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AN ARTISTIC GYMNASTICS PROGRAM TO PROMOTE PRAXIC, COGNITIVE AND SOCIAL SKILLS IN CHILDREN WITH SLD: A CASE STUDY

UN PROGRAMMA DI GINNASTICA ARTISTICA PER PROMUOVERE LE ABILITÀ PRASSICHE, COGNITIVE E SOCIALI NEI BAMBINI CON DSA: ANALISI DI UN CASO

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Abstract

Several studies suggest that physical exercise promotes wellbeing and ameliorate cognitive functioning. Here we investigate whether physical education and sport, such as artistic gymnastic practice improves cognitive, affective and social skills in a nine-year old child with specific learning disorders (SLD). We implemented a motor intervention program articulated in basic artistic gymnastic exercises and evaluated its effectiveness in developing and enhancing the child's skills and competences. The participant received 32 sessions (2 per weeks) of the motor intervention program over 10 months. Several dependent measures were monitored, such as praxis abilities, cognitive functions and individual engagement. Results showed that the child exhibit increased praxis abilities (in terms of laterality of space movements and balance responses), cognitive functioning (in terms of number of produced motor combinations) and social skills (in terms of motivational engagement). In conclusion, motor intervention programs based on artistic gymnastic are recommended to enhance coordination abilities and social skills in individual affected by learning disabilities.

Questo lavoro di ricerca ha origine dall'analisi di come il movimento, l'educazione motoria e lo sport, in particolare la ginnastica artistica, possano aiutare i bambini con disturbi specifici di apprendimento, disprassici e non lateralizzati a migliorare le loro abilità prassiche e le loro competenze cognitive, affettive e socio-relazionali. Lo studio descrive l'osservazione di una bambina di nove anni con una diagnosi di disturbo specifico dell'apprendimento (DSA) con marcate difficoltà nelle abilità prassiche. È stato implementato un programma di sviluppo motorio costituito da esercizi di ginnastica artistica di base e tarato sulle specifiche esigenze cognitive e prassiche della bambina per promuovere lo sviluppo di specifiche competenze di coordinazione motoria, cognitive e socio-relazionali. Il programma si è svolto in un arco temporale di 10 mesi con una cadenza bisettimanale. I risultati mostrano uno specifico miglioramento nelle abilità prassiche (lateralizzazione dei movimenti ed equilibrio), di memoria (in termini del numero di combinazione motorie riprodotte) e socio-relazionali (in termini di numero di volte che la bambina prendeva l'iniziativa al gioco con l'insegnante o le compagne). In conclusione, si evidenziano le potenzialità educative che lo sport e il movimento hanno durante l'età evolutiva sia nel contesto sociale che in quello scolastico, permettendo di creare contesti inclusivi in cui ogni ragazzo ha pari opportunità e può sviluppare al massimo le sue potenzialità individuali. In particolare, il programma motorio proposto può rappresentare un valido ausilio per il miglioramento delle abilità prassiche nei soggetti con disturbi specifici di apprendimento.

Keywords

SLD, Dyspraxia, Artistic Gymnastic, Movement Program, Education.

DSA, Disprassia, Ginnastica Artistica, Programma motorio, Educazione.

Introduction

Sport plays an important social role as it represents an educational tool and transmits positive universal values that contribute to the promotion of the inclusion, participation and social aggregation and is an instrument of prevention (Caplan, 1965) and psycho-physical well-being (WHO, 1948).

CONI (Italian National Olympic Committee) has always been committed to ensuring that sports practice is increasingly widespread among young people starting from the school environment, through sporting proposals and specific training interventions and is committed to foster motor practice, physical and sports with the aim of spreading awareness and culture of movement among the population.

Even the "National guidelines for the nursery and primary school curriculum" of 2012 give a lot of importance to the body and movement considered, since preschool, as an important means of relating to oneself and others.

In addition, numerous medical and scientific researches have shown that regular sporting activity brings the subject in developmental age and his body multiple benefits on a physical, psychological, cognitive and motivational level (Carthy, 2018).

