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Customized Exercises in Physical Education for the Psychomotor Development of Blind Learners

[Ejercicios físicos adaptados en la Educación Física para el desarrollo psicomotriz de educandos ciegos]

[Exercícios físicos adaptados em Educação Física para o desenvolvimento psicomotor de alunos cegos]

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ABSTRACT

Introduction: The practice of physical exercises by blind learners must include curricular adjustments to the elements and processes of teaching, in keeping with the sensorial deficit, and particularly, retardation in the psychical processes of general motricity.

Aim: This paper aims to design a set of adapted physical exercises to enhance the



learners' psychomotor capacities through the Physical Education lesson.

Materials and Methods: A pre-experimental study with minimum control was done for three years (2019-2021). The sample was selected from an intentional non-probabilistic sampling. Accordingly, four fourth-year blind students were chosen.

Results: The procedures used helped determine the shortcomings of the teaching-learning process, and to process the data obtained. A set of physical exercises were adjusted, according to the main psychomotor defects observed in the visually impaired. The implementation of this proposal favored customized assistance during the teaching-learning process, depending on the needs, possibilities, and potentialities, with 75 % of the sample reaching a high response level, as opposed to 25 % that showed low levels.

Conclusions: This study showed higher stimulation of psychomotor development in blind students, through the set of physical exercises customized to their needs in the Physical Education Lesson.

Keywords: Blind learners, psychomotor development.

RESUMEN

Introducción: en la práctica de ejercicios físicos, para educandos ciegos, se debe tener en cuenta las adaptaciones curriculares, a los elementos y componentes del proceso docente educativo, en correspondencia con el déficit sensorial y específicamente al retraso en el desarrollo de los procesos psíquicos y de la motricidad en general.

Objetivo: la investigación tuvo como objetivo elaborar ejercicios físicos adaptados, para el desarrollo psicomotriz en educandos, en la clase de Educación Física.

Materiales y métodos: se realizó un estudio de diseño pre-experimental de control mínimo, con tres años de duración (2019-2021). La muestra escogida se realizó a partir de la técnica de muestreo no probabilística intencional, con la selección de cuatro educandos ciegos que cursan el cuarto grado de la enseñanza primaria.

Resultados: los procedimientos utilizados permitieron, determinar las insuficiencias del proceso enseñanza-aprendizaje y procesar los datos, se ofrecen ejercicios físicos que fueron adaptados a partir de los principales trastornos psicomotrices presentes en los educandos en situación de discapacidad visual. Con la aplicación de esta propuesta se



realizó una atención diferenciada al proceso de enseñanza- aprendizaje, en correspondencia con las necesidades, posibilidades y potencialidades, lo que incidió que el 75 % alcanzara un nivel alto en su evaluación y solo un 25 % nivel bajo.

Conclusiones: el estudio mostró el logro de la estimulación del desarrollo psicomotriz alcanzados, en los educandos ciegos, con la aplicación de los ejercicios físicos adaptados en las clases de Educación Física.

Palabras clave: educandos ciegos, desarrollo psicomotriz.

RESUMO

Introdução: na prática de exercícios físicos, para alunos cegos, deve-se levar em consideração as adaptações curriculares, aos elementos e componentes do processo educacional de ensino, em correspondência com o déficit sensorial e especificamente o atraso no desenvolvimento dos processos mentais e habilidades motoras em geral.

Objetivo: o objetivo da pesquisa foi elaborar exercícios físicos adaptados, para o desenvolvimento psicomotor em escolares, na aula de Educação Física.

Materiais e métodos: foi realizado um estudo de desenho pré-experimental de controle mínimo, com duração de três anos (2019-2021). A amostra escolhida foi feita por meio da técnica de amostragem não probabilística intencional, com a seleção de quatro alunos cegos que cursam a quarta série do ensino fundamental.

