TEACCH METHOD IN PHYSICAL EDUCATION TO IMPROVE THE PARTICIPATION OF STUDENTS WITH AUTISM SPECTRUM DISORDER

MÉTODO TEACCH EM EDUCAÇÃO FÍSICA PARA MELHORAR A PARTICIPAÇÃO DE ALUNOS COM TRANSTORNO DO ESPECTRO AUTISTA

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ABSTRACT

The participation of students with autism spectrum disorder in physical education is compromised by difficulties derived from characteristics of this disorder. The Treatment and Education of Autistic and related Communication Handicapped Children (TEACCH) method has been proved effective in improving learning in this group. This article describes a TEACCH-based intervention program that was used to improve the participation and achievement of a male and female student with ASD in physical education lessons. Several strategies were implemented in this program, namely, spatial organization, concept of complete, routines, and visual materials, to achieve this goal. A qualitative case study was conducted, which used participant observation. The results of this study revealed longer motor engagement, lower anxiety, fewer disruptive behaviors, better understanding of lesson dynamics and tasks, and a higher level of autonomy. This study may be used as a reference for physical education professionals to design new programs adapted to each school context.

Keywords: autism, physical education, TEACCH method.

RESUMO

A participação de alunos com transtorno do espectro autista na educação física é comprometida por dificuldades derivadas de características desse transtorno. O método Tratamento e Educação de Crianças Autistas e Deficientes de Comunicação Relacionadas (TEACCH) provou ser eficaz na melhoria da aprendizagem neste grupo. Este artigo descreve um programa de intervenção baseado no TEACCH que foi usado para melhorar a participação e o desempenho de um aluno de ambos os sexos com autismo nas aulas de educação física. Várias estratégias foram implementadas neste programa, a saber, organização espacial, conceito de completo, rotinas e materiais visuais, para atingir esse objetivo. Foi realizado um estudo de caso qualitativo, que utilizou a observação participante. Os resultados deste estudo revelaram maior envolvimento motor, menor ansiedade, menos comportamentos disruptivos, melhor compreensão da dinâmica e das tarefas da aula e um maior nível de autonomia. Este estudo pode ser utilizado como referência para os profissionais de educação física elaborarem novos programas adaptados a cada contexto escolar.

Palavras-chave: autismo, educação física, método TEACCH.

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1 INTRODUCTION

"Physical activity is the process of engaging in bodily movement that results in energy expenditure" (McKenzie & Kahan, 2008) and "ensure healthy growth and development in young people" (World Health Organization [WHO], 2022). The school environment is considered one of the most important points of intervention to increase children's physical activity participation (Moon et al., 2022; Wilson et al., 2022). Consequently, physical education (PE) is prioritized in quality education because it facilitates the harmonious development and comprehensive education of children (Gil et al., 2008).

Physical activity is also essential for the physical well-being and quality of life of children with Autism Spectrum Disorder (ASD) (Cuesta et al., 2017). Recent systematic reviews have highlighted the benefits of planned physical activity (Soldan et al., 2021) and PE in school (Hortal-Quesada & Sanchis-Sanchis, 2022) for the cognition, motor skills, communication, socialization, and behavior of children and adolescents diagnosed with ASD.

According to Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria (American Psychiatric Association [APA], 2014), ASD is a neurodevelopmental disorder characterized by persistent impairments in communication and social interactions in various contexts and by restricted and repetitive patterns of behavior, interests, or activities. These patterns are manifested as two or more of the following deficits: stereotyped or repetitive motor movements, use of objects, or speech; insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behavior; highly restricted and fixed interests that are abnormal in intensity or focus; and hyper- or hyporeactivity to sensory input or unusual interest in sensory aspects of the environment. Consequently, during PE lessons, students with ASD struggle to grasp the main ideas of a situation, follow instructions, and filter or selectively attend to stimuli, producing sensory oversaturation. Students with ASD also have difficulties in retaining and retrieving information, anticipating, and working independently. They struggle to self-regulate and control their behavior, inhibit automatic responses, and understand and react to interpersonal social situations (Merino et al., 2014). Therefore, teaching methods and communication systems favoring the participation of people with autism are required in schools and PE.

The Treatment and Education of Autistic and related Communication Handicapped Children (TEACCH) method is an effective and widely used intervention approach (Mesibov & Howley, 2012) based on the principle of structured teaching with visual media. In this approach, a predictable sequence of activities is organized within a structured physical space, with flexible routines and work systems that are structured and presented visually (Myers & Johnson, 2007). Mesibov and Howley (2012) explain the benefits of TEACCH programs. Their organization and physical structure make the lesson interesting,

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clear, and manageable for students with ASD, minimize distractions, and promote consistent and effective work. Setting specific, clearly demarcated areas for learning activities, with readily accessible and ready-to-use materials, helps them know where to go and function independently. Furthermore, clear visual information can reduce anxiety and promote independence. Schedules minimize their sequential organization difficulties, help them know what they are doing and anticipate activities, and facilitate transitions between activities, thus promoting autonomy and reducing anxiety. The work system provides information about their expected actions, how many tasks are required of them, how they can gauge their progress, when they have finished, and what happens (the concept of "done"). Images, symbols, numbers, colors, or objects can communicate this information to students who cannot read. This approach enables them to understand situations and expectations, stay calm, be independent, learn better, and reduce behavior problems arising from confusion and anxiety (Gallego, 2012).