This contribution arises from the analysis of how movement, motor education and sport, in particular artistic gymnastics, can help children with specific learning disorders (SLD) (Law 170/2010; APA, 2014) to improve practical and cognitive skills as well as affective and socio-relational skills.

In particular, the case of a nine-year-old girl with a specific learning disorder has been examined and a motor development programme has been proposed to her, consisting of basic artistic gymnastics exercises calibrated to her specific cognitive and relational needs, in order to support her praxic and cognitive skills as an assistance to the school intervention.

The observation and the motor development program took place during the hours of training in the gym. The child's skills were assessed at two different stages: before (December 2019) and after the program submission (October 2020). The child has been following the motor development programme for 10 months, regularly carrying out a series of exercises specially prepared on the basis of the methods described below.

The aim of the research is to demonstrate the effectiveness of the motor program as an aid for the improvement of praxis and cognitive skills in subjects with SLD[1].

1. The relationship between the improvement of executive functions and cognitive development

The term "Executive Functions" (EF) was used for the first time by Muriel Lezak, in 1938, in order to consider the types of cognitive abilities that allow a person to perform an independent, adaptive and targeted action.

The ability to program and plan a sequence of acts or actions to achieve a purpose, their inhibition, problem solving and self-control are also part of the EF.

Three components of executive functions have been identified that characterize the most

1 This work is the result of Giorgia Ferracuti's master's thesis in Pedagogical Sciences.

complex cognitive processes, including inibition (stimulus control), working memory (ability to retain information) and cognitive flexibility (ability to modify one's perspective and adapt to changes in the surrounding environment) (Miyake, Friedman, Emerson, Witzki, Howerter, Wager 2000).

A deficit in executive functions characterizes several neurodevelopmental disorders such as Attention Deficit and Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD) and Specific Learning Disorder (SLD) with particular reference to evolutionary dyslexia. Comparing the performance of these subjects with those normal, it can be pointed out a degradation in the three components of the FE (Vicari, Di Vara, 2017; Reiter, Tucha, Lange, 2005; Marotta, Varvara, 2014).

1.1 Motor activity for the developmental age

During his life, the human being acquires knowledge, skills and abilities that are classified into motor, social, relational, communicative, affective and cognitive. They are all connected to each other, in fact, even to acquire a motor gesture, the subject needs to develop cognitive and socio-relational skills (Casolo, 2014).

According to the aforementioned reasons, the development of motor skills during the developmental age cannot be thought of as detached from the social, emotional and psychological ones. Motor education is the core of the development and learning processes of each subject, especially during childhood. The body has the task of facilitating and mediating learning; in this way the didactic action is configured as a formative intentionality that allows specific methodologies to be put into practice, in order to foster the cognitive, emotional, expressive, communicative, relational, social and moral potential of the person. (D'Elia, Sibilio, 2015).

Learning allows to get new automatisms, whose repetition over time allows the transformation into daily behaviors, called motor skills. In the educational field, motor learning has a double function: allowing the subject to get a "know-how" to improve its performance costantly and helping to train functions which develop at the same time to the repetition of the required motor task.

The motor learning process is divided into three phases: the development of raw coordination, the development of fine coordination and its strenghtening, which is the final result of the learning process (Casolo, 2014).

Over the last few years there has been an integration between different philosophies of learning thinking, including programming pedagogy, cognitive structuralism and pedagogy of the person, which reach a perspective that considers teaching as flexible, integrated and adaptable to the educational context. It is necessary to create an environment for the student that is equipped with appropriate facilities, with the aim of stimulating the motivation to learn and allowing the promotion of the self-efficacy, in other words the self-satisfaction.

Moreover, motor learning is influenced by three factors: individuals, which depend on the self; environmental factors, which depend on what is outside the self and the factors related to the motor task oriented towards the achievement of a set goal (Bandura, 1997).

