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Inclusive game system for the development of motor coordination in students with autism spectrum disorder

Sistema de juegos inclusivos para el desarrollo de la coordinación motriz en estudiantes con trastorno del espectro autista

Sistema de jogo inclusivo para o desenvolvimento da coordenação motora em escolares com transtorno do espectro do autismo

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ABSTRACT

Physical Education has proven to be an effective tool to develop physical and mental conditions in human beings. However, even the proposals in favor of making inclusive education a reality for students with autism spectrum disorder do not achieve the globally expected levels. That is why, the objective of this work is to design a system of inclusive



games for the development of motor coordination in students with autism spectrum disorder, in the Physical Education class. To achieve this purpose, the survey, the pedagogical test and observation were used as fundamental methods at the empirical level. The results of the diagnosis point to poor knowledge on the part of Physical Education teachers about the treatment of students with this disorder, so it is proceeding to the task of developing a system of games for the development of motor coordination that gradually incorporated them into socialization in the group, and a pertinent evaluative system where superior results could be seen quantitatively and qualitatively.

Keywords: motor coordination, inclusion, autism spectrum disorder

RESUMEN

La Educación Física ha demostrado ser una herramienta eficaz para desarrollar condiciones físicas y mentales en el ser humano. Sin embargo, aún las propuestas a favor de hacer realidad la educación inclusiva en estudiantes con trastorno del espectro autista no logra los niveles mundialmente esperados. Es por ello que en esta obra se plantea como objetivo diseñar un sistema de juegos inclusivos para el desarrollo de la coordinación motriz en estudiantes con trastorno del espectro autista, en la clase de Educación Física. Para lograr este propósito se emplearon como métodos fundamentales del nivel empírico la encuesta, la prueba pedagógica y la observación. Los resultados del diagnóstico apuntan a un deficiente conocimiento por parte de los docentes de Educación Física sobre el tratamiento de los estudiantes con este trastorno, por lo que se procede a la tarea de elaborar un sistema de juegos para el desarrollo de la coordinación motriz que gradualmente los incorpore a la socialización en el grupo, y un sistema evaluativo pertinente donde se pudieron apreciar resultados superiores cuantitativa y cualitativamente.

Palabras clave: coordinación motriz, inclusión, trastorno espectro autista.



RESUMO

A Educação Física tem se mostrado uma ferramenta eficaz para desenvolver as condições físicas e mentais do ser humano. No entanto, mesmo as propostas a favor de tornar a educação inclusiva uma realidade para alunos com perturbação do espectro do autismo não atinge os níveis globalmente esperados. Por isso o objetivo deste trabalho é desenhar um sistema de jogos inclusivos para o desenvolvimento da coordenação motora em alunos com transtorno do espectro do autismo, na aula de Educação Física. Para atingir este propósito, o inquérito, o teste pedagógico e a observação foram utilizados como métodos fundamentais a nível empírico. Os resultados do diagnóstico apontam para pouco conhecimento por parte dos professores de Educação Física sobre o tratamento dos alunos com esse transtorno, por isso passam à tarefa de desenvolver um sistema de jogos para o desenvolvimento da coordenação motora que os incorpore gradativamente à socialização em o grupo, e um sistema avaliativo pertinente onde resultados superiores pudessem ser vistos quantitativa e qualitativamente.

Palavras-chave: coordenação motora, inclusão, transtorno do espectro autista.

INTRODUCTION

The environments in which students with autism spectrum disorder (ASD) perform best are those that are structured and contain activities with a beginning and an end, because although their difficulties with motor tasks must be taken into account, it is not the main problem when performing physical exercise (Berkeley et al., 2001).

Education worldwide within the school framework has considerably increased its prestige, due to the recognition of the importance it has in the training of new generations and Physical Education (PE) programs have been established for all levels and types of education; its practice is mandatory from initial education to university, where adaptations and methodologies are made to integrate students with educational needs such as ASD.



The characteristics of ASD and the constant change of keys in the practice of group sports make learning sports rules very difficult, although possible in people with autism, as demonstrated by studies whose results have been positive (Berkeley et al., 2001).

When researching autism, it is concluded that it is a broad topic, with countless classifications that are in constant study and discovery; Kanner (1943) mentions that autism is not a mental illness, but a disorder of brain functions called early infantile autism that affects children in different ways and one of them is motor development disorder (Baldares and Orozco, 2012). On the other hand, Wing (1996) introduces the term ASD and characterizes it as difficulties with motor function that includes large movements of the arms, legs, trunk or feet and the coordination of different muscles, joints and bones (Jordan, 2015).