This study's purpose is to present a PE intervention program based on the TEACCH method and identify the resulting improvements in the participation of a male and female primary school student diagnosed with ASD (Level 3).

2 METHOD

This research was designed as a case study, encompassing the complexity of a singular case and interesting in its particularity, which aims at comprehensively analyzing the interaction with its contexts. The aim was to conduct structured and qualitative research, highlighting the sequences of events in their context and personal situations (Stake, 2007) through participant observation in a non-interventional study. The teacher (the lead author of this study) designed and taught the lessons and collected data, without disturbing the daily activity of the case, to find innovative alternatives and improve the teaching-learning process. Therefore, the observer was integrated into the group as another member, participating in the environment and taking notes non intrusively (Pérez et al., 2012).

2.1 PARTICIPANTS

A boy and girl diagnosed with ASD level 3, according to DSM-5 criteria (APA, 2014), are from a public school with two special education classrooms in Spain. They require considerable help, given their minimal social communication and marked interference in daily life due to their inflexibility and difficulties with change and focus (Hervás et al., 2017). Based on their development, skills, and needs, the participants

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attended their regular classes for five hours a week and remained in the special education classroom for 20 hours a week. The PE lessons were included in their regular class.

These children were diagnosed with ASD because they had not developed verbal language and lacked effective means of communication. Consequently, they sought ways to express their needs, which sometimes led to disruptive behavior. They made demands through contact with caregivers and teachers, taking them by the arm and directing them to the place or objects that they wanted. They presented visual contact and body language abnormalities, with deficiencies in the comprehension and use of gestures, which were more pronounced in the girl; additionally, they manifested simple motor stereotypies, sometimes accompanied with guttural sounds. Sporadically, owing to anguish when facing changes, struggling to understand instructions, or refusing to follow them, the children inflicted self-harm or hit objects, but never people. They maintained inflexible routines and responded adversely to some sounds, especially the girl, and had restricted and fixed interests (e. g., the girl moved colorful and shiny objects between her fingers, and the boy watched the same movies repeatedly, stopping and restarting the video). Regarding sensory perception, the girl was fascinated by moving lights and showed indifference toward interpersonal games and other people, moving away and avoiding contact. In turn, despite his occasional approaches, the boy struggled to adjust his behavior in various social contexts and imaginative play, which hampered social interaction.

2.2 INSTRUMENTS

Informal interviews were initially used to gather first impressions and initiate contact. Subsequently, their transcripts were used to compare the interview data with information gathered using other instruments for triangulation. Anecdotal records were used to annotate behaviors and their possible triggers during the pre-intervention PE lessons. These anecdotal records were used, always individually, when facing an abnormal situation or identifying an unusual behavior; the date was noted, significant event was described, and occurrences were interpreted. These records guided the design of the intervention program and field diary, which served to evaluate changes in post-intervention behaviors (Table 1).

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Table 1. Field Diary to evaluate changes in behaviors of students with ASD in physical education

POST-INTERVENTION OBSERVATION
Undesired behaviors
Growling and grunting (making guttural sounds), expressing a state of agitation
Flapping and/or rocking back and forth as a sign of anxiety
Hitting objects, the ground, or one's own body, expressing a state of anguish
Adopting a closed posture as a way of isolating themselves from the group
Placing their hands over their ears as a form of evasion
Remaining self-absorbed, abstracted, or lost in their own thoughts
Avoiding visual contact
Trying to avoid any type of contact with their peers
Showing lack of involvement in the tasks and lack of initiative to complete them (remaining immobile)
Resisting physical guidance (modeling)
Abandoning the motor task before completion
Showing reluctance to stay in the group
Wandering around aimlessly
Escaping and staying in spaces away from the activity and group
Searching for tactile stimuli as a form of regulation
Constantly needing a support person to perform a task
Going to the toilet as a way of expressing their desire to end the lesson
Desired behaviors
Knowing and independently starting and ending the routines of the lesson
Knowing and performing greeting and farewell tasks calmly
Performing greeting and farewell tasks while establishing eye contact with the teacher
Identifying the three zones of the space (station system)
Understanding that they must complete the three main tasks in each lesson
Going to the starting area of the next motor task after completing the previous task
Understanding, during the task, what has been done and what remains to be done
Identifying when each task is completed by hiding the number and motor skill pictogram
Observing the pictograms and understanding them
Recognizing a previously performed motor task by looking at the corresponding pictogram
Recognizing a previously completed motor task by observing the space and material required for its completion
Staying in the right place for the task, guided by the materials placed in the area

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2.3 PROCEDURE

In the 2017–2018 academic year, the teacher and observer met the two students with ASD. Their needs triggered this research. At the study's outset, informal interviews were conducted during the PE lessons with the students' tutors and support people, all of whom were educational therapists.

In the 2018–2019 academic year and the first trimester of the 2020–2021 academic year, the first observation was performed to identify, through anecdotal records, repetitive behaviors showing low participation and poor performance in PE. During this process, the informal interviews continued for data comparison.

The next step comprised designing the intervention program based on the data collected thus far and scientific literature on the TEACCH method. The objective was to reduce maladaptive behaviors and facilitate participation, thereby improving motor skills and the possibilities of social interaction within the group/class.

The program was implemented within school hours during the second and third periods of the 2020–2021 academic year (February–June) and was repeated at the beginning of the 2021–2022 academic year. After each lesson, the field diary (Table 1) was completed to assess the resulting effects.

