



PANORAMA  
ISSN: 1909-7433  
ISSN: 2145-308X  
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Politécnico Grancolombiano  
Colombia

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PANORAMA, vol. 13, núm. 25, 2019

Politécnico Grancolombiano, Colombia

**Disponible en:** <https://www.redalyc.org/articulo.oa?id=343963314031>

**DOI:** <https://doi.org/10.15765/pnrm.v13i25.1263>

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Artículos de investigación científica y tecnológica

# STRENGTHENING PROBLEM-SOLVING CAPACITIES THROUGH THE DEVELOPMENT OF MOTOR SKILLS IN STUDENTS IN THE FIFTH (5TH) GRADE OF ELEMENTARY SCHOOL

Fortalecimiento de la capacidad de resolución de problemas a través del desarrollo de habilidades motrices en los estudiantes del grado quinto de básica primaria

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PANORAMA, vol. 13, núm. 25, 2019

Politécnico Grancolombiano, Colombia

Recepción: 11 Diciembre 2017  
Aprobación: 21 Marzo 2019

DOI: <https://doi.org/10.15765/pnrm.v13i25.1263>

Redalyc: <https://www.redalyc.org/articulo.oa?id=343963314031>

**Abstract:** The right to education is only possible if the school complies with the social mandate to impart knowledge that demonstrates the application of criteria, methodologies and didactic strategies required for students' comprehensive training. Strengthening problem-solving capacities through the development of motor skills is a process that is based on rescuing physical education from an often-unfair undervaluation of the area, which has prevented teachers from making significant contributions to the improvement of pedagogy and educational quality through the execution of their curriculum. This is the premise that guided the research herein, which, following a descriptive qualitative design methodology and the application of a didactic unit, concludes that there is an intimate relationship between motor development and the development of cognitive skills, strengthening students' problem-solving capacities and critical thinking to a great extent.

Education, comprehensive training, problem-solving capacity, motor skills, physical education, study plan, educational quality, pedagogy, undervaluation, methodologies, didactic strategies, didactic unit, cognitive ability, critical thinking.

<https://doi.org/10.15765/pnrm.v13i25.1263>

**Keywords:** Education, comprehensive training, problem-solving capacity, motor skills, physical education, study plan, educational quality, pedagogy, undervaluation, methodologies, didactic strategies, didactic unit, cognitive ability, critical thinking.

**Resumen:** El derecho a la educación solo es posible si la institución escolar cumple con el encargo social de impartir conocimientos que evidencien la aplicación de criterios, metodologías y estrategias didácticas requeridas para la formación integral de los estudiantes. El fortalecimiento de la capacidad de resolución de problemas por medio del desarrollo de habilidades motrices es un proceso que se fundamenta en el rescate de la Educación física de esa injusta mirada de subvaloración del área, impidiendo que desde la ejecución de su plan de estudios por parte de los docentes se puedan hacer aportes significativos para el mejoramiento de la pedagogía y la calidad educativa. Esta es la premisa que orientó la presente investigación, que con un diseño cualitativo descriptivo en su metodología y después de aplicar una unidad didáctica, concluye que existe una íntima relación entre el desarrollo motor y el desarrollo de habilidades cognitivas, fortaleciendo en gran medida la capacidad de resolución de problemas y el afianzamiento de un pensamiento crítico en los educandos.

**Palabras clave:** Educación, formación integral, capacidad de resolución de problemas, habilidades motrices, educación física, plan de estudios, calidad educativa, pedagogía, subvaloración, metodologías, estrategias didácticas, unidad didáctica, habilidad cognitiva.

## INTRODUCTION

The research entitled “Strengthening Problem-Solving Capacities Through the Development of Motor Skills in Students in the Fifth (5<sup>th</sup>) Grade of Elementary School” focuses on the problem of the insignificance given to the area of physical education, recreation and sports, in the implementation of the study plans in the branch of San Marcos de Leon of the Simon Bolivar Educational Institution, located in the municipality of Planeta Rica, department of Cordoba.

The purpose of the project was to follow-up on motor skills as prerequisite to strengthen problem-solving capacities, based on the aforementioned discipline’s teaching.

The theoretical perspective was built based on references to the phenomenon of undervaluation and marginalization of physical education in the educational process; it also addresses studies on the importance of motor skills development over cognitive skills generation and on the individual’s comprehensive training.