1.2 The importance of motor activity in the context of cognitive development

Motor skills and corporeality are important elements for the improvement of the personality and cognitive development of every child (D'Elia, Sibilio, 2015). Through corporeality, education is considered a useful tool for the design of personalized teaching schedule as it allows you to expand the educational experience. Motor activity, in the pedagogical field, is the elective tool for the development of cognitive, relational and communicative skills (Gomez Paloma, 2014). It also contributes to the construction of transferable skills in multiple areas, determining the conditions for improving the ability to effectively manage difficulties.

Pedagogists such as Piaget, Bruner and Gardner promoted the link between the quality of the child's motor activity and the development of his cognitive processes. It is the motor experience that promotes awareness of its own body, considered as an expression of the subject's personality through the development of praxis, relational and communicative skills.

Piaget asserted that thought was an internalized action, in fact, the experience that the child has with his body is a precious source that creates the basis for the development of personality and psychomotor sphere. (D'Elia, Sibilio, 2015).

Jean Piaget's theory of genetic epistemology argues that motor skills are the basis of human development, in fact, in the "motor sense stage" the child, through the senses and motor skills, repeats behaviors (previously simple reflexes) to explore his ownbody (primary circular reactions) and the surrounding environment (secondary circular reactions), gradually adapting and evolving. By performing activities such as crawling and rolling, the child indulges his curiosity and understand the meaning of far and near. (D'Elia, Sibilio, 2015). A child who has the ability to move is a child who actively participates in his own development process. The greater the experiences lived by the individual through movement, the greater the neuronal connections and behaviors that, depending on the situation, the individual will be able to implement (Casolo, 2011).

Recent studies have shown a tight link between the sensorimotor system and higher cognitive functions; in particular, Embodied Cognition Science supports the idea that there are potentials within the didactic corporeality, affirming that cognitive processes occur thanks to the different systems that are responsible for controlling the body. (Paloma, 2014,2017; D'Elia, Sibilio, 2015)

Motor activity has the ability to stimulate, inhibit, improve or regress the child's learning process, in fact an inadequate body experience negatively affects the development of his intellectual, emotional and social skills.

The body allows children to experience personal efficiency and the development of new ways of relating with others; moreover, motor and sport activity gives students the opportunity to go beyond discrimination by making strength on the acquired skills over those lacking, and on the personal determination to overcome obstacles and limitations. It also allows for the creation of inclusive contexts in which prejudices about those with disabilities are eliminated and values the differences of all students, reaching a real equal opportunity environment (Casolo, 2011).

The body is considered as a mediator and a tool that amplifies individual potential in all contexts of life, especially in the school. Alongside the factors considered personal, attention must also be given to those contextual which can make the environment positive or negative if considered as facilitators or barriers in relation to the activity and participation of the subjects, as highlighted in the International Classification of Functioning, Disability and Health (WHO, 2001).

1.3 Developmental dyspraxia and treatment of praxis

Letizia and Giorgio Sabbadini (2005) define dyspraxia as a failure to pursue an intentional activity. They identify different types of dyspraxia including oral, verbal, constructive, gaze, walking, clothing, and classify it into two categories: primary, which consists in the absence of other pathologies and obvious neurological signs; and secondary, which is characterized by the presence of other pathologies or syndromes, for example Down syndrome, attention disorders, specific language and learning disorders.

Dyspraxia therefore replaces a multi-systemic disorder with motor, representative and perceptive difficulties that become difficulties in the body scheme and movement in very large spaces.

Praxia, defined as the ability to perform intentional voluntary movements, requires that other schemes are functioning well and coordinated with each other. The acquisition of praxia

involves a real learning process, with the aim of letting the execution of automatic actions become habitual. The characteristics of the dyspractician can be recognized starting from kindergarten. During his growth, the subject showes difficulties in situations which can usually be considered automatic, such as dressing and undressing, organizing a game or in drawing and gestures moments (Risoli, 2013).

Considering the school environment, specific disorders in writing are also found in dyspraxic subjects; in particular we are talking about dysgraphia, and reading, especially when it concerns ocular dyspraxia. There are several methodologies that have developed operational models for the intervention and rehabilitation of subjects with dyspraxia, based on the methodology of Embodied Cognition. Some examples can be the SAM Method, the intervention protocol of the Multisensory Space Integration Method and the APCM protocol. which will be described in the next paragraph.