3 DESCRIPTION OF THE TEACCH-PE INTERVENTION PROGRAM

TEACCH-PE is based on TEACCH educational techniques. For all lessons, the space was organized by introducing visual barriers and removing distractors (one task in each delimitated space); flexible routines were established at the start, end, and during the lesson (transition between tasks); and information was provided through visual materials. Additionally, mechanisms were established to identify the start, progression, and completion of the initiated task.

The program comprised 16 25-minute-long weekly lessons. A new task was introduced in each lesson, and two of the three main tasks from the previous lesson were repeated. These revision tasks served to reinforce learning and assess whether the students remembered and performed them with greater autonomy.

Physical guidance was used to induce the desired movements and modeling was applied to encourage imitation. PE objects, pictograms, and known gestures of the Spanish sign language, such as "good" or "done," were used as visual aids. Simultaneously, words matching the pictograms or gestures were spoken as verbal aids. To further clarify, the strategies of the TEACCH-PE program are explained below.

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3.1 START AND END ROUTINES

The start routine comprised bringing the PE pictogram from the special education classroom to the panel placed on the gymnasium door. Then, the student entered and sat in the "assembly square," formed by four Swedish benches, always located in the same place and close to the start. In the end routine, the student returned to the "assembly square" and, after completing the farewell task, retrieved the PE pictogram, returned to the classroom, and deposited it in the box of completed activities. During the initial lessons, the student was physically guided by the support person, avoiding mistakes, hesitations, or other distractions. This strategy was used to help the students locate themselves in space and time, identifying more clearly the start and end of the class.

The entire teaching team used the same pictograms to identify the same terms, extracted from the Aragonese Center for Augmentative and Alternative Communication, which enables its generalization and use in contexts outside the school environment.

3.2 GREETING AND FAREWELL TASKS

The greeting and farewell tasks were performed in the "assembly square". They were the same for all the lessons, but small variations were introduced as the program progressed.

The greeting task comprised passing a ball, which encouraged eye contact and cooperation with classmates and the PE teacher. This task was relevant because the work in the other classrooms was individual, without interactions with classmates. However, in PE, the space was shared, and the teacher was not the usual tutor. This strategy was used to start with a well-known and simple proposal, which required no effort to understand and ensured success in its execution, thus promoting a state of tranquility and preventing anxiety and initial rejection.

The farewell task was a massage with a sensory ball. It focused on tactile sensory perception to influence state of regulation, providing a pleasant and calm moment at the end of the lesson.

3.3 ORGANIZATION OF THE SPACE INTO FIXED STATIONS

Comprised transferring the system of trays used in the special education classroom to the PE class. Each student was assigned a corner with a table, chair, and shelf, on which three trays were placed. These trays contained pictograms 1, 2, and 3 and the materials needed to complete the three activities, working from left to right. After removing pictogram 1, the child would place it in the box of completed activities. Subsequently, the child would finish the work with trays 2 and 3 sequentially.

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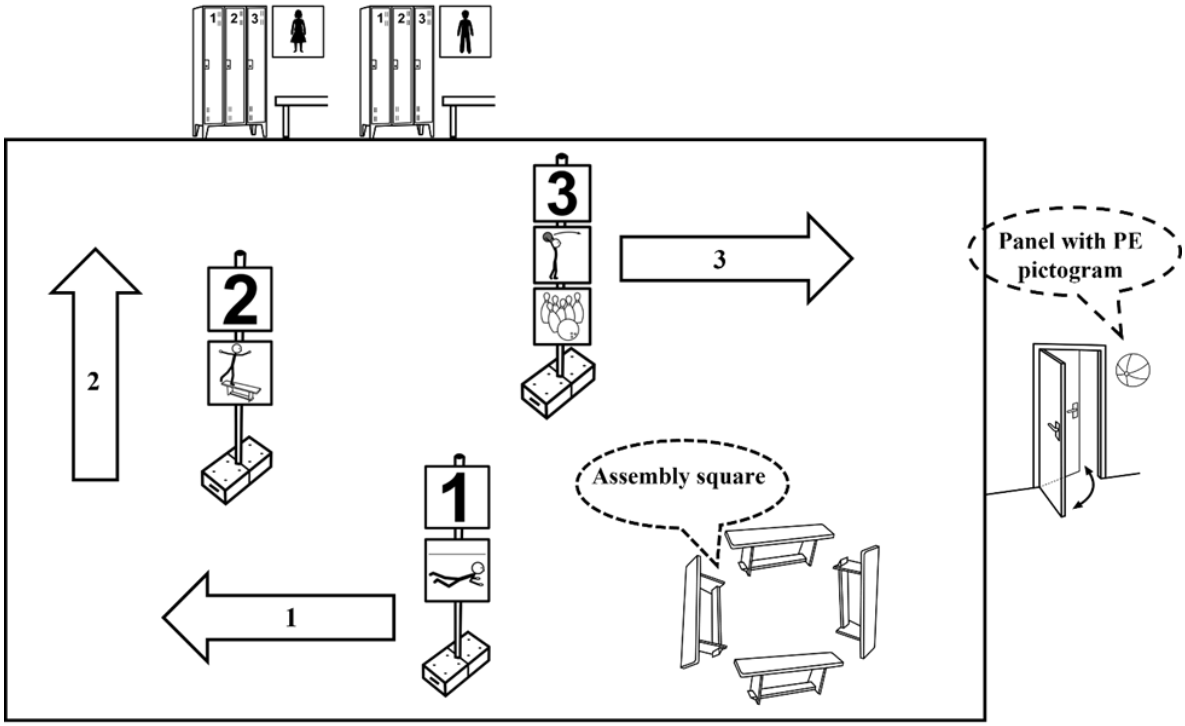
The space in the gymnasium was divided into three fixed areas, which simulated the three trays (Figure 1). Each area was marked with pictograms 1, 2, and 3, attached to a vertical bar. The dimensions of the pictograms were larger than usual (21x21 cm.). The essential materials were placed appropriately in each space to enable the students to perform the tasks without distractions and facilitate the execution of motor skills. At each task's completion, the pictogram was rotated 180° to hide the number. This strategy aimed at enabling the students to understand the organization of the lesson, become confident, and improve work efficiency.

