale și coordonării. În urma testelor aplicate și rezultatelor obținute putem afirma că un program bine structurat de activitate fizică influențează dezvoltarea copilului din punct de vedere al schemei corporale care fiind corect integrată evită existența unor tulburări de schemă corporală destul de frecvente la copii.

*Concluzie:* Dezvoltarea fizică armonioasă a copilului este influențată de un program de activitate fizică, fiind indicată participarea timpurie la aceste programe pentru evitarea tulburărilor de schemă corporală.

*Cuvinte cheie:* schema corporală, educație fizică, plan de intervenție.

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## Introduction

Body scheme influences motor development. It is a stage of motor development in which body movements and positions become known through contact with various objects in the environment. As a result, the body scheme is considered the image that each person has about his own body in the relationship between body segments and the environment. The influences of Physical Education and Sport on this concept are observed from the general and specific objectives of physical education, that target harmonious physical development and prevention and correction of postural and physical deficiencies. Also, the psychomotor objectives influence the development of the body scheme in two directions: as the nucleus of the self-image and as a landmark in the adjustment of movements. The formation of the body scheme is a process that goes through several stages. In the first stages is about the importance of free movement in the family environment followed by movement in various psychomotor activities [1]. Along the way, the child manages to know the parts of the body, by observing each segment, a stage followed by the spatial-corporal orientation and then by the temporal-corporal orientation. Physical education and Sport through its objectives influence the development of the body scheme by forming time coordinates of movements and memorizing them, developing static and dynamic balance and motor intelligence. These abilities and attitudes are formed during a learning cycle [2].

Physical activity is associated with many benefits for the development of the body scheme but most children do not meet national recommendations. Prevention of body scheme problems is considered to be one of the benefits for children to become more active, therefore most interventions aimed at developing the body scheme incorporate a physical activity program. Participation in various programs of additional physical activities has a positive effect on the evolution of the body scheme contributing to the perceptual-motor development of the child [3].

The purpose of this review is to summarize the scientific literature that has examined the importance of physical activity programs in the development of body scheme in primary school students by identifying methods and tests used to test body scheme on motor development, spatial-temporal orientation and coordination. What was most interesting were the methods used to analyze the influence of physical activity on the body scheme and how the intervention plan was applied and the results obtained.

**Hypothesis:** It is assumed that with the help of a structured plan of physical activity, PE class can influence the development of children's body scheme in primary school.

## Methods

### A. Inclusion criteria

The studies were included if:

- the subjects were aged between 6-11;
- they used the following tests: Goodenough, Piaget-Head, Harris, Ozeretski-Guillmann
- they used the experimental method;
- they were written in English, French or Spanish.

Studies were excluded if:

- the subjects were over the age of 11;
- they did not use structured intervention programs;
- there were review articles, case studies, conference papers, editorials, abstracts and letters.

### B. Information Source

We used the electronic databases Research Gate and Web of Science for finding the articles. The search criteria included terms such as methods, intervention plan, age of children and body diagram. We selected only the articles related to the influences of an intervention plan on children. The keywords used were: "body scheme", "physical education", "intervention plan".

## Results

The initial search resulted in 120 articles, from which we selected 30 according to the inclusion criteria. 2 articles were deleted because they appeared as duplicates in the various databases. 12 other studies were deleted after a review of the title. 76 of them did not meet the inclusion criteria. Thus, a total of 30 studies were included in this narrative review about the development of the body scheme, spatial-temporal orientation and coordination through an activity plan (figure 1). For the analysis and discussion of the results, the following data were extracted: subject (sex, age); study design; tools; intervention; results. We divided the results section according to the main results obtained from the studies and the psychomotor component analyzed. Table 1 shows the subjects (sex, age), method of analysis and main results of the selected studies in terms of motivation.