1.3.1 The SAM Method, the intervention protocol of the Multisensory Space Integration Method, and the APCM protocol

As is known, the goal of any rehabilitation project for people with dyspraxia is to help them achiving a good adaptation to environmental stimuli. Sabbadini (2005) argues that a subject is the more normal, the more his functions are able to adapt and modify, considering the changes in the environment and the objectives that are gradually set for him.

It is therefore important to design the environment in which the child operates to make it available and accessible, providing him qualitatively effective information and to meet his learning needs.

In the research of recent years, based on the theories of Embodied Cognition, the hypothesis that experiences, gained from the body, play an essential role in cognitive development is increasingly reaffirmed. According to this new perspective, therefore, with respect to the emergence of new studies, the close link perception-action-cognition is emphasized. Cognition depends on having a "capable" body in terms of sensorial and motor functions and, above all, on the type of experiences that the body had the opportunity to carry out.

In this context, the SAM (Sense and Mind) method is used in the event that a subject showes difficulties in dynamically designing body and external space maps, intervening on their definition or multimodal redefinition and integration. With this method, the spatial maps that are of an egocentric type are constructed in the first person, in order to get the ability to create motor images in the third person (Risoli, 2013).

The intervention protocol of the Multisensory Spatial Integration Method takes the theoretical basis from the SAM Method; it can be defined as a "cognitive-motor intervention" and is used to treat dyspraxia, working on the awareness of space and acting to its intent.

It works in a targeted way on space-time and on the creation of mental images; it helps in the construction of the analysis and synthesis processes, through the correct use of stimuli and the conscious processing of data in order to allow the passage from an unconscious level of use of his own body to a conscious one (Sabbadini, 2005).

The APCM protocol (Praxis and Motor Coordination Skills), also based on the theories of Embodied Cognition and developed by Letizia Sabbadini, Yael Tsafrir and Enrico Iurato (2009), studies sensory-motor skills and the degree of their integration. It is a tool for evaluating children from 3 to 8 years old. It has been repeated several times over time and, for this reason, it allows a comparison between the initial and final data and it gives the possibility to adapt the intervention by enhancing the strengths and identifying the critical points of the child. The APCM protocol emphasizes the fact that cognitive development is closely linked with the development of motor functions and their control to achieve a goal.

2. Aims of the study

This study describes the motor development intervention implemented to support a nine-year-old girl diagnosed with LSD, who has clear difficulties in both praxis and cognitive skills. The goal was to develop and enhance the child's motor and personal skills through a motor development program divided into a series of basic artistic gymnastics exercises.

2.1 Methodology

The observation of the girl was made over a period of 10 months, from December 2019 to October 2020. The subject of the analysis is a nine-year-old girl who attends the fourth grade of a primary school in the outskirts of Rome. The girl was diagnosed with LSD at the end of the second grade.

2.2 Intervention procedures

The intervention was preceded by a semi-structured assessment through the use of a grid that recorded the skills described in paragraph 2.4.

The evaluation was made by recording on the grid the level reached in relation with the specific dimensions, during the execution of basic artistic gymnastics exercises.

After the first evaluation, the intervention was started and, as described in detail in the following paragraph, was composed by a series of basic gymnastic exercises designed on the motor and cognitive skills that emerged during the evaluation and specific activities to promote sociability through the involvement of the teammate. At the end of the intervention, a new evaluation was performed in order to determine the level of effectiveness of the intervention itself.

In the first phase, the girl trained at the gym twice a week for 2 hours for a total of 4 hours per week, so the intervention took place for a total of sixteen sessions and with a total of 64 hours in attendance. The second phase, due to the national lockdown, established in order to contain the spread of the COVID-19 virus pandemic, took place online: at the initial stage the girl had to send photos and videos recorded of her practice at home while following the indication given by the teacher; then, the evaluator sent to the girl one hour video lessons where exercises were explained and shown, in order to carry on the sport development program.

The girl has always attended the online classes, consistently showing a gradual increase in participation and involvement.

