International Journal of Early Childhood Special Education (INT-JECSE)
DOI:10.9756/INTJECSE/V14I6.307 ISSN: 1308-5581 Vol 14, Issue 06 2022

THE CORRECTION OF HAND SUBJECT-PRACTICAL ACTIVITY OF PRESCHOOLERS

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Summary
The article explores the possibilities of purposeful correction of hand subject-practical activity of preschool children on the example of the formation of the main hand functions. For this purpose, a pedagogical teaching experiment was organized, in which two groups took part: experimental and control. The basis was the systematic work on the formation of basic hand functions in children as: power (push, step, hang), coordination (two-handed coordination, manipulative, instrumental); functions related to the speed of movements of the wrists (keyboard, winding, rotating). For each of the listed functions, special complexes of corrective exercises were developed, which were implemented during the experiment in the following forms: basic training (up to 30 min), supportive training (up to 15 min), a standard warm-up for hands (5 min), homework.
The analysis of the obtained data made it possible to conclude that purposeful and systematic work on the formation of the basic hand functions in preschoolers made it possible to significantly improve their effectiveness, which, in general, had a positive effect on hand subject-practical activity. It is assumed that this, in turn, should contribute to the improvement of both speech and cognitive development of children, which will be the subject of research in separate articles.

Keywords: wrist functions, rehabilitation, physical education, sport exercises.

INTRODUCTION

The deep interconnection of hand movements and functions of the brain, in particular, speech and cognitive development, has long been known. According to I. M. Sechenov: “The human hand is an additional organ of his brain, brought to the periphery”.

V. A. Sukhomlinsky wrote that the streams of abilities of children are at their fingertips. The more skill in a child's hand, the smarter the child is. He believed that hand exercises were a powerful means of improving the performance of the cerebral cortex.

Isaac Newton argued that even if there was no direct proof of the existence of God on earth, the presence of a thumb would prove it! Immanuel Kant, saying that a person's thumb is just a brain that crawled out! In Su-Jok therapy, the thumb is also given special importance as the projection zone of the whole person and, to a greater extent, of his brain.

Carl Gustav Jung argued that often the hands know better how to solve a problem with which the intellect has fought in vain.

The above statements of great thinkers of different times inspire to search for opportunities to use such a unique relationship of the hand and its functions with the psychophysical development of a child.

We find great opportunities for the development of hand skills and independence of children in the achievements of Maria Montessori - Montessori pedagogy. According to her technology, preschool children should be able to do a lot with their hands in the educational process and everyday life, serving themselves, becoming independent of the help of an adult. This greatly improves household, educational and social adaptation, and improves the quality of their life.

A number of authors [1-4, 10, 11, 14, 15, 17-24] were investigated various aspects of the subject-practical activity of preschoolers, however, we failed to find systemic approaches to the development of this problem. Studying for more than 30 years the possibilities of physical development of preschoolers in Ukraine and Russia, we did not find in the program documents and methodological developments a systematic approach to the formation of hand functions in children as the basis for their successful psychophysical development and subsequent effective socialization.

In this regard, it seems relevant to develop a system of targeted correction of the main hand functions in preschoolers as the basis for their successful subject-based practical activity.

AIM OF STUDY

The purpose of this study is to develop a methodology for targeted correction of the main hand functions in preschool children and to test its effectiveness through a pedagogical experiment. This study addresses the following issues:

1. To highlight and characterize the main hand functions in preschoolers.
2. To develop complexes of exercises for the purposeful formation of the main hand functions in children.
3. Check the effectiveness of the developed methodology through a pedagogical experiment.

MATERIAL AND METHODS

Study Design

The study was carried out on the basis of testing certain wrist functions of preschoolers before and after their purposeful formation with the help of special exercises.

Participants

The formative pedagogical experiment was carried out during the year (2018-2019) based on preschool educational institutions №2 in Aksai; №22, 42, 44 in Novocherkassk; №15 in Kerch. The experimental group included 104 children aged 5-7 years. The control group included 106 children of the same age. The control group was engaged in a standard kindergarten program, and in the experimental group, a new author's method of formation and correction of wrist functions in preschoolers was introduced.

Methods

In this study, the following methods were used:

1. Theoretical methods of analysis, systematization and classification of information on the problem.
2. The method of practical testing of physical exercises for the formation of hand functions.
3. Testing the motor fitness of children (measurements).
4. Formative pedagogical experiment - to test and prove the effectiveness of the author's methodology for the formation of hand functions in preschoolers.
5. Methods of mathematical statistics: the arithmetic mean, the dynamics of the increase in the result, the Student's criterion of reliability.