Resultados: os procedimentos utilizados permitiram determinar as insuficiências do processo de ensino-aprendizagem e para processar os dados, são oferecidos exercícios físicos adaptados dos principais distúrbios psicomotores presentes em alunos com deficiência visual. Com a aplicação desta proposta, foi realizada uma atenção diferenciada ao processo ensino-aprendizagem, em correspondência com as necessidades, possibilidades e potencialidades, o que fez com que 75% atingissem um nível alto em sua avaliação e apenas 25 % a um nível baixo.

Conclusões: o estudo mostrou o alcance da estimulação do desenvolvimento psicomotor alcançado, em alunos cegos, com a aplicação de exercícios físicos adaptados nas aulas de Educação Física.



Palavras-chave: alunos cegos, desenvolvimento psicomotor.

INTRODUCTION

Diversity is one of the characteristics that make humans unique, giving them the chance to be part of the cultural richness of a homogeneous society. Several disabilities, such as intellectual, sensorial, or motor, have been determined. Children with special educational needs demand full support to achieve true social inclusion. In Cuba, the construction of ways and alternatives to achieve real inclusion is an endeavor of many.

The experts at the World Health Organization (WHO, 2019) have stated that a disability is any restriction or absence of the capacity to perform actions in the same way or degree which is considered normal for a human being, being blindness (eyesight below 20/200) is a life condition that affects the perception of images totally, sometimes it may consist of a minimum perception of light, preventing the blind person from getting visual information of the surroundings.

Approximately 180 million people in the world have a visual disability. Among them, between 40 and 45 million are blind, accounting for 0.9% of the world's population. Because of population growth and aging, the estimates for 2020 were 38.5 million, and by 2050, 114.6 million will have this condition. Ninety percent of blind people live in developing countries, of which approximately 13% with a visual disability are children between 0 and 13 years of age (World Health Organization, 2019).

Bautista and González (2020) found that the psycho-motor alterations observed in blind children are generally associated with "the spatial perception, balance, knowledge of the body scheme and image, attitude, and the development of the voluntary motor inhibition capacity, the organization of time structure, general dynamic coordination, moving, walking, running, squatting, jumping, and clear obstacles."



Other researchers, such as González and Checa (2022), Díaz, Durán, and Agudelo (2020), and Guajardo (2018), have focused on school students who suffer from a disability. They coincide in that the teaching-learning process adapts and changes depending on the type of educational need observed. Besides, changes can be made to the curriculum, projects, and physical activities for school insertion and socialization with their surroundings.

Research done by Perán and Fernández (2022), and Clavijo (2021) tackled communication strategies, as well as activities for motor development, reading and writing learning, and linguistic attitude of the visually impaired or blind in the pedagogical context. These studies confirm the existence of shortcomings that threaten the development of skills and capacities. They stress the importance of physical exercise based on their strengths, rather than their flaws.

An analysis of the scientific literature related to Physical Education for the blind revealed that the main experiences corresponded to the following authors: Arrate and Cabrera (2020), Arrate & Isaac (2022), Castillo and Romero (2020), and Dabbagh (2022), whose contributions constitute the theoretical, methodological, and practical rationales. These authors have provided novel elements to the conception and organization of adapted Physical Education with a systemic approach, in which the contents of this discipline are adjusted. They also highlight the relevance of physical exercise for the multilateral and harmonious development of learners with sensorial disability.

In that sense, Ramírez, Olivo, and Cestre (2021) noted that psychomotor development is the most complex form of integrated learning, in keeping with the experiences of the child, and their reactions to these experiences, using their motor skills. The goal of psychomotricity is that the child knows how to act toward any external stimulus. Hence psycho motor stimulation,

- Nurtures the perceptive capacity through a child's knowledge, about their bodies, and how to respond to an external stimulus.
- Organizes the capacity of movements represented or expressed through signs and symbols.



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- Stimulates emotional and affective development.
 - Contributes to the child's social development, and provides the tools to set up relationships in unfavorable situations.