The purpose of the motor program was to improve her abilities to plan, coordinate and consciously control motor and cognitive actions, considering the motor program as a valid aid for the improvement of her praxis skills.

2.3 Intervention description: timing and activities

The intervention started in December 2019, the month in which the girl, as already mentioned, was subjected to an initial assessment of her abilities by performing the exercises shown in Table 1. The aim of this program is to help her improving her motor, cognitive and relational skills in the eleven dimensions considered. The treatment started in the gym until March 2020 and then, due to the pandemic spread, continued online, on the Jitsi Meet web platform. In September the gym reopened, allowing the teacher to realize the final evaluation on the girl in October 2020.

During these 10 months the child's participation and learning were monitored in progress, observing the execution of the exercises provided (Table 1)

First phase: carried out in presence

The girl was accompanied to the gym by her parents immediately after school. She was able to independently reach the locker room, wear her training clothes and put all her belongings in the locker. The training session took place in a small group of 10 girls between 8 and 9 years-old. In the group, there was not any girl with evolutionary difficulties. This context brought out even more the difficulties possessed by the subject under examination, in fact even the child realized that she was unable to perform certain exercises compared to her teammates.

The training session was divided into a first warm-up phase lasting about half an hour in which children, by raising the temperature of the muscles, prepare their body to deal with the work with tools, in order to reduce the possible causes of injuries. At this stage, the work was focused on the ability to react, laterality, space-time orientation, static and dynamic coordination, the combination of movements and social interaction.

The second training phase was characterized by exercises made up for the development of flexibility understood as joint mobility and muscle elasticity of the legs, arms and back, lasting half an hour. This phase is subdivided into a quarter of an hour of active mobility, understood as the ability to maintain certain positions thanks to the use of muscle tension (forward, side and backward jerks of legs and arms) and a quarter of an hour of passive mobility, understood as the maximum opening capacity reached by the action carried out by external forces, e.g the force of gravity (right, left and front split and bridge). Theses exercises are centered on the enhancement of static and dynamic coordination, the combination of movements, dynamic balance and social interaction.

The second hour of training was divided into half an hour of free body exercises and half an hour of exercises on the beam. The first half hour required high physical endurance, good development of the upper and lower limbs and good abdominal capacity; music was played, in order to increase the exercises difficulty. In this phase, the work was concentrated on the following dimensions: space-time coordination, memory (motor and cognitive), static and dynamic coordination, static and dynamic balance, capacity for rhythm, coordination of movements and social interaction.

Lastly, the training on the beam allowed children to to train their balance, thanks to great variety of exercises which can be made, depending also from the level of children preparation. In this last phase, the work was concentrated on the enhancement of memory, dynamic and static balance dimensions.

Second phase: carried out online

During this stage, at first the teacher sent photos and videos of exercises to the girl which had to be reproduced by her, stimulating the cognitive sphere, working on memory and information recall.

After the spread of the pandemic, the work continued through video lessons, in which the exercises of the grid were taught live, especially working on: coordination, combination of movements, balance, rhythm skills, laterality and memory.

The focus on static and dynamic balance dimensions[2] were aimed at achieving greater control of the body in certain positions required by different exercises.

The work on laterality dimension[3] is characterized by exercises that work both on the ability to orient, therefore the distinction between right and left, and on dominance, therefore recognition of the strong and weak side.

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2 E.g. “Maintain balance on the toes of both feet, keeping legs together and straight, and arms straight out” (Static balance) and “Walk forward, back and sideways on a 10-centimeter wide balance beam or board” (Dynamic balance).

3 E.g. “Raise the arm requested by the teacher during the run” and “Throwing a ball at a target by aiming with one eye”.

The exercises on the reaction capacity dimension[4] aimed to train the subject's ability to react to one or more stimuli based on the context. Capacity for rhythm dimension[5] works on the subject's ability to perform a motor act in a specific chronological order over time.

The items of the space-time orientation dimension[6] have the purpose of working on the subject's ability to be able to orient his own body in the two dimensions of space and time in relation to himself, others and the surrounding context.