Some recent research linked to the topic of physical activity applied to students with ASD and people with special educational needs values the practice of inclusive education. It is considered that global education has needed to consider this area of citizen education for a long time, since an increase in children with physical, motor and intellectual disabilities is foreseen, especially in recent times. However, some studies have revealed the lack of knowledge of teachers, especially PE professionals, to treat students with ASD, and despite the fact that there have been educational organizations working in this direction for several years, a lack of link between them is estimated (Sánchez et al., 2019).

Authors such as Vazquez et al. (2020) not only dedicated themselves to determining the lack of knowledge of PE teachers on this topic, but also proposed strategies for its treatment. These researchers encouraged methods to promote language and the understanding of the development of social and interaction skills such as the willingness to execute actions and follow orders, adapt to specific contexts, assimilate stories, organize vocabulary through photographs and drawings and express phrases supported with pictograms, among other related activities.

In his studies, Simón (2020) proposes strategies for the treatment of individuals with ASD in the context of PE; the difference lies in the guide that is presented to lead the teacher in



working with this type of special educational need. This author organizes his proposal through a decalogue for the promotion of physical activity, made up of the following components: individualization, structured physical environment, visual supports, social relationship, simplification, possibilities of success, breaks and familiarization.

However, in the area of PE and sports, to improve the situation of students with ASD, swimming and horse riding have gained more frequent space, with the exception of the work of Obrero and García (2021) who propose their alternative from the practice of basketball. Meanwhile, Díaz et al., (2021) insert soccer into an eight-month sports program and demonstrate superiority in the results regarding sociability, better muscle control, and inclusion.

It is recognized that it is very difficult to obtain positive achievements in these students without the mediation of interdisciplinarity, that is, without the collaboration of other teachers from various disciplines who can also contribute to the improvement of their physical, motor and mental capacity; for example, the studies by Narvárez and Lara (2021) present a methodology to address this problem in an interdisciplinary way, from the combination of physical and mental activity.

In the research by Hortal and Sanchis (2022), a review is made of articles related to strategies and methodologies for the treatment of students with ASD, which serves as a basis to discern which activities have been most used to mitigate the complexities of this type of disorder and carry out a group of exercises and productive and developmental activities.

Among the 11 articles reviewed, it stands out that cooperative play encourages the participation of students with ASD in PE sessions; that psychomotor activities and team games, accompanied by a correction of verbal interaction towards reflection, improves stereotypical behavior; behavior and emotional control are also improved, among other psychosocial benefits.

At the level of communication, the work of Floril and Llamuca (2022) stands out, who demonstrate the method of treatment and education of children with autism and associated



communication problems, to motivate and facilitate the area of language and communication; enhance physical activity to make writing success possible; significantly develop gross motor skills that directly affect the movements of arms, legs and feet and impact the development of various activities. To enhance this area, physical exercises such as jumping, crawling and rocking were applied, which together contributed substantially to stimulating these areas.

In this system of educational influences that is not only the responsibility of the institution, but of all the factors that affect its development, the role of caregivers cannot be missing. In this sense, Barros (2023) proposes a product called specialized educational care services, an initiative proposed after applying a diagnosis that resulted in the poor preparation of caregivers and the lack of adapted material and technological pedagogical resources to face this educational challenge.

In this entire environment of inclusive education, strategic treatments from PE or adapted physical activity, there remains a space to be addressed of great significance, and that is related to the evaluation processes. There are not many who are dedicated to this part of didactics, among them are Pizarro et al. (2023) and Martín et al. (2023).

Based on these authors, the guidelines that must be taken into account for an assertive evaluation are assumed to provide sufficient time for the student to prepare, ensure that they understand the evaluation instructions, provide essential resources for them to take the exam, lead to feel comfortable in the evaluation and allow the source with which they feel most confident to be used. In the case of physical-motor activity, the teacher must provide additional time for students with this disorder and resort to oral evaluation.

From the analysis carried out, it is considered that the proposals for physical activities for students with ASD have not yet reached the generally expected levels, so the it was proposed as objective to design a system of inclusive games for the development of motor coordination in students with ASD in PE class.



MATERIALS AND METHODS

The study was carried out at the "United Nations" educational center in the province of Guayas, within the 2023-2024 school year. The feasibility of the system was validated from the pre-experiment.