Vera, Juanes, and Carmentate (2021), express that the characteristics of Physical Education with a physically-educative-based approach are not possible without the pedagogic customization of diversity. To provide equal opportunities, distinguish the demands, favor co-education, and therefore, provide equal attention to both sexes, instead of performing activities for the most capable and gifted only, which can foster rejection and mocking of the least capable, are some aspects teachers must consider in their lessons and activities.

This paper aims to design a customized set of adjusted physical exercises to enhance the learners' psychomotor capacities of blind learners through the Adjusted Physical Education Lesson.

MATERIALS AND METHODS

This research took place at the Ernesto Guevara de la Serna Educational Facility in the municipality of Bayamo, Granma (Cuba). The total sample consisted of four students (aged 9 on average) with a visual disability and it was selected intentionally. The inclusion and exclusion criteria for the selection of blind students are stated below.

- Inclusion criteria: blind learners with normal intellectual capacity, and a general diagnostic consisting of congenital blindness. the students also had psychomotor disorder due to the sensorial disability.
- Exclusion criterion: The presence of a different ophthalmological diagnostic.



In that sense, the study also included specialists in blind student education (teachers of Physical Education, Psycho Pedagogy, and Orientation and Mobility). Several techniques and methods were used, such as theoretical (analytical-synthetic, systemic-structural-functional) to design the adapted set of exercises.

The empirical methods were structured observation (Physical Education lessons), documentary review (psycho-pedagogic records of the students, medical records, Physical Education program of general education), measurements, experiment (pre-experiment), interview, methodological triangulation, and statistical-mathematical methods (descriptive and inferential statistics), to evaluate the basic motor skills and capacities and implementation of the physical exercises adjusted.

The evaluation of the psycho-motor development was made through the methodology and evaluation at high levels (independence), mid-levels (relative independence or joined design), and low levels (no independence).

The following indicators of psychomotor development were evaluated.

1. Static coordination.
2. Eye-hand coordination.
3. Eye-foot coordination.
4. General dynamic coordination.
5. Spatial orientation.
6. Movement rhythm.
7. Thin motricity.

The following indicators of basic motor skills were evaluated.

1. Walking.
2. Running.
3. Jumping.
4. Throwing.
5. Throwing-catching.



6. Carrying.

These indicators were evaluated through basic tests of physical capacities and basic motor skills customized to each blind student by the authors of this research.

RESULTS AND DISCUSSION

The practical result of the thesis dissertation suggested by the main author was taken as a reference to address the existing problem through the teaching-learning process to promote psychomotor development in blind students, particularly, in the Physical Education lesson. The adjusted physical exercises were designed and adapted after a systematization process organized in the Physical Education lesson to orient the investigative logic.

In similar studies, authors like Bautista and González (2020) did studies on the diagnostic of the current physical component in an 8-year-old subject to method selection, functional tests, and corresponding adjustment to physical exercise, as well as the assessment of the viability of the tests suggested as alternatives to the diagnostic of the physical component, in the context of Physical Education, using the self-perceptiveness method.

In this research, other methods have been adapted to enhance Physical Education teachers' performance with blind students. Besides the tests of motor development and basic motor skills were assessed, as they underwent changes operating in the teaching-learning process and the stimulation of the blind students' psycho-motor development.

Teaching blind students demands the following working methods

- Joint design: the blind students will perform the adapted physical exercises with the teacher's help (teacher-student techniques).



- Relative independence: the blind students will perform the adapted physical exercises with the teacher's limited help.
- Independent work: the blind students will perform the adapted physical exercises without the teacher's help.

Proposal of adapted physical exercises to enhance the learners' psychomotor capacities through the Physical Education Lesson

General objective: To perform the adapted physical exercises with a customized approach for the stimulation and development to enhance the learners' psychomotor capacities through the Physical Education Lesson.

Duration: 45 minutes.

Weekly frequency: four times a week.

Contents:

Adapted physical exercises for static coordination

Objective: To perform physical exercises adapted to varied conditions to enhance static coordination.