The memory is considered very important for the execution of the gesture in the correct manner, to improve performance and for cognitive development, and takes place in the execution of exercises such as "Reproduce a series of elements in sequence: jump in extension, flip forward and rotate" and "Reproduce the sequence: jump in extension, flip forward and rotate with the teacher's corrections". The static and dynamic coordination dimensions[7] are composed by exercises, which train the subject's ability to learn a new movement, control, modify and use it according to the demands of the task. The exercises included in the combination of movements[8] dimension have the purpose of bringing the subject to be able to coordinate the different movements of the different body segments to make a determined gesture. Social interaction[9] is a dimension characterized by specific exercises with the aim to promote a mutual exchange of interactions through communication processes both towards classmates and adults.

Thanks to the slower spread of the pandemic, it was possible to restart the training sessions in the gym as before the national lockdown, and in October 2020 the girl was finally evaluated, using the same grid, and results recorded and data collected were analyzed.

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Name		Evaluation date		
Age		Evaluator		
Year of birth		Place		
Sex				
Dimension	**Exercise explanation**	**Reps, seconds, tools used**	**Consultant**	**Notes**
Static balance	Maintain balance on left foot with opposite right leg flexed keeping arms straight out	use the stopwatch to record the balance time	.....	*The teacher will have to check the correct execution of the exercise: standing posture, legs straight and arms stretched out.*
	Maintain balance on right foot with opposite left leg flexed, while keeping arms straight out	use the stopwatch to record the balance time	.....	
	Maintain balance on the toes of both feet keeping legs together and straight, and arms straight out	use the stopwatch to record the balance time	.....	

4 E.g "Belly on the ground, head towards the end of the field, stand up at the clapping of the hands and take a sprint towards the end of the field".

5 E.g. "Run adapting the pace to the rhythm performed by the teacher with clapping of hands".

6 E.g "Run and perform an extension jump with 360° rotation and land with feet together".

7 E.g "Jump in place- by opening and closing arms and straight legs at the same time" (Static coordination) and "walking, around the arms three times forward and three times back" (Dynamic coordination).

8 E.g "Throwing the ball to a teammate, while walking and catching it, without dropping it".

9 E.g "Take the initiative in starting a game with one or more teammates".

Dynamic balance	Walk forward, backward, and sideways on a 10-centimeter wide balance beam or board	3 times	.....	*The teacher will have to write down the number of falls and the time it takes to get to the bottom*
	When running from the baseline, stop on a line of the court, first with one foot and then with the other, while maintaining balance	use the stopwatch to record the balance time	.....	*With the help of the stopwatch, the teacher will note the time in keeping the balance*
	When running from the baseline, stop on a line of the court, feet together while maintaining balance	use the stopwatch to record the balance time	.....	
	Walk forward with your eyes closed, on a 3mt beam on the ground, and keeping your arms straight out	3 times	.....	*The teacher will have to write down the number of falls and the time it takes to get to the bottom*
Laterality	Extract a ball placed between two pegs of the backrest	5 times	**R L**	*The teacher should note how many times the right and left arm is used.*
	Throwing a ball at a target by aiming with one eye	3 times	.....	*The teacher will have to observe which eye is closed.*
	Raise the arm requested by the teacher during the run	30 seconds	.....	*The teacher should observe and write down how many times the analyzed person recognizes the command*
Reaction ability	Belly on the ground, head towards the end of the court, stand up with the clapping of the hands and take a sprint towards the end of the court	3 times	.....	*The teacher should note how much time elapses between the clapping of the hands and the analyzed person's reaction*
	Belly to ground, feet towards the end of the court, rise with the clap of the hands and take a sprint towards the end of the court	3 times	.....	
Rhythm ability	Run adapting the pace to the rhythm performed by the teacher with clapping of hands	3 laps	.....	*The teacher will have to observe and write down how long the analyzed person manages to maintain the rhythm of the pace or if he cannot follow it*
	Jump up every 3 steps	10 times	.....	