**PRISMA 2009 Flow Diagram**

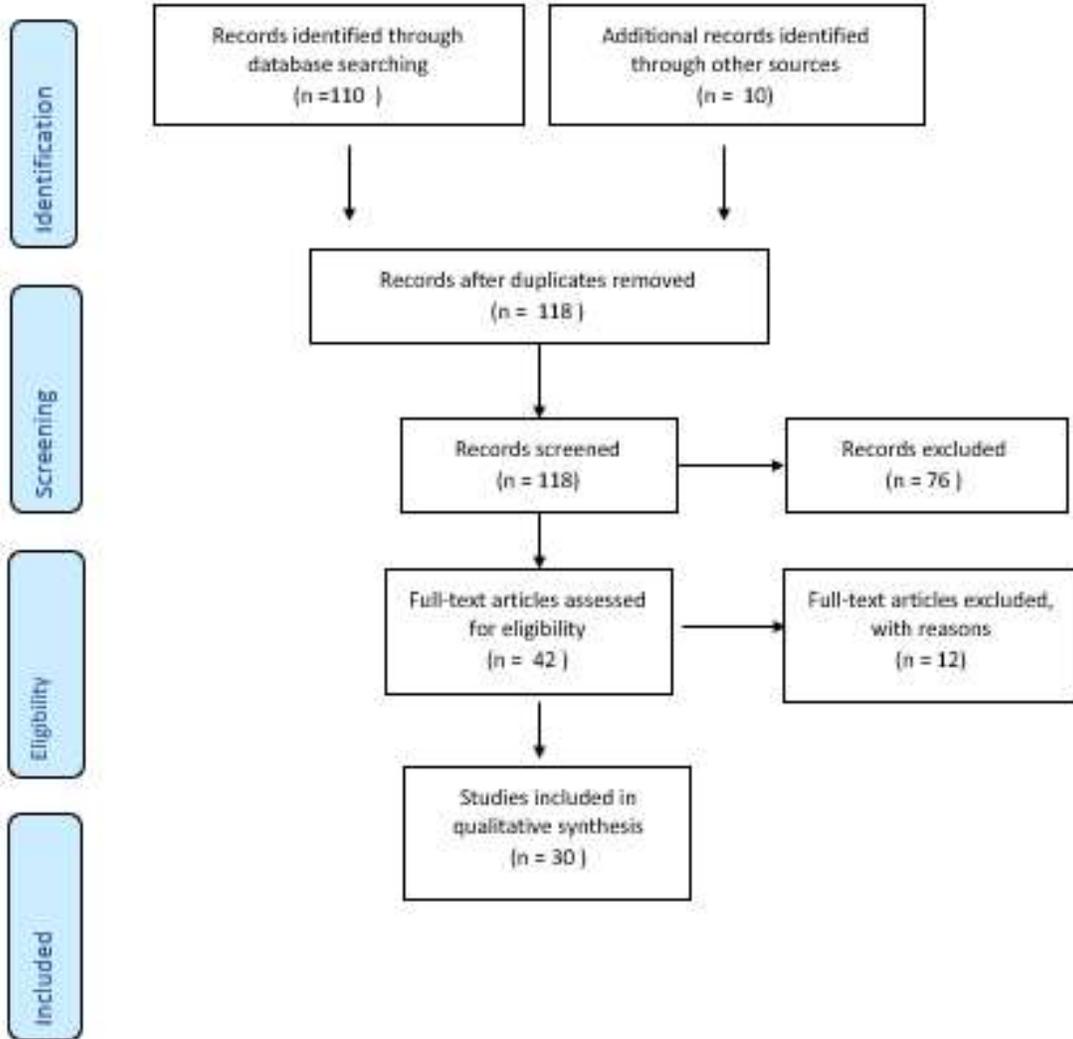


Fig. 1 Diagrama Prisma

**Table 1.** Results of the selected studies

No.	Article	Target group and psychomotor component analyzed	Method	Results
1.	Hélder, J., Teixeira, C., Barcala-Furelos, R. (2015)	324 children Aged between 3 and 5 years. Body scheme.	Psychomotor assessment test.	The role of preschool education is fundamental to the child's development process. Structured physical education is important for the psychomotor development of preschool children because it increases their overall development.
2.	Ene, M., I., Iconomescu, T., M., Talaghir, L., G., et. al (2016)	96 children Aged between 4 and 6 years. Body scheme and space-time orientation	Their testing was obtained by adapting the test that highlights the ability of spatial orientation and body scheme.	After tests, it was observed that after completing the physical activities with the proposed objectives, the spatial orientation and body schemes improved significantly. Physical activities significantly influence the development of body scheme and spatial orientation.
3.	Arnáiz Sánchez P., Lozano Martinez J. (1992)	45 children Aged between 5 and 6 years. Body scheme.	Goodenough Test	The children who participated in this educational experience enriched their training process and the elaboration of the body scheme.
4.	Sabău, E., Niculescu, G., Gevat, C., Lupu E. (2014)	65 children Aged between 6 and 8 years. Body scheme and space-time orientation	Body awareness test; Temporal awareness test; Spatial awareness test.	Perceptual-motor experiences build a strong foundation to support future academic learning. It is important for children to start perceptual-motor training earlier. Physical activity contributes to the child's perceptual-motor development and his healthy lifestyle.
5.	Beaulieu, J., (2000)	20 children Aged between 3 and 4 years. Body scheme.	Peabody Motor Development Scale Test (Folio and Fewell, 1983)	Practicing psychomotor activities has a significant influence on the child's development.
6.	Cristuță, A., Gloria, R. (2015)	Aged between 6 and 11 years. Body scheme, laterality, space-time orientation	Piaget-Head Test (right – left) Test Harris, Ozeretski-Guillmain Test	Children in primary education have a different level of manifestation of psychomotor skills.
7.	Abalașei, B., Popescu, L., (2017)	1 child Age: 6 years Body scheme	Goodenough Test	Body scheme plays a key role in the child's evolution. It influences both the growth process and the development process of the individual.
8.	Făgăraș P., S., Rus C., M., Vanvu G. (2014)	34 Aged between 51 and 72 months ± 3 moths. Body scheme	Goodenough Test	The education of the perceptual motor structure can be considered to be an element of the upper structure in the body diagram.
9.	Angel, P. Riano, J. y Rivera, A. (2019)	22 children Aged between 4 and 6 years Body scheme	Goodenough Test	Playful activities, focused on promoting the definition of laterality, coordination and global practice, as well as experiential activities with pedagogical orientation, focused on acquiring various experiences from the senses are the main ones to promote the development of the body scheme.