To study the formed wrist functions in older preschoolers, the well-known tests "Hanging pear" (timed hanging on the crossbar), "Pyramid" (putting 5 wooden balls with a hole on the rod), "Big buttons" (stringing 5 large buttons on a cord (25 cm long) with a knot), tapping test "Chicken" (setting with this pencil the maximum number of points in 10 seconds in a square of 10x10 cm) (Efimenko, 2015), "Push" (pushing from the chest with two hands a stuffed ball weighing 1 kg for a distance in a sitting position on a growth chair), "Cart-1" (steps on the hands at a distance of 5 meters, an adult holds the child with his hands by the ankles), "Knots" (timed tying 5 knots on a cord with two hands), “Screwdriver” (timed tightening the screw with a screwdriver: a hex screwdriver with a diameter of 0.7 cm), “Key” (timed tightening a bolt with a wrench: bolt length - 4 cm, diameter - 2 cm), “Hammer” (hammering 8 plastic pegs into the hole), “Spindle-1” (winding on the wrist of the leading hand in a clockwise direction of a rope 1.50 m long), “Spindle-2” (winding on the wrist of the leading

hand against clockwise direction of a rope 1.50 m long); “Spindle-3” (winding a rope 1.50 m long on a stick, alternately with each hand: in the clockwise direction, and then counterclockwise); “Spindle-4” (winding a rope 1.50 m long on a forefinger, alternately with each hand in each direction), “Winch” (timed winding rope 2.50 m long with hands on a rolling pin with 35 cm long and diameter 4 cm: in the clockwise direction, and then counterclockwise), “Screw-nut” (timed tightening the screw-nut with fingers of leading hand: bolt length - 4 cm, diameter - 1 cm), “Bolt” (timed tightening the bolt into screw-nut with fingers of leading hand: bolt length - 4 cm, diameter - 1 cm), “Bolt and screw-nut” (simultaneous tightening of a bolt and screw-nut towards each other), "Spinner" (rotation with forefinger of a standard spinner (the spinner is held with one hand, and the rotation is performed with the other hand: calculate how many finger movements the child makes in 10 seconds). The initial and final study was carried out on 9 wrist functions, tested on 20 tests The results were processed by methods of mathematical statistics.

Procedures

Testing was carried out during physical education classes in kindergarten - for this, 2-3 researchers were needed, depending on the situation. The leadership of kindergartens and the parents of the children were informed about the upcoming pedagogical study and gave their consent. Initially, the research program was approved by the Ministry of Education of the Rostov Region.

For this study, we have chosen the most important wrist functions for a preschool child:

1. Power:

- **Pushing**. Historically, a duel, fight or fight between opponents usually began with mutual repulsion of each other. This algorithm for sorting out the relationship has retained its relevance today. It serves as a softer version of the percussion function. Like the blocking function, it carries a preventive orientation. With the help of preliminary light repulses with one or two hands, the child (person) warns the partner (opponent) of his unwillingness to continue contact or interaction with him. Repulsion, in this case, means rejection of another child (person) or a situation related to him.

This function should be trained with the help of pushing movements directed both at the weighted object and at the partner (carefully).

- **Stepping**. This function is phylogenetically very ancient since it was already possessed by amphibians, who carried out their movement due to the step movements of the front limbs. Later, in the course of evolution, this vital function was preserved and developed in reptiles, and then in mammals.

Today, when a child moves in an emphasis lying down, on his stomach and crawling on all fours, the hands are the first to master the step movements, which in the future will have a beneficial effect on the development of full-fledged steps of the legs when walking, climbing, running and jumping [12]. Alternating stepping movements of the right and left hands contribute to the formation of **cross-coordination of the upper and lower extremities**, the construction of interhemispheric neural interconnections, the maturation of the necessary neural substrate of the brain, which will have a positive effect on the mental development of children. (поменять extremity на limb)

The development of this function should be based on various step movements on the hands in the prone and on all fours.

- **Hanging**. Hanging on the hands is a very ancient type of movement, which was formed in the course of evolution as a means of salvation, survival, preservation of one's life. It was especially well developed in primates, which spent most of their time in trees.

Today, the hang function is realized during the early ontogenesis of a developing child and also forms the basis of climbing and several modern sports: gymnastics, acrobatics, rock climbing, mountaineering, sailing, etc. To train this function, you need to use different hanging options.

2. Coordination:

- **Two-handed coordination**. It is one of the late phylogenetic functions of the human hand, the pinnacle of its evolutionary development. It was this function that allowed humans to powerfully transform the world and achieve such significant progress. Two-handed coordination can be perfect only when a full-fledged network of interhemispheric neural connections between the left and right hemispheres of the brain is formed.