Space-time orientation	Free run in the gym court avoiding the tools (n° 6)	1 minute	.....	*The teacher will have to write down the number of objects that are not avoided*
	In pairs run to meet and jump giving each other an high five with two hands.	3 times	.....	*The teacher should write down how many times the couple can do the exercise correctly.*
	Run and perform an extension jump with 360 ° rotation and land with feet together	2 times	.....	*The teacher will have to observe the correct position of the body in flight (head, shoulders, pelvis and heels aligned) and the landing, which will have to be with feet together and write down the success or failure of the task*
Memory	Reproduce a sequence of elements: jump in extension, flip forward and rotate	repeat the sequence 3 times	.....	*The teacher will not have to dwell on the correct execution of the elements but will have to write down how many times the sequence is performed correctly*
	Reproduce a sequence of elements: jump in extension, flip forward and rotate in the next lesson		.....	*The teacher will write down the amount of items that are remembered*
	Reproduce a sequence of elements: jump in extension, flip forward and rotate with the teacher's correction		.....	*The teacher will write down the amount of items that are remembered with their corrections*

Static coordination	Move the arms in place at the same time, twice upwards and then twice sideways	repeat the sequence 3 times	.....	*The teacher will request that the exercise be done with outstretched arms and will write down how many times the sequence is performed correctly*
	Jump in place by opening and closing arms and straight legs at the same time	30 seconds	.....	*The teacher will observe how long the correct execution of the exercise is maintained: legs and arms straight*
Dynamic coordination	Go under obstacles of different heights of 40-50 cm.	3 times	.....	*The teacher will have to write down the success of the task*
	Walking, around the arms 3 times forward and 3 times back.	repeat the sequence 5 times	.....	*The teacher will have to observe and write downhow many times the analyzed person can complete the sequence*
	When walking raise opposite arm and bent leg, e.g. right leg and left arm.	30 seconds	.....	*The teacher will have to observe and write down how many times the analyzed person is able to carry out the exercise as described*
	While running, circle the arms 3 times forward and 3 times back.	30 seconds	.....	*The teacher will have to observe and write down how many times the analyzed person can complete the sequence*
Combination of movements	Raise the arms sideways alternately upwards and then, together, keeping legs together and arms straight	30 seconds	.....	*The teacher should write down how many times the analyzed person can reproduce the sequence with a correct execution: legs together and arms extended*
	Throwing the ball to a teammate while walking and catching it without dropping it	5 times	.....	*The teacher will have to write down how many times the analyzed person can catch the ball without dropping it*
Social interaction	Take the initiative in starting a game with one or more teammates		.....	*The teacher will have to write down how many times the analyzed person takes the initiative during a training session*
	Take the initiative in starting a game with the teacher		.....	*The teacher will have to write down how many times the analyzed person takes the initiative during a training session*
	Time spent in group activities (e.g.: playing a game in a group)		.....	*The teacher should observe and write down how much time the analyzed person spends in group activities and whether participation is active or passive*

Table 1: Semi-structured grid for the evaluation of praxic, cognitive and socio-relational skills

2.4 Tools

The initial assessment of the child was conducted by creating a semi-structured grid built ad hoc for recording the results relating to changes in motor and cognitive behaviors that occurred over the 10 months of treatment.

The grid is made up of eleven different dimensions which, in turn, are composed by different items, in which the exercises carried out during the artistic gymnastics classes are explained (Table 1). The grid consists of three columns. The first column "repetitions, seconds, tools used" shows the number of repetitions of the single exercise or of the sequences of exercises proposed, the time (expressed in seconds) used to perform the exercise and the tools used to record the balance time (for example the stopwatch). The second column is dedicated to recording the results, while the last column reports the evaluator's observations.

The eleven dimensions taken into consideration are: static balance, dynamic balance, laterality, reaction capacity, rhythm capacity, space-time orientation, memory, static coordination, dynamic coordination, combinations of movements and social interaction.