10.	Rintala, P., Pienimäki, K.,	54 de children	Psychomotor proficiency test	The movement contributes to the overall development of children with developmental disorders.

	Ahonen, T., Cantell, M., & Kooistra, L. (1998)	Aged between 6 and 10 years. Body scheme.		
11.	Volle M. et al. (1984)	Aged between 6 and 11 years. Body scheme Laterality.	Body perception test Piaget Head Test	The influence of a necessary physical education program on children in primary schools between the ages of 6 and 11, reports a significant result on the development of the body scheme.
12.	Hélder, J., Teixeira, C., Barcala-Furelos, R., Abelairas-Gomez, C., Arufe-Giraldez, V. (2015)	95 de elevi Aged: 3 years Body scheme	Psychomotor tests (pre-tests) were used to assess the development of students' body patterns.	The structure of a physical activity program is important for preschool children because it increases their overall development.
13.	Pescari, T., A., Popescu T., L. (2012)	Aged between 5 and 6 years Body scheme.	Test used: Psychomotor scale portage containing 28 parameters	The prophylactic program applied to improve the luggage and engine components of the subjects was a real success and the results obtained lead to the confirmation of the hypotheses.
14.	Dellatolas, G., Viguier D., Deloche, G., De Agostini M. (1998)	Preschool children aged between 5 and 6,4 years took part in this study.	Simple cognitive tasks: children were asked to show their left hand, right eye, left ear and right hand.	The differential use of logical thinking can partially explain these differences. The neuropsychological implications of these developmental findings are discussed
15.	Corral-Guillé, I., Rivera-González, R., Ontiveros-Mendoza, E., et al. (2019)	58 children Aged between 3 and 5 years Body scheme	Picq and Vayer Test Wechsler Preschool and Primary Information Scale (WPPIS).	Psychomotor development in preschoolers is the main predictor of the performance function of children with hypothyroidism.
16.	Gallotta, M., Baldari, C., Guidetti, L. (2018)	25 girls Aged between 4 and 6 years Body scheme	BOT-2 Bruininks-Oseretsky motor skills test-Short form (BOT-2 SF).	A playful and extremely varied intervention of physical activity, performed by a specialized teacher, was more effective for the development of motor skills of preschool girls.
17.	Gomendio, M.; Maganto, C. (2000)	47 subjects Aged between 6 and 7 years.	Picq and Vayer test (1985 Silva and Martorell socialization battery (1983)	The results highlight the effectiveness of a physical activity program for children, aimed at psychomotor development, improving self-concept and developing socialization.
18.	Martínez, E., J., Justo, C., F. (2008)	43 children Aged between 4 and 5 years. Body scheme, motor development	PCAM (Thinking Creative in Action and motion) (Torrance, 1980)	Psychomotor intervention is a valid and effective procedure for improving motor creativity in early childhood.
19.	Neto, F., R., Amaro, K., N., Prestes, D., B., Arab C. (2011)	39 children Aged between 6 and 10 years.	Body scheme was evaluated by the motor skills	The development of motor skills, especially the body scheme are fundamental for the development of skills essential for academic learning.