The qualitative descriptive methodology derived from a non-experimental study allowed describing students’ behavior, basically from the moment in which previous ideas were identified, and helped overcome learning obstacles based on the application of a didactic unit as instrument to determine the strengthening of problem-solving capacities through motor development.

The conclusion was that motor development is a fundamental process in the generation of cognitive skills, which enable the development of problem-solving capacities in different contexts.

### *Identification of the Problem*

The research process was steered by the question: How to strengthen students’ problem-solving capacities through the development of motor skills in the area of physical education, recreation and sports?

In those terms, the identification of the problem included the following elements:

The right to education. Ensuing this constitutional mandate, educational institutions must abide by the social order of sharing knowledge and training based on quality education that is equivalent to the community’s expectations in terms of the service rendered by school system.

This intention has not been fulfilled because of the prevailing tradition and culture in education as to the sense of prioritizing certain areas from the development of the pedagogical process, neglecting the content and importance of others that, from the design of the study plan, are

considered irrelevant subjects. As with the specific case of “physical education, recreation and sports, an area that has not been valued in all the entirety of its dimension” (Saenz – Lopez, 1995).

On some occasions, children engage in nursery rhymes and popular games while they wait for their turn for a sports activity scheduled for the day. There is still a “lack in motivating teachers to exploit their motor skills and dexterities” (Bores, Castrillo, Diaz and Martinez, 1994, p.41). This situation reflects the ideas of Protoc (cited by Kirk, 1990) who described that physical education practically has no identity as a subject and that “it is currently becoming the recipient of a mix of unequal activities (dance, football, play)”. Some studies correlate motor development with children’s cognitive development and language (Yamauchi, Aoki, Koike, Hanzawa, & Hashimoto, 2019; Zeng *et al.*, 2017).

Therefore the problem lies in the difficulty of teachers to implement the development of the guidelines and fundamentals of the area of physical education, recreation and sports. As proposed by Dorado (2015, p.23), “physical education is considered an activity which opposes the development of the mind”, being unaware of the importance of this discipline to contribute to the interdisciplinary development, along with the other areas in the study plan.

The area’s undervaluing and lack of awareness by teachers regarding the discipline’s specific knowledge and prerequisites set it aside from educational priorities, as Saenz – Lopez (1999) explain “the marginality of physical education as an area of little importance”.

With the aim of making improvements, these obstacles must be an given adequate treatment that is based on the design of a pedagogical and didactic proposal focused on redirecting teaching and learning of the area which is the subject of this study, in order to understand the connection between motor development and the cognitive process, exhorting that children’s performance when exercising their motor skills reflects their level of qualification in terms of cognition and thinking skills.

As concluded by Campo Ternerera (2010), “a child with expected motor skills for his/her age, will accordingly reflect cognitive and language development”. Knowledge of these theoretical and practical implications is a basic aspect, not just for physical education teachers, but for every agent involved in the educational process, thus contributing to the development of meaningful specific and interdisciplinary knowledge, and to the betterment of standards of educational quality, “getting over traditional teaching as an outdated model in the area of physical education” (Camacho and Amaya, 2011).

Finally, a study entitled “Do Cognitive Training Strategies Enhance the Development of Motor and Positive Psychological Skills in Football Players? Perspectives of a Systematic Review”, analyzes how younger football players use overall and specific cognitive images techniques to a greater extent than older players (Slimani *et al.*, 2016), which could encourage this research’s hypothesis in this research.

## THEORETICAL FRAMEWORK

The theoretical framework was built with ideas that deem physical education as a fundamental area, rebutting the notion of undervaluation that was identified in several studies. It also articulates the theories of motor development and its effect on problem-solving capacities.

Concerning the undervaluation of the area of physical education, the work on the importance of this primary discipline by Saenz-Lopez (1999) stands out; conducted in Universidad de Huelva with beginner teachers of physical education, its main purpose was to diagnose the most noteworthy problems of teachers who have recently graduated, one of the main objectives was to get to know the significant valuation of this subject in elementary schools (Yi, Kang-Yi, Burton, & Chen, 2018; Chan & Fung, 2018; McCoy, Zuilkowski, & Fink, 2015). It concluded that teachers' performance does not match the expectations of the area in terms of development of competences, skills and comprehensive development processes.