This function can be based on such methodological directions as: joint two-handed coordination without objects, two-handed interaction with objects (for example, "ball school"); autonomization of coordination of the right and left hands (“the right-hand does not know what the left hand is doing”) both without objects and with objects.

- **Manipulative**. Historically, the structure of function originated in the most developed tribes, which, with the help of tools, began to actively transform their lives, making them more comfortable and successful.

Today, the effectiveness of household, educational, labor and social adaptation depends on his ability to successfully **manipulate various objects**: when taking various items, hygiene procedures, dressing, undressing, putting on shoes, taking them off, household procedures, etc. In the future, manipulative wrist success will have a beneficial effect on the speech development (Efimenko, 2018) of children, educational skills in drawing,

writing, design, in the manufacture of handicrafts, various works of art. In the future, this will create the preconditions for more successful, perfect labor, production skills in any field of activity.

The course can be based on the following **conditional sections of manipulations**: hygienic, household manipulations, table manipulations, educational manipulations, sports, labor (occupational therapy).

• **Instrumental**. The presence in the hand, playing the role of a tool (tool), allows you to turn an elementary manual movement into a purposeful and meaningful **instrumental act** that will allow the child to desire result (pouring sand into a bucket with a shovel or pouring water from a watering can) and feel the fulfilment of what was done. This function is very close in its essence to manipulative, but it has a more advanced modern resultant effect.

In this regard, **occupational therapy** adapted to the conditions of kindergarten and preschool age plays an invaluable role. Prospects for the development of this direction are seen in the creation of a methodology for the use of **elements of occupational therapy** in the physical development of preschoolers. It presupposes the approbation of the corresponding **occupational therapy structures** (machines, stands, blocks corresponding to a set of adapted tools).

3. Functions of the wrist related to the speed of movement:

• **Keyboard**. Due to this amazing ability to **autonomously move each of the ten fingers in a given plane at the right place and with a certain amplitude** the great music of all times was written, and today significant computer progress has become possible in our life. Most gadgets today use the keyboard wrist function of their use as the basis of their functioning. It's not for nothing that one of the main parts of a computer is called a keyboard. It can be assumed that the freer and more independent the movement of each finger, the higher the brain potential of this child in many of its manifestations. And vice versa, a clenched wrist, incapable of opening fingers and their free movement, indicates that this child has serious problems in psychophysical development.

It is assumed that the keyboard movements of the fingers can be successfully trained both on keyboard electromechanical structures and with the help of drums (other percussion instruments). The significance of the keyboard function of the hand lies in the fact that these movements involve the pads of the fingers, which contain the densest network of nerve endings - drumming with the **pads of the fingers**, the child maintains the cerebral cortex in an active state, stimulates his brain activity.

• **Winding**. This function is already more related to the two-handed function - it is supposed to wind a thread, fishing line, rope, harness, braid on a rod, bobbin or coil in circular, winding movements of the wrists.

Historically, this function was used when winding vines, belts, ropes, ropes for hunting, fishing, military affairs, river and sea navigation, rock climbing, travel, etc.

Today, the developing value of this function lies in the fact that winding movements with the wrist, like no other movements, **stimulate the function of the wrist joint**, which provides an excellent stimulating effect on the cortical structures of the brain.

• **Rotational**. This function, as it were, continues the rolling function, but at a higher, mature evolutionary level, since it involves the rotation of a thinner cylindrical object only with the fingers. Historically, this hand function could be formed in the procedures of weaving threads, ropes, fishing, braiding hair, making jewellery, etc.

Today, this wrist function is most clearly represented in the manual (fingers) screwing and unscrewing screw-nuts, "lambs", bushings, which must be taken as the basis of developmental training.

The results of the research of wrist functions before the start of the pedagogical experiment and after its completion were recorded in the universal testing protocol (Table 1).

№	*Function name*	*Test name* / *Obtained result*		*Note:* - *A comment* - *Difference in results*
		Initial	*Final*	
Power				
1	***Pushing***	Push		Ball weight – 1 kg
		210 cm	258 cm	+48 cm
2	***Stepping***	Cart – 1		Hand-walking
		5 s	3.6 s	-2,4 s
3	***Hanging***	Hanging pear		Hanging on the bar
		31 s	46 s	+15 s
Coordination				
4	***Two-handed coordination***	Nodules		Tying 5 knots
		35 s	30 s	-5 s
5	***Manipulative***	Pyramid		Building of pyramid (4 sections)
		6 s	4 s	-2 s
6		Big buttons		Stringing of 5 buttons