		Body scheme.	development scale - EDM	
20.	Mori, H, R. (2008)	90 children Aged between 5 and 8 years. Body scheme and coordination.	Test: the psychomotor scale in Picq and Vayer	Coordination and motor skills are related to memory. Motor skills are related to spatial relationships.
21.	Serrano, J., Castel-Branco, A., (2018)	18 children Aged between 4 and 6 years Body scheme	Goodenough Test	We can see an evolution in relation to the number of indicators in the graph of children aged between 4 and 6 years.
22.	Valenta, M., (2018)	Aged between 5 and 8 years. Spatial-temporal orientation Body scheme.	Test: subtest E of the battery test.	It can be concluded that it is possible to reject (among all subjects) null hypotheses of the three hypothetical statements.
23.	Cousin, S., (2005)	Aged between 8 and 9 years Body scheme, coordination/balance	Bruininks Oseretsky Motor proficiency test (1978)	The impact of implementing an individual program in physical education and primary health classes has a significant influence
24.	Gervais, I., (2005)	Aged between 5 and 6 years. Body scheme, coordination.	Goodenough Test	This study opens up interesting directions of exploration in terms of raising children's bodies
25.	Oprea A., (2004)	24 children Aged between 4 and 13-14 years Body scheme, coordination.	Ozeretski - Guilmann Test	Following the application of a complex program for the recovery of psychomotor skills, the fourth-grade students from the special school, with moderate / mild deficiency and the second-grade students from the mainstream school can, due to the level of development of psychomotor skills level obtained after application the intervention program, carry out the physical education class together, without any significant differences between the two groups of students.
26.	Lynette Dunbar, B., (2010)	Aged between 6 and 7 years Body scheme	Test battery	The change in awareness of body patterns was significant at a percentage level, with three degrees of freedom, but movement skills failed to show a change that was statistically significant.
27.	Mello, L., M., (2003)	40 children Age: 9 years Body scheme	Goodenough Test	In the test, the results showed a better score for females and there was a narrow relationship between the number of articles and school performance.
28.	Mamani, M., Casa, M., Cusi, L., Laque, G. (2019)	234 children Aged between 5 and 6 years Body scheme	Goodenough Test	The results indicate that 30.1% of children aged 5 and 6 years have a bright level of normal knowledge. According to age, 37.5% of 6-year-olds have a much higher level of knowledge than 5-year-olds. It is concluded that most children have a level of normal knowledge that is bright to far superior.
29.	Arnáiz Sánchez, P., Lozano Martínez J., (1992)	45 children Aged between 4 and 6 years Body scheme	Goodenough Test	The children who participated in this educational experience had an enriched process of formation and elaboration of the body scheme
30.	Bălan, V., Mitrache, G., (2015)	1 child Age: 11 years Body scheme.	Goodenough Test	Body scheme is one of the basic psychic structures for the mental and somatic development of the individual. The development of the body scheme represents a basis for the constitution of the psychic interior.