Figure 1. Organization of the space into fixed stations during the PE lessons



3.4 IMPLEMENTATION OF THE CONCEPT OF COMPLETED ACTIVITY

This strategy was applied using several approaches (Figure 2). When the task involved handling mobile objects, the children had to move a ball in each repetition. Thus, the students visualized at all times how many balls they had already carried and how many they had left to finish the activity. In displacement tasks, cones were placed at the end of the path to inform about the number of repetitions. After each repetition, the students shifted a cone to the start of the path. Thus, they understood that

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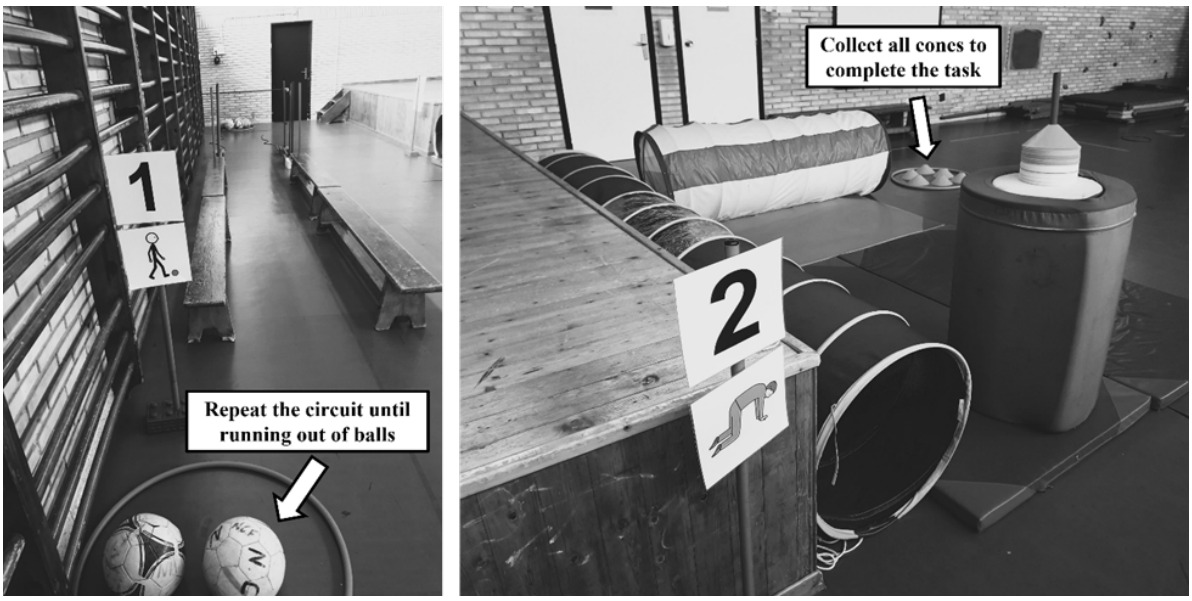
they had to collect all cones to complete the activity. When required by the organization of the space, materials of the task, or complexity of the motor pattern, a panel with a photograph of each student was placed under the number of cards corresponding to the required number of repetitions. With each execution, the children would walk up to the panel and remove a card to insert it into the box of completed activities placed immediately below. To avoid confusion, a different color was assigned to each student's cards. This color was always the same and matched the color of their notebook in the special education classroom. This strategy aimed at reducing the frustration of not knowing the duration and progress of the activities.

Figure 2. Application of the concept of completed activity in PE classes



3.5 USE OF VISUAL MATERIALS

Other pictograms (21x21 cm), placed under pictograms 1, 2, and 3, were introduced to provide visual cues reminding the student of the motor skill required in each task (e.g., climbing, balancing or jumping). Color coding was also used by assigning materials with a specific color to each student, and spaces were delimited visually (e.g., using hoops to mark the position of the student).

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3.6 LESSONS OF THE TEACCH-PE

Table 2 presents the program's first lesson. This lesson serves as a model and includes the complete information about the start and end routines and the greeting and farewell tasks, and descriptions of the activities of the main phase.