3. Results

The results obtained by the girl during the first and second evaluation are described and commented below. In particular, Table 2 shows the scores recorded immediately before (pre-intervention) and after (post-intervention) the submission of the motor development intervention. The scores were calculated starting from the average of the items that indicated the most relevant results with respect to each dimension (in terms of time used, expressed in seconds, to perform motor performance, or in terms of frequency with which the required behaviors occurred).

The comparison between the first and second evaluations highlights important progress achieved in most dimensions.

Dimensions	**Pre-intervention**	**Post-intervention**
Average scores		
Static balance	8,3	**16,7**
Dynamic balance	15,3	**13,3**
Laterality	3	**6**
Reaction capacity	6,5	**4**
Rhythm capacity	0	**10**
Space-time orientation	1	1,3
Memory	0,3	**2,3**
Static Coordination	1	**3**
Dynamic Coordination	1,7	**5,3**
Combinations of movements	2	**6**
Social interaction	0,5	**7**

Tab.2 Observation of the skills measured through the semi-structured grid before and after the evaluation

More specifically, it can be observed that in the "static balance" dimension (Avg = 8.3 vs 16.7) and "Laterality" (Avg = 3 vs 6), there was an increase equal to almost double the initial score. In particular, the girl was able to maintain the balance for a time similar to her classmates by increasing the control of her body and individual body districts.

A moderate improvement was observed in the "dynamic balance" dimension where there is a decrease in the number of falls and in the complete execution of the beam, (Avg = 8.3 vs 16.7). Similarly, a moderate improvement is also observed in the "ability to react" dimension (Avg = 6.5 vs 4).

Instead, a significant improvement can be observed in the "rhythm capacity" dimension, which indicates that the girl was able to follow the correct rhythm proposed in the exercises (Avg = 0 vs 10), and in the "memory" (Avg = 0.3vs2.3), which indicates the ability to reproduce the required sequences both in the same training session and in the following ones, managing to remember all the elements of the required exercise, even with the correction of the teacher. An improvement can also be observed in the dimension of "static coordination", where the girl has

been able to reproduce the sequence given by the teacher and to maintain the correct execution of the exercise over the foreseen time (Avg = 1vs3), and in the "Dynamic coordination", in which there has been a signifcant improvement in the reproduction of the sequence in a defined time and being able to complete the sequence proposed by the evaluator (Avg = 1,7 vs 5,3). There is also a triple increase in the score recorded for regarding the dimension "combination of movements" compared to the initial assessment (Avg = 2 vs 6). In particular, the girl is able to combine different body areas together and simultaneously perform the required exercise by collaborating with her classmates through the use of tools (for example a ball).

Finally, a satisfactory improvement occurred in the "social interaction" dimension with an increase of 6.5 points compared to the initial evaluation (Avg. = 0.5 vs 7). It has been noted an increase of interactions with both classmates and the teacher by actively participating in the proposed activities.

Despite the treatment, however, only a slight improvement was recorded in the "space-time orientation" dimension, also confirmed by the subjective observation of the teacher relating to the fact that the girl still has difficulty perceiving her body in space, (Avg. = 1 vs 1.3).

4. Concluding remarks

The purpose of this study was to verify how the motor intervention used, also as a cognitive enhancement, produces benefits both at the motor-praxis and cognitive level in a subject with SLD.

The creation of this program allowed to record significant improvements at the praxis, cognitive and socio-relational levels in a nine-year-old girl with SLD. The improvements recorded are not limited to the motor field, but also concern the cognitive sphere and have allowed the girl to enhance her self-esteem even at school level, thanks to the awareness of knowing that she can succeed in situations in which she would not have tried before for fear of 'failure. The study also highlights the great difficulty in some areas of "space-time orientation", relating to the poor ability to perceive her own body in space during exercises, and perceive herself and others in the surrounding context.

The results of this work, relating to a single experimental case, obviously cannot be generalized to the population of children with SLD. However, given the success of the intervention, it is desirable to analyze the effectiveness of this intervention program in a larger sample of subjects that allows to verify the validity of the proposed hypotheses.

This program can be considered effective in promoting the development of praxic, cognitive and relational activities of children with SLD, supporting the speech therapy therapeutic intervention and inclusiveness.

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