The population was made up of nine students of Basic General Education (EGB in Spanish) from the "United Nations" educational center, which has a total of 101 students, and was selected by the intentional non-probabilistic criterion, where it was assumed that they presented a diagnosis of ASD ; they would like to practice PE, sports and recreation; the age will range between seven and eight years; they will be in good health and will master basic motor skills such as walking, throwing, running and climbing.

The fundamental methods of the empirical level that were used in the research were: survey, pedagogical test and observation. (https://drive.google.com/drive/folders/1S_Ju5k4C59VDlwcrWFV_DKN6JI1D54lj?usp=drive_link).

For its preparation, the requirements of the curriculum for pedagogical competence were taken into account, which is in force in the 2023-2024 school year, as well as the characteristics and interests of the students themselves. The implementation of the proposal allowed to appreciate advances in the level of development of motor coordination in the subjects under investigation, the increase in motivation and their skills.

In order to substantiate the development of motor coordination in students with ASD, theoretical methods were also used such as historical-logical, analysis and synthesis, inductive-deductive, systemic -structural and the system approach that allowed establishing the interaction between the elements that formed the system of inclusive games for motor coordination.

Percentual analysis was used to evaluate and compare the results produced by the instruments used, figures and tables for the presentation of quantitative and qualitative results. The search that was carried out allowed to know the specific situation of the state of



development of motor coordination in the students and determine the main causes that affected their inclusion. With these results, a systematic work began that allowed to delve deeper into the object of study, as well as identify what was necessary, aimed at achieving the objectives for the application of this research.

The diagnosis was taken as a starting point to assess the current state and, accordingly, promote work on scientific bases that enhances the transformation towards the desired end. In addition, it was necessary to start from the phases that were taken into account for the application of the diagnosis such as:

- Determination of the dimensions that must be evaluated, in correspondence with the expected ideal.
- Determination of the indicators that include the components, and their evaluative precision.
- Development, application and evaluation of instruments that allow obtaining the required information.

RESULTS

During the 2023-2024 school year, the development of motor coordination in students with ASD was researched, in 3rd EGB of the "United Nations" educational center in the province of Guayas, with the aim of designing a system of inclusive games that contribute to their development. As results of the work, a survey, a pedagogical test and observation were carried out (whose templates are displayed at: (https://drive.google.com/drive/folders/1S_Ju5k4C59VDlwcrWFV_DKN6JI1D54lj?usp=drive_link)).

Through the survey carried out on the selected sample, with the objective of verifying the satisfaction in terms of knowledge, execution and interest of the students towards the development of motor coordination, five of them, 55.56% expressed that they like to be stronger than what they currently are and four, 44.44% do not really know what they want,



this showed that game planning must be deepened inclusive for the development of motor coordination, in PE classes.

Based on the experience of the authors of the research as PE teachers and on observation of classes by other professionals in the subject, it was possible to verify that there are few exercises used for the development of coordination in children with ASD that allow their inclusion, pedagogical practice revealed this problem in the teaching-learning process, where these students presented the following difficulties:

- They expressed little willingness to work on motor coordination exercises.
- Insufficient coordination.
- Incorrect execution of exercises-games with a competitive nature.
- Concern if they are given the same exercise as the group in general.

A pedagogical test was carried out with the objective of diagnosing the state of preparation of the students in motor coordination, it showed that there are very few in the first level, both females and males fell below the average results. Only three (males), 33.33% of the total, were able to reach the regulations for the grade and sex. The instruments applied so far demonstrated that there is a need for theoretical and physical preparation, based on the development of motor coordination, to contribute to a certain extent to raising the levels of learning and development in this component.

The class observation guide allowed us to evaluate the cognitive state of the students, the level of development of skills, motivation and attitudes, through the mastery of games for the development of motor coordination. It was found that six, 66.67%, had a medium level of knowledge about the games, the rest were located at a low level regarding knowledge, in general sense the domain is insufficient for the development of coordination, since 66.67% were at a low level; The level of acceptance of the coordination games was represented by four students, 44.44%, and the application of hygiene when performing the exercises must be improved.



The integration of the results in the applied instruments allowed to determine the potential and limitations of the diagnosis:

Potentials:

- The existence of an area to develop the PE class.
- There is a diagnosis of the students.
- They feel satisfaction from playing the games.
- They express interest in being included in the games.