Likewise, Garcia (1994) reiterates "physical education's low status is due to a lack of specialists, material or facilities". Bores, Castrillo, Diaz and Martinez (1994, p. 40), collecting students' opinions, which assert that "another manifest constant is the undeniable regard of P.E. (physical education) as a secondary subject". On the other hand, according to these results, the cognitive learning applied to sports students is considered to be positive in the development of basic skills and is connected with increasing athletic and academic performance, as well as sports sequences (Turan, Dişçeken, & Kaya, 2019).

Causes for this situation are diverse. On one hand, Kirk (citing Hargreaves, 1977) comments that "unfortunately, some subjects, preoccupied with developing the child's intellect, are considered to be above other practical subjects such as physical education, which for many, is last on the knowledge hierarchy".

From a psychological approach, a review study shows the connections between dynamic systems and development theories that may be analyzed in education. To do so, it mentions some background on the appearance of complex systems in psychology, which resulted in its inclusion in developmental psychology, especially synergy and its application to Bernstein's theory of movement. Esther Thelen and Paul van Geert state that developmental psychology is explained by describing several properties of dynamic non-linear systems and some types of methods to study the psychological change that may affect the teaching processes in this area (Castro-Martinez, Sierra-Mejia and Florez-Romero, 2012).

There is a belief of low status in the association between physical activity and intellectual capacities. Just as McDonald (cited by Dorado, 2015) manifests that "physical education is considered a manual activity, contrary to the mental activity that predominates in school, which is why some students and teachers consider it to be devaluated". Pascual (1997, pp. 20-21) believes that "also influencing this discredit is the current idea about education in which technology and scientific knowledge

thrive, yet physical education seems to be left out”. Other studies suggest the possibility of associating social conditions, examining children with higher socioeconomical levels and proposing differences caused by unequal access to meaningful content in learning processes (Florez-Romero, Arias-Velandia and Benitez-Camargo, 2013).

Contextualized in the Colombian aspect, the research entitled “Pedagogical Characterization of the Area of Physical Education, Recreation and Sports, Developed in Secondary Educational Institutions in the Department of Huila” (Camacho and Amaya, 2011). This study mentions traditional teaching as an outdated model, which is developed by teachers in classes at some educational institutions.

In terms of the existing connection between motor and cognitive development, (evinced in the ability to solve problems and in the consolidation of critical thinking), the study leveraged the psychogenetic theory proposed by Le Boulch (1993) that is based on human movement. The author believes that “there is a solid connection between the development of motor skills and behavior, since it aids in the development of a person’s main qualities and assists in the adaptation to the surroundings and environment”.

In that context, the development of basic skills and dexterities as well as its continuation towards more specific execution levels constitute the foundation to face the daily challenges of an individual’s routine, and that deep down, reflect their true capacities and competences to solve the problems that are intrinsic to daily lives.

It is necessary to clarify that a problem is “a new and surprising situation, if possible, interesting or troubling, to which the beginning and ending are known but not the processes through which they can be attained” Pozo, (1995, cited by Figueroa and Rodriguez, 2009, p. 16).

Regarding the evolution in problem-solving capacities as an indicator of progress in cognitive processes linked to motor development, Campo Ternera (2010) explains that “there is a positive and highly significant correlation between the areas of perceptive discrimination, memory, reasoning and conceptual skills and total score of the motor area”.

This statement derives from the proposition that ponders that “a child with motor acquisition for his/her age, will in accordance present cognitive and language development”.

Undoubtedly, the connection between the cognitive and motor aspects is key to analyze human behavior. In that regard, Pastor (2012), citing Piaget, emphasizes on the importance of motor skills and uses a statement from the famous Swiss psychologist that proposes “it is obvious that motor skills play a key role in the coordination of actions, coordination to which the property of construction of intelligence is attributed”. Meaning that an adequate motor development generates conditions for an individual to boost and strengthen his/her cognitive processes and to enhance problem-solving capacities.