Methodology: IP. Standing on the metatarsus of both feet, head upfront, hands around the waist. IP. Standing on the metatarsus of one foot, head upfront, hands around the waist. IP. Standing on the heels of both feet, then perform a slight rise from the metatarsus, head upfront, hands around the waist. IP. Standing on the heels of one foot, then perform a slight rise from the metatarsus, while the other leg is high to the front, head upfront, hands around the waist.

Adapted physical exercises movement simultaneity

Objective: To perform physical exercises adapted to varied conditions to enhance movement simultaneity.



Methodology: IP. Standing, walking slowly or quickly, following the beat of a particular object used by the teacher to perform the exercise. IP. Standing, running slowly or quickly, following the beat of a particular object used by the teacher to perform the exercise.

Variants: Walking to the left, to the right, forward, and backward.

IP. Standing, jumping slowly or quickly, following the beat of a particular object used by the teacher to perform the exercise.

Variants: Jumping to the left, to the right, forward, and backward.

IP. Standing, jogging slowly or quickly, following the beat of a particular object used by the teacher to perform the exercise.

Variants: Jogging to the left, to the right, forward, and backward.

Adapted physical exercises for general dynamic coordination

Objective: To perform physical exercises adapted to varied conditions to enhance general dynamic coordination.

Methodology: IP. Standing, the upper limbs are elevated on the side, then make circles with the arms forward and later backward. IP. Walking to the directions indicated by the teacher (left, right, forward, and backward). IP. Standing, and running to the directions indicated by the teacher (left, right, forward, and backward). IP. Standing, marching on the spot, with arm and leg coordination. IP. Standing, jumping with the two feet together, with arm and leg coordination, to the directions indicated by the teacher (left, right, forward, and backward).

Variants: Using the upper limbs. First the left arm, then the right. The feet, first the left foot, then the right.



Adapted physical exercises for eye-hand coordination

Objective: To perform physical exercises adapted to varied conditions to enhance eye-hand coordination.

Methodology: IP. Throwing a homemade ball into a box in front of the student (1-3 m), then a partner with an object will use a clinking object to locate the box. Then the distance from the box will increase, depending on the student's preparedness. IP. Throwing a ball upward with clinking objects inside, then try and catch it.

Variants: Using the two hands. First the left hand then the right.

Adapted physical exercises for eye-foot coordination

Objective: To perform physical exercises adapted to varied conditions to enhance eye-foot coordination.

Methodology: IP To carry a soccer ball with clinking objects inside, three meters from the student. Then the distance increases, depending on the student's preparedness. IP Carrying a soccer ball with bells inside, through obstacles, three meters from the student, then this distance is increased, depending on the student's preparedness.

Variants: The feet, first the right foot, then the left.

Methodological steps for the implementation of the set of adapted physical exercises in the Physical Education lesson

Starter:

Contents: Recognition of the location, pulse taking, joint preparation, and general and special warm-ups. Then the attention will be customized depending on the possibilities and potentialities of the blind students, thus preparing them to assume the active practice of physical activities. This part includes the utilization of hearing and touching devices, as well as the co-active, cooperative, and reactive methods, particularly



designed for the work with blind learners. They should also be able to recognize the implements. It lasts 10 minutes.

Main Part:

Contents: This segment lasts 10 minutes; it is intended for the development of motor skills and capacities. The adapted physical exercises for psychomotor development are advisable in this part, in keeping with the previous arguments. Exercises for static coordination, movement simultaneity, general dynamic coordination, eye-hand coordination, and eye-foot coordination. This part includes the utilization of hearing and touching devices, as well as the co-active, cooperative, and reactive methods.

Final part:

Contents: It aims for student recovery, considering the games introduced for war-up, as well as the adaptation of teaching aids and individual relaxation techniques. It lasts 5 minutes.

After collecting the information through observation of the Physical Education lessons to evaluate the psycho-motor development of the blind students, exploration of the psycho-pedagogic records, the features of the program of the fourth grade, elementary education, and the interviews of specialists in blind education, the following results were presented:

- The diagnostic revealed that all the students in this research suffered from congenital blindness. The main role of the external stimuli in the development of motor skills, and the layout of cognitive development is lower in this population, as a result of limitations in their sensorial ways (touching, hearing, taste, and smelling), and the distortion produced in these senses.
- Their insufficiently coordinated walk leads to losses in the natural balance needed to keep steady, having an irregular pace with irregular length and stereotyped movements (blindism).