**Research overview**

Comparing the articles in the first category that follow the influences of a structured intervention program on psychomotor development, we notice that the age of students who participated in the study is specific to primary education. The design of the articles is similar to the method used, namely the experimental one. The subjects are randomly divided and structured programs are used between pretest and posttest in order to identify how body scheme is influenced in primary education. Even though the intervention programs differ, when comparing the results we notice that they significantly influence the development of the body scheme. Test results show that after completing a structured program of physical activity the body scheme improved significantly ( $p < .05$ ). Thus we can conclude that physical activity program is important in the development of the body scheme. If the body scheme is correctly integrated, the child will develop harmoniously, but if there are disorders, they will negatively influence the child's development. The body scheme is an element that underlies the child's psychomotor development.

The articles in the second category emphasize the importance of a structured intervention program on psychomotor development in primary school students. The design is similar due to the method used, the experimental one, the random division of the subjects and the use of interventions in pre and post-test phases. The purpose is to identify how they influence the body scheme and the spatial orientation. The mode of intervention is different through the program and tasks used. However we notice that the test results show a significant improvement in both body shape and spatial orientation. Based on the conclusions from statistical results we can say that early participation in a structured program or right-left exercises reduce disorders of body pattern and laterality, bringing a plus in the emotional, social and behavioral life of students. The last category includes articles that targets the psychomotor development on body scheme and coordination after the application of a structured program of activities. The design is similar through the experimental method used, randomization of subjects and the use of programs of activities as an intervention. Even though there are significant differences the purpose is the same: to observe the influences on primary school students after applying the intervention plan. Comparing the results we notice a significant improvement of coordination and body scheme regardless of the intervention plan applied. Based on the statistical results we can say that participation in a physical activity program contributes to the development of coordination and body scheme. Comparing the three categories, we notice that the age of the study participants is similar. The target group is primary school students. The design used in all the three categories is similar. All used the experimental method. There was a control group and an experimental group. There was an initial test, followed by the intervention and the final. The common goal was

to influence body scheme through structured programs. The articles in the second category also followed the influences on spatial orientation. Those in the third category in addition to the body scheme also monitored coordination after the application of a structured physical activity plan. The results of the studies in all categories show a significant influence on body scheme, spatial orientation and coordination. We can conclude that a well-structured program of physical activity influences the child's development in terms of body scheme, which if correctly integrated avoids the existence of body scheme disorders, that are quite common in children. The harmonious physical development of the child is contingent on a program of physical activity.

**Discussions****A. Summary of records**

The detailed analysis of several pieces of information led to several conclusions regarding the aspects involved in the evolution of the body scheme. Most specialists agree with the education of body scheme through various physical activity programs at an age adaptable to psychomotor changes. Volle M. and Tisal M. [3] examined the influence of a physical education program on primary school children for four years. In the first two years the emphasis was on socialization, independence and the development of various motor skills. In the other two years the main goal was to build cardiorespiratory and muscular strength. Additional physical activity showed a positive result on the development of body scheme. Children from the supplementary classes had an additional 5 hours of physical education per week while the control group continued with the standard Quebec program. The tests applied after going through the training program under the guidance of the physical education teacher were the perception of body dimensions, the Piaget laterality test, verticality, finger recognition. These were performed annually by a professional psychologist. Mello, L., M. [4] demonstrates in his study the importance of a physical education program based on skill themes. The children's ability to generate different movement patterns has been significantly improved in response to the use of critical thinking strategies in physical education. The study involved 50 children divided into three groups (A, B, C). Each group received different tasks. Group A of 16 children had 20 physical education lessons based on skill topics using indirect teaching styles. Group B of 17 children had 20 lessons on organized games using direct teaching styles. Group C of 17 children received no treatment. Statistical analysis revealed that group A scored higher compared to group C in the posttest. Gamendio M. and Magando A. [5] highlight through the results of their study the effectiveness of a physical activity program for children oriented towards psychomotor development, self-improvement and socialization

development. The experimental group highlights a positive effect of the intervention program in dynamic coordination, balance, spatial organization and self-conception reducing apathy and withdrawal behaviors. The experimental group of 23 first grade students had 25 lessons during the year according to the program, and the control group of 24 students attended the courses imposed by the school. In the pre and post-test phase, the following evaluation tools were administered: Picq and Vayer psychomotor profile, Villa and Auzmendi self-conception perception scale, and Silva and Martorell socialization battery.