Table 2. Lesson 1 of the TEACCH-PE program for children with autism. Climbing, Crawling, and Throwing

START ROUTINE	**GREETING TASK**
The child places the PE pictogram on the start panel (located outside the gymnasium), enters and sits in the assembly square.	**Passing the ball:** Sitting on the assembly square, the teacher passes the ball to the child, whose receives with both hands and passes the ball back
MAIN PHASE	
Station 1 (S1). Climbing to put a ball in a bag: The child climbs the wall bars laterally (with mats underneath), takes a ball from the hoop at the end, walks to the bag at the beginning and repeats (three balls). **S2. Crawling to collect cones:** After crawling under four hurdles, the child takes a cone from the hoop at the end of the path and walks to the start, inserts the cone into a bar, and repeats (three cones). **S3. Throwing a ball into a box:** Each student is seated inside a hoop, 2 m from a wall. A box is placed in front of each hoop and attached to the wall. Another box with tennis balls is placed in front of the hoops. The teacher marks the turns placing the tennis balls in front of one student. The student throws the ball overhand, trying to get it into the box. The task ends when the box runs out of balls.	
FAREWELL TASK	**END ROUTINE**
Massage with a sensory ball: The teacher massages different parts of the student's body with a hedgehog ball, while the student remains seated in the assembly square.	The student exits the gymnasium, picks up the PE pictogram, returns to the especial education classroom, and places it in the box of completed activities.
OBSERVATIONS: The start and end routines and the new structure of the lesson are incorporated based on the TEACCH method. The girl and boy will be physically guided by the adult support person, avoiding mistakes, hesitations, or other distractions at the start and end of the lesson.	

Since the structure of the first lesson was maintained in the rest, the lessons 2 to 16 only presents the tasks that were progressively introduced and the specific observations (Table 3). In each lesson, a new task was introduced to the main phase, and the other two tasks were repeated from the previous lesson. The first activity that was modified was the intermediate task in the second lesson, to ensure that the students felt secure at the start and end of the lesson. Henceforth, the tasks were modified in the following order: station one, three, and two. This rotation was repeated until the end of the program. In the observations section, the relevant aspects of each lesson are reported.

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Table 3. TEACCH-PE program for children with autism. Lessons 2 to 16

L2. Climbing, Balancing, and Throwing	**S1. Climbing to put a ball in a bag.** **S2. Balancing level by level:** The child maintains balance while walking along different surfaces from level 1 to the highest level they can reach. Level 1: a rope lying on the ground. Level 2: two Swedish benches placed side by side. Level 3: on a Swedish bench. Level 4: an upside-down Swedish bench. The student completes the circuit by walking from the level at which the activity ends to the cones area, picking up one, and bringing it to the start to insert it through a small vertical bar (three cones per student). **S3. Throwing a ball overhand into a box.**
	Observations: The teacher explains the motor skill required through the following sequence: showing the pictogram of the task, saying the corresponding word, completing the circuit, and remaining behind the student to guide the student.
L3. Belly crawling, Balancing, and Throwing	**S1. Belly crawling to put a ball in a bag:** This involves belly crawling under 4 hurdles. The horizontal bars should be placed at a height that prevents the child from crawling on all fours, forcing the child to lower his/her center of gravity, dragging the chest and pelvis on the floor. The child takes a ball from the hoop at the end of the circuit, walks to the start to place the ball in a bag (three balls per student). **S2. Balancing level by level**. **S3. Throwing a ball overhand into a box**.
	Observations: Physical guidance is gradually weaned and used only when the student needs contact and accompaniment during the activity. Modeling is maintained in S1 (which is presented for the first time) and in the following two only if the student does not start the execution once the pictogram and material for the task have been presented.
L4. Belly crawling, Balancing, and Aiming	**S1. Belly crawling to put a ball in a bag.** **S2. Balancing level by level.** **S3. Aiming while sitting on an exercise ball:** Each student starts by sitting on an exercise ball facing a wall approximately 3 m away. Hoops of different sizes are hung on the wall at varying heights. The child throws a foam ball to the wall, aiming at one of the hoops. To the right of the hoops, a photograph of each student is placed on the wall above eight colored laminated cards (each child has eight cards of the same color). After each throw, the student walks to the panel, removes a card, and inserts it into the box of completed activities, located underneath the panel. Inserting the last card marks the end of the task.
	Observations: Physical guidance is used to lead the student to the panel and, using his/her arms from behind, make him/her remove his/her card and insert it into the box of completed activities.
L5. Belly crawling, Crawling through Tunnels, and Aiming	**S1. Belly crawling to put a ball in a bag.** **S2. Crawling through tunnels:** The child crawls through two play tunnels (shaped into an "L") on all fours, takes a cone from the hoop at the end of the path, walks to the start, inserts the cone through the vertical bar (three cones per student). **S3. Aiming while sitting on an exercise ball.**
	Observations: A variation is introduced to the farewell task, which will be maintained in the following sessions. The students massage themselves rather than being massaged by the teacher, although it is modeled behavior. The adult sits in front of the students and exemplifies the self-massage, so that the students can mimicking the behavior.
L6. Dribbling, Crawling through Tunnels, and Aiming	**S1. Dribbling:** The children dribble a ball with their feet between two lanes delimited by Swedish benches in the first path, by bricks in the second path, and by ropes in the third path. They repeat the circuit until running out of balls (three per student), that is, until they have dribbled all balls from inside a hoop at the start of the circuit to a net at the end. **S2. Crawling through tunnels.** **S3. Aiming while sitting on an exercise ball.**