Limitations:

- The disposition to carry out activities related to motor coordination is insufficient due to his disorder.
- The time allocated within the PE class for the development of coordination is limited.
- Insufficient knowledge about the importance of motor coordination.
- Limited development of skills to work independently.

Characteristics of the inclusive game system for the development of motor coordination in students with autism spectrum disorder

Degree of amplitude: The limits that define the applied game system are established.

Analytical approach to the object: the game system analytically represents the proposed objective and the real possibility of its application must exist.

Integrative nature: it addresses the different activities for the inclusion of students with ASD and allows strengthening student-teacher communication on a psychological and pedagogical level, which promotes better preparation for PE classes.

Guiding nature: serves as study material for teachers and students to develop coordination.

The game system is based on different theoretical foundations: philosophical, sociological, psychological, pedagogical and biological, in which the levels of application in the



institutional research line "Society, Inclusion and Diversity" are demonstrated, as well as the Sub- line "Methodologies, Projects, Curricular Adaptations and inclusion in sports and recreational physical activity", the identified problem is taken as a reference, a system of inclusive games is designed and applied to be implemented within PE classes with the aim of developing motor coordination in students with ASD.

The following characteristics are also evident in the game system:

- Intentionality: is aimed at strengthening the teaching-learning process of motor coordination in students with ASD.
- The degree of completion: it is defined that the preparation of students is carried out through games that link theory with practice in such a way that they promote the formation of knowledge, skills, motivations, attitudes and ways of proceeding that are necessary for them in the daily life.
- Referential capacity: the actions that make up the system are closely linked to problematic situations in practical life and the school community.
- Flexibility: it has the capacity to introduce the results of scientific and social development with a logical sequence.
- Simplicity: although the games respond to the three levels of knowledge, there are no major complications for students to solve.
- Dynamic nature: it offers the possibility of interaction between students and teachers, as well as between them during the execution of the exercises.

For the development of the game system, it was taken as a starting point the analysis of the results of the comprehensive diagnosis and the results of the systematization of the general theoretical and methodological foundations of the game system, characterized by:

- The starting point is the comprehensive diagnosis, to determine the potential and needs of the students.
- Its objective is integrative.
- The games are developed for the development of motor coordination in students with ASD, this allows creating the bases for the development of the skills of the



different sports, the object of study of the degree, and serves as support for the application of the rest of the abilities in PE classes.

- The use of different sources, based on the interests and motivations of the students with a view to raising their intellectual preparation.
- The establishment of existing relationships between facts, phenomena and processes; necessary premises for the development of creative capacities, initiative and independence.
- The use of different forms of evaluation (self-, co- and heteroevaluation).
- A high level of application and independence is required.
- Exercises are provided that promote the development of motor skills.
- It contributes to the development of values and volitional qualities, for the formation of the personality of the new man, through PE.
- The way to evaluate coordination is taken into account for the implementation of the system.
- The general objective is aimed at developing motor coordination in students with ASD in PE classes, in accordance with the requirements of the Ministry of Education.

Inclusive games for the development of motor coordination in students with autism spectrum disorder. (Examples of actions carried out)

Action #1

Name: The train

Objective: perform a medium-duration race (6 minutes), with a stable rhythm, through a game.

Materials: flags and chalk.

Organization: teams are formed in rows behind a flag, a mark is placed where the students are located 1.50 m away and a line is drawn with chalk; at 2 m, the obstacles begin to be placed in a zigzag shape; and in the end, others from 2 ms from the last obstacle. The distance is 50 metros.



Development: at the sound of the whistle they begin to jog in place, when the whistle blows for the second time they begin the race in a gentle jog towards where the obstacles that must be skirted on the way are located, the return is in a straight line to the place starting point, the mark is turned around and the same route begins again. An attempt should be made to maintain distance between each student. This exercise must be done several times until completing the time assigned by the teacher.

Note: the distances at which the obstacles are located, the quantity and the meters to be covered are the option of each teacher, taking into account the time of the course in which the game is applied and the conditions of the area.

Method: stable repetition with extensive interval.

Organizational Form: team.

Dosage: 3 repetitions, with active rest.

Rule: The team that finishes first wins.

- The student who is taken into account to decide the winner is the last one to enter.
- If when the whistle blows that means that the game ends, no team has completed the course, the team closest to the finish line wins.