Cousin, S. [6], presents through the results of his study certain indicators that are related to the implementation of an individual program in physical education classes, emphasizing the improvement of participants' motor skills. Bruininks Oseretsky Motor Proficiency Test was chosen for testing to measure gross and fine motor skills in children aged 8 to 9 years. Sabău, E., Niculescu, G., et al. [7], considers that perceptual motor experiences build a strong basis to support future academic learning. This is important for the child's development if physical training and physical activity start at an appropriate age. It also contributes to the perceptual motor development of the child and his healthy lifestyle. The statistical analysis reported a significant result. There were differences between the first group that participated in additional sports activities and the second group that followed the physical education course according to the curriculum. In their study, Hélder, J., Teixeira, C., et al. [1] present the importance of physical education and the role of the physical education teacher in the development of children aged 5 to 6 years. This stage through the quality of teaching practices stimulates children in terms of characteristics and individual needs, and the development of several essential skills. The statistical analysis reported a significant result observing the differences between the control group and the experimental one that participated in a program developed by the physical education teacher. Those in the control group did not have access to this program and took part in the standard program imposed by the Ministry of Education. Gallota MC and Baldari C. [8] consider a playful and extremely varied intervention of physical activity performed by a specialized teacher more effective for the development of children's motor skills. The statistical analysis of the control group practicing independent physical activities and the experimental group performing various physical activities under the guidance of a specialized teacher reports significant differences in control and coordination, speed and agility. Oprea A. [9] highlights through the results of his study the importance of a physical activity program. The main objective in his research was to assess psychomotor abilities, using the Ozeretski - Guilmann test before and

after the application of the intervention program. The results show that those who benefited from the intervention program registered significant improvements on psychomotor skills.

The conclusions we observed in all the studies evaluated in this review are as follows:

- Studies have highlighted the role of Physical Education teachers in child development. We argue that Structured Physical Education is important for the psychomotor development of preschool children because it increases their overall development.
- After completing the physical activities with the set objectives, the spatial orientation and body scheme improved significantly. Physical activities significantly influence the development of body scheme and spatial orientation.
- Body scheme has a key role in the child's evolution. It influences both the growth process and the development process of the individual.
- Children who participated in educational programs, enriched their training process and the development of the body scheme.
- The influence of a necessary physical education program on children in primary schools, reports a significant result on the development of the body scheme.

#### **B. Limitations of this review**

It can be considered that the limitations of this study are related to the Physical Education curriculum imposed by the ministry which could influence the results of the elements discovered through the intervention plans. From the beginning of this analysis, we specified that we are looking at how an intervention program influences the body scheme. We considered that the follow-up of the results is necessary, in order to later conclude whether an intervention from a kinesthetic perspective is necessary.

#### **Conclusions**

Body scheme is considered to be the image that each individual has about his body, through which he appreciates the relationship between body segments and the environment. Another approach to this concept comes from the perspective of neuropsychology, through the analysis of developmental disabilities, stages of knowledge and use of the body scheme through neuropsychology. The influences of Physical Education and Sports on this concept can be observed from the general and specific objectives for the harmonious physical development and correction of physical and postural deficiencies but also through psychomotor objectives that influence the development of the body scheme in two directions: the core self image and as a landmark. in the formation of movements. The formation of the body scheme is a

process that goes through several stages. In the first stages we can see the importance of free movement in the family environment followed by movement in various psychomotor activities. Along the way, the child manages to know the parts of the body, by observing each segment, a stage followed by the spatial-corporal orientation and then by the temporal-corporal orientation. Physical education and Sport through its objectives influence the development of the body scheme by forming the time coordinates of movements and their memory, the development of static and dynamic balance and motor intelligence. These abilities and attitudes must be formed during a learning cycle.

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