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L7. Dribbling, Crawling through Tunnels, and Bowling	**S1. Dribbling.** **S2. Crawling through tunnels.** **S3. Bowling game:** The children throw a ball using a boccia chute to try to hit the pins. Small hoops in which they await their turn are placed, and footprints to mark the throwing spot. On the wall, to the right of the pins, a photograph of each student is placed above eight colored laminated cards (each child has eight cards of the same color). After each throw, the student walks to the panel, removes a card, and inserts it into the box of completed activities, located underneath the panel. Inserting the last card marks the end of the task.
	Observations: The number of repetitions in S1 is increased from 3 to 5. This increase is maintained in the next lesson.
L8. Dribbling, Jumping down, and Bowling	**S1. Dribbling.** **S2. Jumping down level by level:** The children complete the jumps, from level 1 to the highest level from which they can jump down. Level 1: jumping down from a Swedish bench. Level 2: jumping down from the mat tower (the tower is twice as high as the bench). Level 3: jumping down from a position higher than level 2. Each student ends the circuit by walking from the highest level that they reached to the cones area, picking up one, walking back to the start, and inserting the cone through a small vertical bar (three cones per student). **S3. Bowling game.**
L9. Stickhandling, Jumping down, and Bowling	**S1. Stickhandling a floorball:** The children drive a floorball with a stick between two lanes delimited by Swedish benches in the first path, by bricks in the second path, and by ropes in the third path. The children repeat the circuit until have driven all balls from inside a hoop at the start to another hoop at the end. **S2. Jumping down level by level.** **S3. Bowling game.**
	Observations: The boccia chute is removed in S3.
L10. Stickhandling, Jumping down, and Shooting on goal	**S1. Stickhandling a floorball.** **S2. Jumping down level by level.** **S3. Shooting on goal – soccer:** A dot sticker is stuck to the ground where a ball is placed, approximately 3 meters from a wall. A small goal is attached to the wall in front of the mark. The children kick the ball trying to score a goal. Small hoops in which they await their turn are placed, and footprints were stuck to mark the position from which they kick the ball. On the wall, to the right of the goal, a photograph of each student is placed above eight colored laminated cards (each child has eight cards of the same color). After kicking the ball, the student walks up to the panel, removes a card, and inserts it into the box of completed activities, located underneath the panel. Inserting the last card marks the end of the task.
	Observations: The number of repetitions in S1 is increased from 3 to 5. This increase is maintained in the next lesson.
L11. Stickhandling, Bouncing a ball, and Shooting on goal	**S1. Stickhandling a floorball.** **S2. Bouncing a ball inside hoops:** Nine medium-sized hoops are placed on the ground in a row ending in front of a wall. The students start inside the first hoop with a ball in their hands, bounce it into the second hoop, pick it up, step into the second hoop, and repeat until the end. On the wall, a photograph of each student is placed above three colored laminated cards (each child has three cards of the same color). After completing all eight bounces, the students remove a card from the panel, insert it into the box of completed activities (located underneath the panel), and return to the first hoop to restart the sequence. Inserting the last card marks the end of the task. **S3. Shooting on goal – soccer.**

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L12. Dynamic and static balancing, Bouncing a ball, and Shooting on goal – soccer	**S1. Dynamic and static balancing:** The children walk on stilts, following a path marked with chalk. At the end of the path, they take off the stilts and stand on a BOSU® located in front of a wall with a panel. The panel has a photograph of each student above three colored laminated cards (three cards of the same color for each child). Balancing on the BOSU®, they remove a card off the panel, insert it into the box of completed activities (located underneath the panel), and return to the starting point, carrying the stilts to repeat the sequence. Inserting the last card marks the end of the task. **S2. Bouncing a ball inside hoops.** **S3. Shooting on goal – soccer.**
L13. Dynamic and static balancing, Bouncing a ball, and Shooting on goal – floorball	**S1. Dynamic and static balancing.** **S2. Bouncing a ball inside hoops.** **S3. Shooting on goal – floorball:** A dot sticker is stuck to the ground to indicate where the floorball would be placed, approximately 3 m from a wall. In front of the mark, a small goal is attached to the wall. The children hit the ball with the stick trying to score a goal. Small hoops in which they await their turn are placed on the ground, and footprints are stuck to the ground to indicate where they should hit the floorball. On the wall, to the right of the goal, a photograph of each student is placed above eight colored laminated cards (eight cards of the same color for each child). After shooting on goal, the students walk up to the panel, remove a card, and insert it into the box of completed activities, located underneath the panel. Inserting the last card marks the end of the task.
	Observations: In S3 the footprints run parallel to the goal to help the children hit the floorball with the stick (the body is rotated 90°).
L14. Dynamic and static balancing, Rolling on the floor, and Shooting on goal – floorball	**S1. Dynamic and static balancing.** **S2. Rolling on the floor:** Three mats are laid down in a row. The students start by lying supine on the mat. They rotate about the longitudinal axis until they reach the end of the mats. They then take a cone from the hoop, return to the vertical bar at the start of the circuit, place the cone on the bar, and repeat the circuit (three cones per student). **S3. Shooting on goal – floorball.**
	Observations: S2 requires using modeling and physical guidance.
L15. Zigzagging, Rolling on the floor, and Shooting on goal – floorball	**S1. Zigzagging:** Ten vertical bars, 1 m apart, forming a line ending in front of a wall. The students start in the first vertical bar, and zigzag between them. On the wall, a photograph of each student is placed above three colored laminated cards (three cards of the same color for each child). After zigzagging, the students remove a card from the panel, insert it into the box of completed activities (located underneath the panel), and return to repeat the circuit. Inserting the last card marks the end of the task. **S2. Rolling on the floor.** **S3. Shooting on goal – floorball.**
	Observations: S1 requires drawing on the ground a line outlining the path to guide the students.
L16. Zigzagging, Rolling on the floor and Ring tossing	**S1. Zigzagging.** **S2. Rolling on the floor.** **S3. Ring tossing:** A hoop is placed on the ground and a cone is placed 1 m from each hoop for each student. The students start sitting inside their hoop. The teacher places a box full of rings in front of the student to mark his/her turn. The student then tries to toss the rings on to the cone. The task ends when the student runs out of rings.