Inquiring into the connection of motor and cognitive development, Vygotsky’s zone of proximal development theory is also cited, which highlights that learning enables a series of internal evolutionary processes

that only operate when the child is interacting with the people in his/her environment (Carrera & Mazzarella, 2001), in other words, that internal evolutionary processes refer to mental processes as dynamic systems and as the result of a biography of certain social circumstances. Which is to say that “the zone of proximal development is not limited to transferring previous knowledge from an adult to the child” (Coll, Palacios and Marchesi, 2003).

## METHODOLOGY

A qualitative research was applied in the development of this work. According to Hernandez, Fernandez and Baptista (2010, p.10) “the qualitative approach may be conceived as a set of interpretative practices that make the world visible, transform it and turn it into a series of representations by means of observations, annotations, recordings and documents”.

The construction and development of the research proposal followed an inductive line, according to Hernandez *et al.* (2010, p.9) it is based on “exploring and describing, to then generate theoretical perspectives. These go from the particular to the general”. In that sense, information collected through different instruments is specifically organized and analyzed, but as data interpretation goes on, broader relationships are established between the different components and/or variables. This strategy is coherent with the implemented non-experimental research design. The choice was based on criteria by Hernandez *et al.* (2010), according to the proposed study, “there is no deliberate manipulation of variables and neither prediction of results”.

The same authors, citing Kerlinger (1979), claim “data is analyzed subjectively”. In this case, the interpretation of information obtained through different sources is conducted following a longitudinal perspective, “observing the evolution of the group in different moments” (Hernandez, Fernandez and Baptista, 2010), in addition to overcoming language obstacles –allowing the researcher to develop actions based on his/her knowledge of the identified problem– and contributing to attaining positive results aimed at shifting the researched reality.

An intervention plan was proposed to complement the process; it consisted on applying a didactic unit, with the purpose of incorporating into the physical education area the elements that might contribute to strengthen the teachers’ practices concerning this discipline and also to the development of cognitive, procedural and attitudinal competences of fifth graders who have been targeted in the research herein.

### *Didactic Unit*

The main axis of the intervention plan adopted for the identified problem was the design and execution of the didactic unit “I play, I have fun and

learn” in the area of physical education. This strategy was implemented for four (4) months in the fifth grade (5<sup>th</sup>) of elementary school in the morning session in the branch of San Marcos de Leon of the Simon Bolivar Educational Institution, municipality of Planeta Rica; the main purpose was to strengthen problem-solving capacities through students’ motor development.

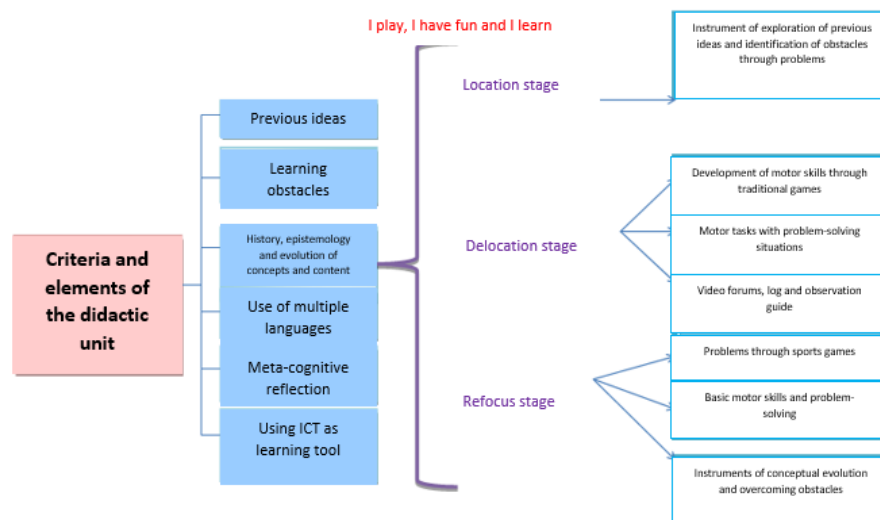
The didactic unit’s conceptualization and design criteria were based on the following proposals:

The didactic unit is a “flexible process for planning how to teach the content related to a specific field of knowledge... to build learning processes in a particular community” (Tamayo and Vasco, 2010, p.107).

Tamayo (2011, p.106) proposes:

With teaching being an activity that involves different entities and not only the transmission of information, there is a need to address education of sciences from a constructivist and evolutionary perspective that integrates aspects such as: concepts’ history and epistemology, students’ previous ideas, metacognitive reflection, multiple languages that comprise ICT and the conceptual evolution process as the aspect that drives training evaluation with the transformation of teachers and students’ initial and final knowledge.