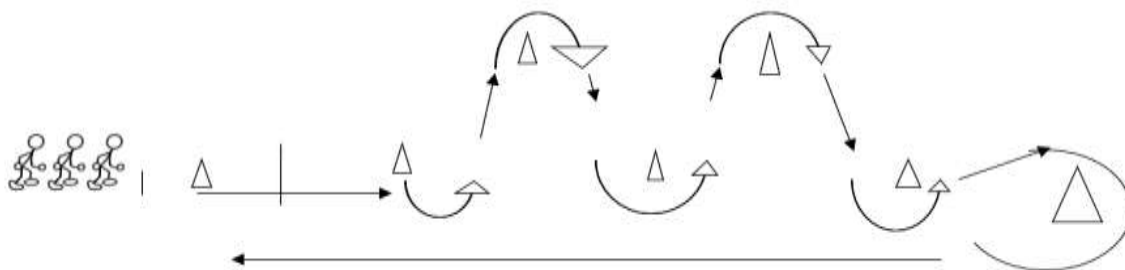


Figure 1. Graphic representation of Action 1

Action #2



Name: Object Change

Objective: develop coordination through play, contributing to inclusion.

Materials: flags, knobs and rings.

Organization: two or more teams are formed and placed behind the starting line; at a distance of 7 m, the first ring is placed with two knobs inside; at 7 m, the second ring is located; at 5 m, a flag is placed and later the final line is at 5 m.

Development: at the teacher's signal, the first students of each team leave and when they reach the first ring, they grab one of the knobs and move it to the other ring and so on until all those inside that first ring are transferred, they continue the course, turning the flag, following the final line and returning to the starting point for the next competitor to start. This moves the objects from the second ring to the first and makes the same journey until the end.

Note: the number of teams, the distance, as well as the number of obstacles to be moved can be increased, all depending on the conditions of each sports area, the number of students and the time of the course in which it is applied.

Method: stable repetition with extensive interval.

Organizational form: team.

Dosage: 3 repetitions, with active rest.

Rules: it cannot be started until the partner crosses the starting line and contacts the hand of the next competitor.

- The objects have to stay inside the ring.
- Objects cannot be thrown, they are placed.
- The team that finishes first wins.



- All members must keep moving (jogging) for the duration of the game. Point is lost for each one who stops.

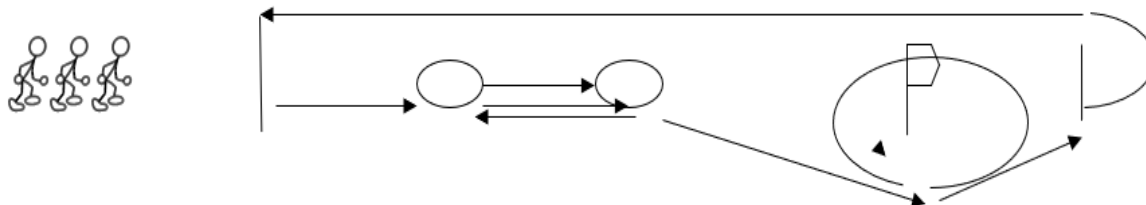


Figure 2. Graphic representation of Action 2

In the evaluation of the effectiveness of the game system for increasing motor coordination in third grade students, through the pre-experiment, the following dimensions and indicators were taken into account:

Dimension I: General knowledge about motor coordination.

Indicators:

- Basic knowledge about motor coordination.
- Knowledge about the importance of developing motor coordination.
- Knowledge of hygiene for games.

Dimension II: Development of skills in games for the development of motor coordination.

Indicators:

- Skills for the development of motor coordination.
- Skills for playing motor coordination games.
- Skills for playing competitive games.

Dimension III: Provision for playing games for motor coordination.

Indicators:



- Interest in PE classes.
- Willingness to actively participate in playing motor coordination games
- Satisfaction in playing games for the development of motor coordination.

To evaluate the proposed dimensions and indicators and analyze the results obtained, a value scale was developed:

High Level: if the response in its entirety behaves very appropriately, there is no element that allows negative details, an excellent mastery of the contents and skills for increasing leg strength is evident.

Medium Level: if the execution is quite adequate, there are difficulties in basic elements for the development of motor coordination.

Low Level: if the response is inadequate, there is a total absence of fulfillment of what is desired.

Initial Finding. In dimension I, referring to the elements of knowledge (Table 1), it was found that there are serious difficulties in the indicators related to basic knowledge about motor coordination, the importance of motor coordination, and hygiene to perform the exercises since they were evaluated between medium and low levels.