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4 RESULTS

The results of the TEACCH-PE program were analyzed using direct interpretation and descriptive narratives. The quality, credibility, and relevance of this qualitative case study are supported by the comprehensive knowledge of the cases, resulting from the teacher-observer's direct interaction with the students from 2017 to 2021.

4.1 PRE-INTERVENTION PE DIFFICULTIES OF THE STUDENTS WITH ASD

Repetitive and similar behavioral patterns were observed during all sessions. The girl frequently arrived at the PE lesson upset because of her mental inflexibility and difficulties with change. The tasks in the PE lessons varied daily, and her classmates' behaviors were unpredictable, causing a sense of disorganization and chaos for her. She usually entered the gymnasium growling and grunting, showing physical resistance and/or swinging her chest. When sitting with the group, she adopted a closed posture, bringing her chest and head closer to her thighs and knees, and staring at the ground. When she entered the gymnasium quietly, she was absorbed and lost in her thoughts. She avoided eye contact with the teachers and any kind of interaction with her classmates. These behaviors manifested her lack of interest in games. The boy showed a better disposition in PE. When told that it was time to start the PE lesson, he took the initiative and went to the gymnasium with his support person. His expression was serene, and he often approached his classmates, almost always the same ones. He would stare at them sporadically, staying a few centimeters from their faces, eyes, or any body part that aroused his interest. He rarely rejected another classmate's approach.

During the lesson, they listened to the explanations, but when the motor activity commenced, they remained immobile, while their classmates began moving and preparing for the activity. Sometimes, the boy followed the group at the beginning, but soon lost his sense of purpose, as he was unable to understand what was being asked of him. When the support person used physical contact to make the boy or girl move, walk up to the group, or start walking, the following events were triggered:

The boy would allow himself to be molded, showing docility in the first tasks. However, owing to cognitive exhaustion caused by the high number of stimuli that he did not understand, he would become reluctant to remain in the group as the lesson progressed and wandered around the space or lay down on the mats located in a corner. When attempts were made to steer him back to the task, he would resist physically, make rejection noises, and in extreme cases, flap his arms and/or cover his ears with both hands. These behaviors arose in the absence of other effective means of communication.

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The girl tried to avoid the activities. Her most common behaviors were escaping to the farthest space or sitting on the floor and using her body weight to resist attempts to move her. In response to the anguish generated by misunderstanding the tasks, interacting with others, and feeling excessive stimuli, she commonly swayed, continuously growled and grunted, hit the ground with her fists, or hit her head with her hands. To self-regulate, she escaped from the environment and maintained a calm state, resorting to tactile stimuli around her (e. g., she touched ropes hanging on the wall).

In terms of both the number of tasks and time spent performing an activity, participation was very low, especially in the case of the girl. They were never able to complete the tasks independently. Occasionally, they were led by their classmates during the activity (e. g., the classmates would hold their hands to help them run or lead them in a dance).

During the final personal hygiene routine, they regained control and calmed down. This routine was familiar. They could execute it with the assistance of an adult and it informed them that the class had ended and that they could return to the classroom, a space that provided them with a familiar and subjectively safe context. On some occasions, the boy went to the toilet to start his routine before the lesson ended. He used this behavior to avoid upsetting situations and communicate his desire to return to the classroom. In lessons during which the girl's state of anxiety and frustration was very high, the personal hygiene routine failed to calm her down, and she left the gymnasium in an undesirable state, which, over time, conditioned her subsequent relationship with PE.

4.2 RESULTS OF THE STRATEGIES OF THE TEACCH-PE PROGRAM

The boy and girl with ASD tangibly assimilated the strategies of the TEACCH-PE program. Both were able to perform the start and end routines without a support person. Moreover, during the greeting and farewell tasks, they showed no disruptive or rejection behaviors. The station system was assimilated by both students because, at the end of a task, they went to the next station. Similarly, when they put away the material of the greeting task, they went to the first station, and when they completed all activities at the last station, they went to the assembly square for the farewell task. Additionally, they internalized the concept of a completed activity, as shown by their behaviors, such as carrying several balls/cones simultaneously or putting several cards together in the box of completed activities to reduce the number of repetitions and complete the activity as soon as possible.

The students understood that turning the pictogram indicated an activity's completion because they moved to the next station, but they were unable to turn them autonomously, as intended. They managed to handle and understand the meaning of the PE pictogram and pictograms 1, 2, and 3 because

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they were used contextually. However, they did not discriminate motor skill pictograms. They did not perform the tasks when only the associated pictogram was shown to them. Nevertheless, they seemed to be able to recognize some of the previously performed motor tasks by looking around the space and at the material because they started the movement without any instruction. In other tasks, however, just arranging the material was inadequate, and they required modeling again.

Lastly, neither student managed to recognize the exact starting point of the next task (for example, footprints marked on the ground), although they did move to the corresponding area.

4.3 DECREASED DISRUPTIVE BEHAVIORS AND INCREASED PARTICIPATION

The disruptive behaviors observed before applying the TEACCH-PE program clearly decreased. This markedly increased their participation and performance in the lessons.