*The Didactic Unit was Structured as Follows:*



**Illustration 1.**  
Intervention Plan

The didactic unit’s design, planning and execution was developed in three stages that complement the pedagogical and didactic dimension of the teaching-learning process of the selected content: location stage, delocation stage and refocus stage (Hochmitz & Yuviler-Gavish, 2011; Kreutzer & Bowers, 2016).

Location stage: the first stage was an exploration of previous ideas about the concept to be taught, as well as an identification of students’ learning obstacles, these were evinced through the application of an instrument



that included metacognitive questions and difficult situations concerning physical activity and sports games, which allowed to observe and detect the initial models and learning difficulties.

Delocation stage: the second stage developed motor skills through traditional games, also, motor tasks involving problem-solving situations, video forums of the topic and observation logs were proposed, all of which aimed at generating a comparison analysis to promote multiple languages for the process of creating knowledge and self-reflection questions to lead students and teachers to progress regarding learning obstacles and conceptual evolution.

Refocus stage: the last stage addressed problems with larger complexity through sports games and motor combinations, which encouraged students to solve problems using strategies and solutions to proposed motor tasks; lastly, in this stage the instrument to undertake the reflection on content appropriation, concept change and transfer to different contexts was applied.

## RESULTS

Results obtained derive from the application of techniques and procedures defined to collect and validate information. That process led to the confrontation of data resulting from the survey – idea exploration workshop (prior to the didactic unit) with the data from the survey – overcoming learning obstacles workshop (succeeding the didactic unit).

Analyzing the results of the diagnostic test of exploration on previous ideas in the motor skills category, illustrated in Chart No. 1, it can be seen that in response to the question: How to transport a ball as you move from one point to another? 70.8% answered: with the foot, 16.7% answered: with the hand, and 12.5% said they would do it using their heads; none of the responses mentioned the forearm.

The 70.8% who answered that they would do it with their foot clearly have an inclination towards football. This is an imprint that characterizes the surveyed group. The rest of the students, 29.2%, answered that they would do it with their head or hand (see Chart N° 1).

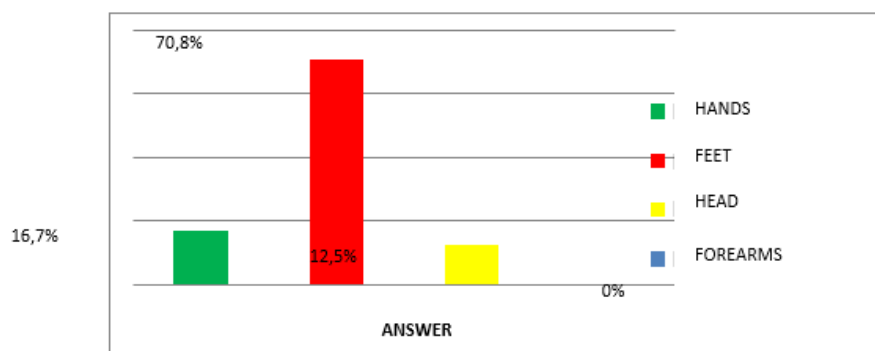


Chart 1

. How would you transport a ball in an initial motor execution?

These answers suggest that answers by the students in the sample prioritized their level of awareness up to that moment in terms of the possibilities of action and decided to choose their feet as the most common, and thus, the most frequent. To this regard, Le Boulch (1993) states that “much of the school learning that is unattained by kids might be likely because they have not been previously aware of their body”.

For that reason, movement and action routines facing specific motor tasks or situations are framed within basic skills, as reaffirmed by Wickstrom (1990) “there are phylogenetic actions that are typical of the human species, these are not learned, are the product of a developmental state in which a human is capable of adapting pre-established motor skills to different external situations”.

The follow-up undertaken reflected conceptual changes in surveyed students after the instrument to overcome obstacles was applied. In this opportunity, a review of the results obtained with the same question but formulated in the instrument to overcome obstacles and illustrated in Chart No. 2, 70% of the students expresses that the ball can be moved or transported using more parts of the body; 20% responded: with the forearm and only 10% opted to say they would do it using their hands. This scenario shows a new perception about the flexibility and versatility of the human body, and of course, a new vision of the motor capacity they acquire as they make progress in an education process of the body and the mind.