- Likewise, they have a slow or no assimilation of motor contents, as well as the basic motor skills and capacities: balance, laterality, rhythm, tempo, overall coordination, and segmentation. Caused by severe overall psychomotor retardation.
- The program, with methodological indications and orientations fails to declare the way to perform a diagnostic, though it refers to its importance as a starting point for the Physical Education teacher to determine the physical development level of the learners.
- The only evidence in the program is the results of the physical fitness exams, rather than other complementary tests that permit qualitative and quantitative evaluations of psychomotor development.
- The diagnostic given to the Physical Education teacher is oriented by the Center of Diagnostic and Orientation (CDO), based on a report provided by the psychopedagogue. The teaching methods implemented are repetition, motor assistance, references, and games.

The characterization of the blind students using the set parameters revealed these outcomes:

As shown in Figure 1, the evaluation of psychomotor development of the blind students, the indicators of static coordination, dynamic coordination, eye-hand coordination, eye-foot coordination, and spatial coordination, showed that 100% of students were low. The other tests: Movement rhythm and final motricity were considered moderate.

These results match the type of disability observed in these students, whose main defects are found in coordinating processes and spatial orientation. Though the execution of the exercises was based on the cooperative (assisted) teaching method, they were unable to meet the set parameters for proper implementation, due to a retardation in the realization of their bodies to perform these activities due to the absence of external visual information.



Besides, there were difficulties in terms of laterality, as one leg was carrying more weight from the body than the other, the body swung when the other leg assumed this role, with an inappropriate posture when moving, thus causing problems in the indicators evaluated. These results showed the little psychomotor development observed in the students, coinciding with Bautista and González (2020), that blind children undergo alterations in their normal movements, which lack coordination in different parts of the body due to the limitations associated with their disability to acquire external visual information.

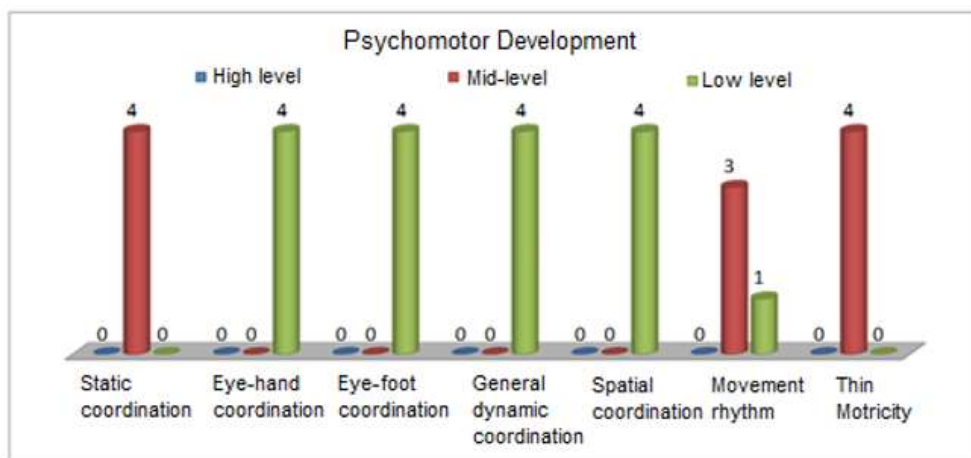


Fig. 1. - Results of an initial measurement made of psychomotor development in the blind students

In the evaluation of basic motor skills (Figure 2), the highest percentages achieved in jumping, throwing, throwing-catching, and carrying, were regarded as low, whereas walking and running were in the mid-level, with no test evaluated as high.