The behavioral changes following the first adaptation lessons were sustained and very noticeable. The students with ASD no longer faced an unpredictable lesson every day. Now, they knew what they had to do, where to go, and what the first task was when they went to the gymnasium. This promoted an initial calm state. Consequently, the children no longer showed vocal stimming, stimming, posturing, or physical resistance at the start of the lesson. Moreover, the greeting task required concentration, which prevented them from remaining self-absorbed or lost in their own thoughts, and encouraged eye contact with the teacher.

During the lesson, when the tasks were introduced, the students required physical guidance and modeling from the adult, at least for the first repetitions. However, they performed known tasks autonomously with only the material or complementary help through modeling. However, the students occasionally required physical guidance to initiate the movement, especially when the activities involved greater physical effort, were not performed completely and successfully, or did not stimulate them. Nevertheless, movement-inducing contacts were no longer resisted. Gradually, the permanent presence of a support person became less necessary.

Both the boy and girl completed all the tasks of the program without dropping out. With the new dynamic, they did not want to stop the activity until, for example, all the balls were in the net, or all the cards were inside the box of completed activities. Their characteristic rigidity and inflexibility played in their favor, maximizing their participation and performance in the lessons.

Simultaneously, their attempts at evading, distancing themselves from, and escaping the group and wandering aimlessly decreased, and aggressive behaviors such as hitting objects and inflicting self-harm were almost completely eliminated. In this new climate of calm and tranquility, they were more willing to

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share space and spend time with their classmates and no longer sought tactile stimuli to regulate their behaviors.

They participated pleasantly in the farewell task and left the gymnasium without agitation, anxiety, or distress. This behavior positively influenced the following sessions.

5 DISCUSSION

First, the informal interviews with the teachers and the anecdotal records were particularly useful to assess the students diagnosed with ASD in PE classes. These instruments were crucial for their psychopedagogical evaluation in the educational context (Coma & Álvarez, 2007) because they enabled us to establish the relationship between disruptive, problematic, or unwanted behaviors and identify the environmental elements that prevent their onset. Defining problematic behavior and identifying triggers were essential in the initial assessment (Hervás & Rueda, 2018). Research shows that students with ASD show a low participation and performance in PE in this phase (Arnell et al., 2018; Heredia & Durán, 2013; Kerem & Kocak, 2020), as well as disruptive or undesirable behaviors in response to states of agitation, anxiety, or distress (De-la-Iglesia & Olivar, 2012; Martínez-González & López-Gil, 2017).

This long and comprehensive initial evaluation of the subjects was essential to design an intervention program that modified and controlled elements that triggered problematic behaviors and, consequently, prevented student participation (Lee & Haegele, 2016). Minimizing undesirable behaviors resulted in positive effects on the general dynamics of the class, corroborating previous findings (Hortal-Quesada & Sanchis-Sanchis, 2022).

The theoretical foundations and practical strategies of the TEACCH method were appropriate for this purpose (Sanz-Cervera et al., 2018). The participants adapted to the strategies introduced to the lessons faster than expected, largely owing to similarities with the organization and operation of their SE classroom, which helped them understand the information and facilitated security, tranquility, and autonomy.

During the TEACCH-PE program, some difficulties in discriminating the new motor skills pictograms were observed because they were only presented in PE lessons, and a new pictogram was introduced every week, without a systematic process of learning, discriminating, and using the new pictograms. A methodical and persistent process must be implemented for the students to comprehend the pictograms (De Paula & Bezerra, 2015). Accordingly, complementary instructions by the teacher or speech-language pathologist may promote comprehension.

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Highly effective strategies were identified in this study. Structuring the space into three stations, using procedures for reporting task progress and completion, delimiting spaces and routes with materials of the motor skills universal set, and incorporating start-end and meeting-farewell routines were key to improving the intervention. As in other studies, using these TEACCH-based strategies improved the participation of students with ASD (González, 2018; Panerai et al., 2002; Virués-Ortega et al., 2013), and alternative and augmentative communication systems produced satisfactory results (Ganz et al., 2012; Mira & Grau, 2017).

This study had positive findings. If the structure of the program is maintained in the long term and extended to all PE lessons, not just a weekly 25-minute lesson, students with ASD may successfully participate in other group-class activities throughout the year and take advantage of physical activity for personal and social development (López-Díaz et al., 2021; Sefen et al., 2020). However, more research is needed to apply these strategies in PE, both in early childhood and primary education, as well as in secondary education, where adaptation difficulties could be greater because the learning process is more complex than the curriculum of this area requires.

The most significant results of this study are the strategies compiled in the section *Description of the TEACCH-PE Intervention Program* and the explanation of how they were introduced throughout the lessons. Considering the study results, TEACCH-PE may be highly useful in providing teachers of students with ASD with a reference on how to apply the TEACCH method in PE and design new programs for improving the participation of these students.

Undeniably, a case study such as this prevents any generalization of the results, especially considering the vast differences between students diagnosed with ASD. Based on the literature review and the results of the observations, the following conclusions are reached:

- TEACCH-PE increases the participation and motor commitment time of students with ASD because the TEACCH method increases their comprehension of tasks and reduces attempts at avoiding these tasks.
- TEACCH-PE decreases the onset of disruptive and undesirable behaviors in students with ASD because the TEACCH method helps them remain calm and reduces frustration, agitation, anguish, and anxiety.
- TEACCH-PE removes the need for a constant and individual support person for each student because the TEACCH method enables students with ASD to work autonomously.

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