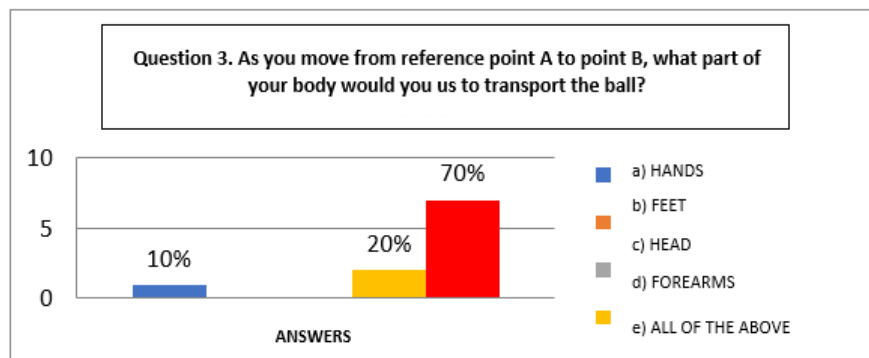


Chart 2.

What part of your body would you use to transport a ball in a motor execution?

Going back on the questionnaire of previous ideas and reviewing the problem-solving process as a category of analysis, in response to the question: Why would you continue doing physical education if you must usually face a problem? (see Chart No. 3).

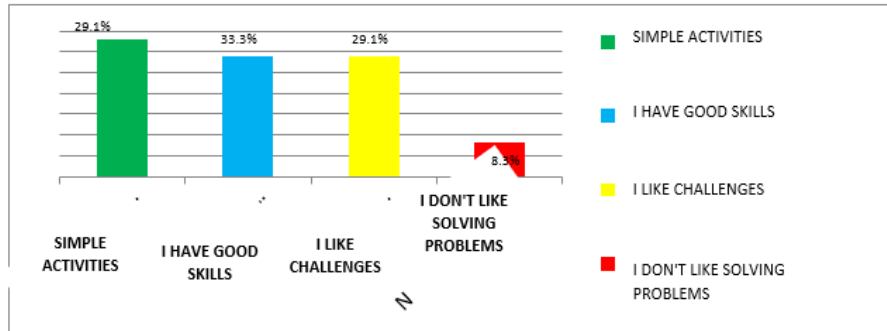


Chart 3

Why do you still practice physical activity?

Surveyed students responded as follows: 33.3% answered by affirming they have good skills, 29.1% said they like challenges, the same percentage is confident because they believe the activities are simple, but 8.3% acknowledged they would rather skip physical activity because they do not like to solve problems. The latter are not aware of Trigueros' (1991) ideas, affirming "that basic motor skills may be defined as fundamental natural movements intended to answer movement problems that are faced by individuals in real life".

The largest percentage in Chart No. 3 (33.3%) refers to the confidence in each one's skills, moreover, 29.1% adds that the activities are simple; possibly, this solution has to do with the traditional view of commonly practiced activities in physical education, such as playing football, running or participating in a dynamic, which are normal routines for children in elementary school, as per Camacho and Amaya (2011) in a study conducted in the department of Huila, in Colombia, they refer to traditional teaching as an outdated model concerning the area of physical education. Interestingly, 29.1% prefer challenges, meaning are open to facing problems.

This group adheres to the suggestions of Pozo, Postigo and Crespo (1995), who say that: "a problem is a new situation, apart from known situations, and which is interesting or troubling". It reflects an intention to take advantage of the benefits offered by a problem to test creativity and inventiveness in proposing solution alternatives.

This idea is reinforced when the data of the first survey or exploration on previous ideas instrument is compared with the results of the evaluative test to overcome learning obstacles (Chart No. 4) concerning the same question, meaning, the need to solve problems when practicing physical exercise. The conceptual change is notorious, since 50% of the students said they enjoy solving problems, yet 10% expressed they like challenges, thus amounting to 60% of the students who recognize physical activity as an option to learn how to solve problems.