In indicator 1, 66.66%, a total of six students showed a low level; 33.33%, an average level in mastering basic knowledge of motor coordination. In indicator 2, 55.56%, a low level and 44.44% showed a medium level in the domain of the importance of motor coordination, as the basis for the development of the rest of the abilities. In indicator 3, 44.44% had a low level and 55.55% had a medium level in the domain when referring to the hygiene to be maintained when performing physical exercises, with emphasis on the development of motor coordination.

For a better understanding of the results of the instruments applied in the initial verification, these were integrated and averaged for each indicator, which revealed the following results in the cognitive dimension:



Table 1. Dimension I. General knowledge about the development of motor coordination

Level of development	Indicator 1	Indicator 2	Indicator 3
High	--	--	--
Medium	33.33%	44.44%	55.56%
Low	66.67%	55.56%	44.44%

In dimension II (table 2), the students presented difficulties in the indicators related to the skills for playing games independently, in the skills for playing coordination, and for playing games with a competitive nature that were evaluated between medium and low levels. It was demonstrated that there are no skills to put into practice the knowledge related to coordination.

In indicator 1, it can be seen that 55.56% had a low level, since they did not show independence, ease or creativity in carrying out the coordination exercises. In indicator 2, the result showed a low level in the development of skills for the execution of coordination games, with 44.44%; likewise, indicator 3 behaved, with difficulties in the development of skills in the exercises-games to increase the development of motor coordination, due to having a low level in this capacity. When evaluating the skills dimension in general, the following results were obtained:

Table 2. Dimension II. Development of skills in games for the development of motor coordination

Level of development	Indicator 1	Indicator 2	Indicator 3
High	11.11%	11.11%	11.11%
Medium	33.33%	44.44%	44.44%
Low	55.56%	44.44%	44.44%

The above shows that in this dimension there are difficulties due to the low level of motor coordination to comply with the established parameters and the students do not have the skills to carry them out.



In la Dimension III (table 3), it can be seen that difficulties were presented in the indicators related to interest in PE classes, the willingness to actively participate in playing the games and satisfaction in carrying out exercises-games for development. of coordination, when evaluated between the medium and low levels.

In indicator 1, related to interest in PE, it was noted that 55.56% were not motivated by the subject. This depends largely on the characteristics of these students, who have social disadvantages associated with their disorder; in indicator 2, 66.67% of the sample was not willing to actively participate in carrying out exercises and in indicator 3, 55.56% presented difficulties, in terms of dissatisfaction in carrying out exercises-games.

Table 3. Dimension III. Provision for playing games for motor coordination

Level of development	Indicator 1	Indicator 2	Indicator 3
High	–	–	–
Medium	44.44%	33.33%	44.44%
Low	55.56%	66.67%	55.56%

DISCUSSION

In this proposal of games to improve the physical-motor situation of students with ASD, it has been demonstrated from a theoretical and practical point of view that the results have been very favorable if it is compared them with their initial state. From the point of view of science in its continuity, it has also achieved transcendence, because if some works are taken as a reference, one can perceive the level of integration that has been achieved.

In the works of Díaz et al. (2021); Obrero and García (2021), the games are more focused on the sports of basketball and soccer. However, these do not offer an evaluative methodology as complete and contextualized as the contribution presented.

The interdisciplinary value shown in the work of Narváe and Lara (2021) is considered, although it is not clearly perceived which are the most developed areas in each exercise, with their respective dimensions and indicators.



In the evaluation, it is assumed that the models of Martín et al. (2023); Pizarro et al. (2023) are very general to be able to determine and monitor the behavior of each student with ASD, in relation to each action that is presented mediated by the order of the games proposed by the system exposed in this article.

CONCLUSIONS

In this work, the effectiveness of PE for the treatment of students with ASD was demonstrated, from theory and practice. The historical evolution of research related to physical activity to improve the socialization of these students was explained, through examples, as well as its distinctive characteristics that include physical-motor and intellectual limitations.

In the diagnosis carried out, it was possible to corroborate the weaknesses in the knowledge that the PE teachers have in the sampled school site, to face the challenges of inclusion, as well as interdisciplinary. The game system applied in this work achieved a favorable impact on students with ASD in the teaching staff of the diagnosed school.

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The author is responsible for writing the work and analyzing the documents.



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