The main difficulties found in walking consisted of not maintaining the proper posture of the head and trunk (erected), since the students were busy looking for the sound stimulus to move, no movement coordination, with incorrect foot support when walking. In running, the difficulties shown consisted of not moving in a straight line or the required width, due to the absence of proper spatial coordination and lack of arm and leg coordination when running, resulting from their visual disability.



In jumping, the movement was performed at a very short distance; the students failed to take off and did not show arm and leg coordination. In throwing-catching, the deficiencies were mainly observed in failing to stand below the ball, turning their heads, shutting or spreading their hands when not listening to the sound of the ball to locate it and catch it, or hitting it when it touched the hands. Carrying the ball: No student could make it alone but with the help of the teacher.



Fig. 2. - Results of an initial measurement made in the tests of basic motor skills

The previous aspects show that the physical exercises for blind students must be adapted to correct the main psychomotor disorders observed, which favor systematic and customized follow-up of these students in their Physical Education lessons, in relation to the motor capacities and skills to stimulate psychomotor development (Table 1).



Table 1. - Comparative results before and after the adapted physical exercises in the Physical Education lessons

Levels Indicators	High		Mid		Low		Wilcoxon test	
	Before	After	Before	After	Before	After	Sig.	Dif.
Psychomotor development.	--	3 75%	--	1 25%	4 100 %	--	0.006	Yes
Basic motor skills	--	3 75%	--	1 25%	4 100 %	--	0.006	Yes

Legend: Sig. Different significance level: Significant difference

Final evaluation of the psycho-motor development indicators and basic motor skills

The statistical significance of the motor indicators results in the post-test (75 % and 25 % of students) was evaluated as high and mid-levels, with an excellent performance of the skill complex, and prevalence of dynamisms and coupling of planned actions with the completion of the objective. Meanwhile, 25 % went from a low level in the pre-test to a mid-level, since they made several elementary errors in the execution of the complex. In general terms, the changes observed were favorable, evidencing the direction of this research.

In the post-test, 75 % and 100 % of students were evaluated as high and mid-levels, with an excellent performance of the skill complex, and prevalence of dynamisms and coupling of planned actions to the completion of the objective set. Meanwhile, 25 % went from a low level in the pre-test to a mid-level, since they made several elementary errors in the execution of the complex. In general terms, the changes observed were favorable, evidencing the direction of this research.

In relation to the studies conducted in this area, authors like Bernate, Fonseca, and Babativa (2023) said that the relevance of motricity development in children has to do with the essential factors of motor development. They also explained why motricity must be fundamental in curricular and extracurricular activities. Besides, parents and teachers should demonstrate the significance of the Physical Education lesson in the development of motor skills, as it covers a broad range of determining factors in the education of children.



Clearly, most studies on students with sensorial educational needs to enhance motricity, require early ages, in which physical exercises can be adapted to their needs, possibilities, and potentialities, as stated by Arrate and Cabrera (2020), and Arrate & Isaac (2022).

After collecting the information through interviews with specialists in blind education, a methodological triangulation ended up in the following results associated with the Physical Education lesson.

- All the students in this research showed psychomotor stimulation during the Physical Education lessons.
- They improved the integration of didactic components during their lessons.
- The teachers considered that the adapted physical exercises are a fundamental tool for psychomotor development. Considering that tests other than the ones in the program were performed, there were similarities with the findings of Bautista and González (2020).

The methodological component of the Physical Education program was improved with non-significant adaptations to physical exercises performed in class.

CONCLUSIONS

The structure and function of the adapted physical exercises in class enabled the organization of the teaching-learning process in the Physical Education lesson to enhance psychomotor development in blind students.

The application of the indicators set helped diagnose psycho motricity and the basic motor skills in the students, which allowed the authors to select and adapt a set of physical exercises in the program of Physical Education.



The adjustments made may be inserted into the program and methodological guidelines of the subject, as an inclusive alternative with a flexible, open, and adaptable perspective to the visual educational needs.

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Conflict of interest statement:

The authors declare having competing interests.

Author contribution statement:

The authors have participated in the redaction of the manuscript and the documentary review.



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