It is important to mention that the remaining 40% of the students manifested liking physical exercise because it makes them think. This ratifies the ideas proposed by Lopez and Vega (2002) in terms of the importance of physical work and more specifically play, when it follows the guidelines of problem approach and emphasizes on finding a

solution through oriented exploration. The authors validate the option of problem-solving with the pretext of play and sports practice.

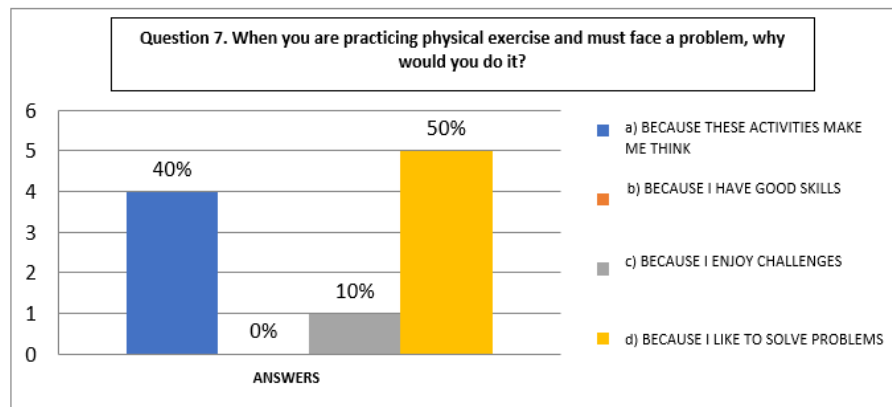


Chart 4.

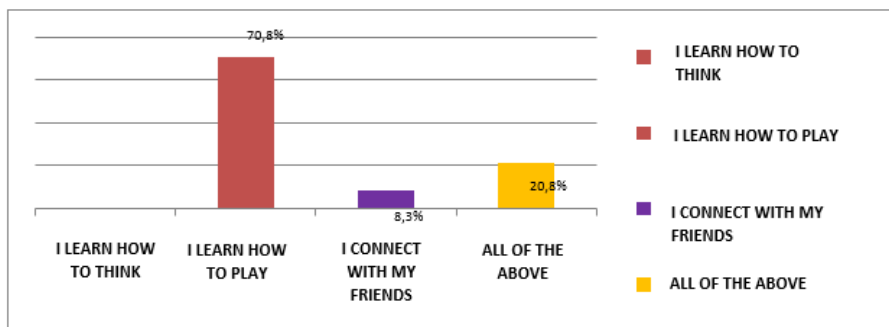
When you are practicing physical exercise and have to face a problem, why would you do it?

To reinforce the previous analysis, this question, included in the overcoming obstacles questionnaire, was answered as follows: How can learning attained in class of physical education, recreation and sports class help in solving a problem? 60% of the students said it helps them solve problems in life, 30% manifested that it helps them think, and just 10% considered physical education to be useful to learn how to move.

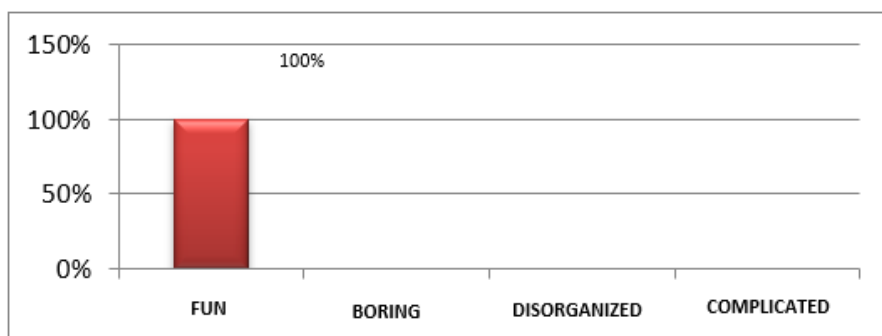
These results evince significant changes in the students concerning the work to be done in physical education, recreation and sports classes, generating commitment among the actors involved to practice pertinent criteria from a pedagogical and didactic point of view, to give the area the place it deserved in the educational system.

Another important category in this research exercise is the undervaluation of the physical education area, which can also be indicated as the attitude towards the area. It must be reminded that the theoretical framework inquires into the way in which the activities are developed in the physical education class and the small value recognized to this discipline by the educational community. For that reason, the area is lagging in results that lead to critical thinking and problem-solving development, often unconnected with the evolution of motor skills.

In that order, the diagnostic test to identify previous ideas included the question: What do I do in the physical education class? (Chart No. 5), to which 70.8% answered that they learn how to play, but none of the students believe they learn to think. However, Chart No. 6 illustrates the question's data about the appreciation of physical education class, all of the students (24) manifested that they consider it to be fun, ratifying the criterion that a privileged scenario with a great motivational level to develop student thinking is being wasted (see Charts No. 5 and 6).



**Chart 5.**  
What do I do in physical education class?



**Chart 6.**  
Appreciation of physical education class.

In this context, the ideas of Mc Donald (1995) are ratified, “physical education is considered a manual activity in opposition to the mental activity that takes precedence in the school, this is the reason why it is devaluated by students and teachers”. Following the same theoretical outlook, Kirk (citing Hargreaves, 1997), comments that “unfortunately, some subjects that aim at developing the child’s intellect are considered above other practical subjects, such as physical education, which, for many, takes the last place in hierarchical order of knowledge”. Bores *et al.* (1994) collect opinions from students and affirm that “other observable constant is the unquestionable consideration that physical education is a second-degree subject”.

Interestingly, the data obtained in the application of the overcoming learning obstacles, especially when inquiring into the benefit of practicing physical exercise and motor skills (Chart No. 7), shows more responses such as not just ‘fun and games’ exclusively, but students also believe they learn how to think, solve problems, and connect to their classmates. These amount to 60%, while the socio-affective component is also notable with 30%, this explains that physical education strengthens relationships with classmates. The remainder 10% says it is useful to solve problems.

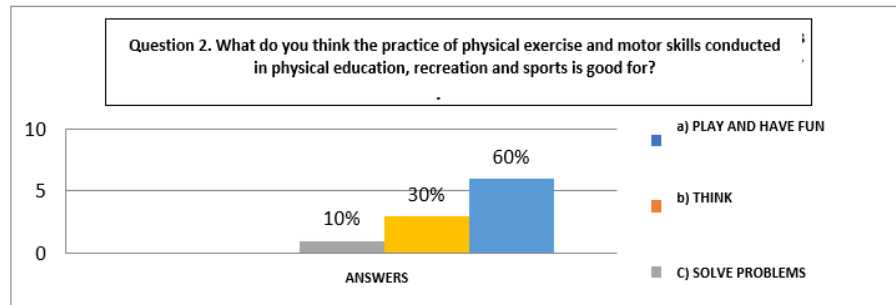


Chart 7.

In the face of these results, it was inferred that as the intervention process of the didactic unit took place, fifth graders in the branch of San Marcos de Leon of the Simon Bolivar Educational Institution began understanding the systematic learning developed the area of physical education, recreation and sports. This output considerably improves the spectrum of the subject, considered by Garcia (1994) to be of “low status” or as an “amorphous subject”.

It is concluded that there has been a lack of empowerment of the main actors involved in the process of physical education, for the subject to get the space and recognition it deserves within the educational community and the authorities that regulate the school system to benefit students’ comprehensive training.

## DISCUSSION

The results of the process of inquiring into the importance of physical education for the students’ training process were interesting and were used to consolidate previous ideas and concepts that supported the research.

Research focused on the treatment of conceptual categories such as: undervaluation of the area of physical education, motor skills and problem-solving. These aspects were used to build a theoretical outlook characterized by the articulation between the elements inherent to each of the concepts identified, ensuing pertinent and appropriate production useful as reliable experience for future research.

The execution of the intervention plan for the application of the didactic unit lead to the conclusion that it is necessary to implement a process of teacher qualification in the area of physical education, aimed at making them aware of the fact that it is possible to strengthen problem-solving capacities through the development of motor skills. This idea, which is the main axis of this research, must be considered a challenge for all the work groups in educational institutions.

The research exercise significantly contributed to an improvement in pedagogical, didactic, research and professional competences of the participants; this process was reflected in improved student results as active subjects in learning, knowledge and development of sciences.

The epistemological challenge of formulating and affirming that there is a fundamental relationship between motor skills and cognitive development focused at strengthening problem-solving capacities and stimulation of critical thinking, was an expectation that was fulfilled as the work was conducted throughout the different stages of the research.

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