		17 s	15 s	-2 s
7	***Instrumental***	Screwdriver		Hex screwdriver; d=0.7 sm -2 s
		9 s	7 s	
8		Wrench		Bolt lenght – 4 sm Bolt diameter – 2 sm -6 s
		26 s	20 s	
9		Hummer		Driving in 8 pegs -5 s
		67 s	62 s	
Functions of the wrist related to the speed of movement				
10	***Keyboard***	Chicken (number of dots)		Leading hand – right hand
		103	102	
11	***Winding***	Spindle – 1		Winding the rope -4 s
		8 s	4 s	
12		Spindle – 2		-7 s
		11 s	4 s	
13		Spindle – 3		-1 s
		11 s	10 s	
14		Spindle – 4		-4 s
		16 s	12 s	
15		Spindle (average result)		-4 s
		11.5 s	7.5 s	
16	***Rotational***	Winch		-2 s
		14 s	12 s	
17		Screw-nut (for fingers)		-1 s
		6 s	5 s	
18		Bolt		Bolt lenght – 4 sm Bolt diameter – 1 sm -0,5 s
		5 s	4.5 s	
19		Bolt+Screw-nut		-2 s
		12 s	10 s	
20		Spinner		Done in 10 s; +6 movements
		30 movements	36 movements	

The algorithm for the formation of basic functions in preschoolers in the experimental group included:

- **Basic training** (30 min) (no more than three wrist functions)

1. Standard warm-up for wrists (up to 5 minutes).
2. The sequence of the formation of wrist functions:

- coordination function (for example, rolling) - 10 min;
- speed function (for example, keyboard) - 8 min;
- power function (for example, support) - 7 min.

It is necessary to devote the most time to the formation of coordination functions, a little less time to the formation of functions related to the speed of movements, and even less time to power functions. This ratio of the time for the formation of these functions is due to the peculiarities of the development of coordination skills in the cerebral cortex and the specificity of energy consumption for the formation of various hand functions. Power functions in this regard are the most energy-consuming.

The three-part structure of the basic training should include the formation of coordination and strength functions as two permanent elements:

1. Formation of **coordination functions (constant component)**.
2. Formation of one function of the teacher's choice (variable component).
3. Formation of **power functions (constant component)**.

The second position in the basic training is variable - as needed, it can be exercises for the formation of sensory functions, mobility functions, functions related to speed.

- **Supportive training**:

1. Standard warm-up for wrists (up to 5 minutes).
2. Training one of the wrist functions of the teacher's choice (usually the most problematic function for a given group of children is chosen) (up to 10 minutes).

- **Homework** on weekends and/or holidays for children in the experimental group should be standardized and include the following elements:

- standard warm-up for wrists;
- training of one wrist function at the choice of the parents (it is advisable to choose the most problematic function for a given child).

Before each of the main training (from the initial lying position, on all fours or sitting), it is imperative to perform a **standard warm-up of the wrists**, carried out according to the following mandatory algorithm:

1. Improvement of trophism (blood supply, temperature rise) of the wrists:

- rubbing both sides of the wrists with the opposite wrist;
- rubbing both sides of the wrists with a woollen mitten;
- patting the wrist with a wrist;
- simultaneous claps with wrists;
- massage of fingers (especially - nail phalanges, “pads” of fingers);
- separate kneading of the thenar (muscle tubercle under the thumb) of each wrist;
- rolling with two wrists of a smooth ball on the palms;
- rolling with two wrists of a massage (with thorns) ball (ball) on the palms.

2. Relaxation of the muscles, joints and ligaments of the wrists (release):

- simultaneous longitudinal shaking with wrists;
- alternate longitudinal shaking with wrists;
- simultaneous and alternate circular shaking with wrists;
- chaotic simultaneous and alternate shaking with wrists (a kind of search with wrists for the available degrees of freedom).

3. Stretching of the muscular-ligamentous apparatus of the wrists:

- circular movements with wrists alternately in both directions;
- extension of four fingers of one hand with the base of the palm of the other hand; then change the roles of the wrists;
- the same thing, but both hands in front of the chest make counter-movements, springing with their fingers;
- hands in the "lock" and turn them in the opposite direction, stretching the tendons of the flexor muscles of the fingers - while it is desirable to change the position of the hands in space (raise and lower, take to the sides, etc.);
- abduction and extension of the thumb of each hand;
- forcibly bring the thumb of the bent hand to the forearm with the help of the other hand;
- to carry out stops with the back of the wrists on an elastic surface on a table, chair, any other support, while varying the direction of the wrists (forward, to the sides, back, etc.) and the weight load on them according to the principle of gradual increase.

4. Toning of wrist muscles (readiness to function):

- rhythmic squeezing of the fingers alternately of the right and left hands;
- rhythmic simultaneous squeezing of the fingers of both hands;
- clenching of the fingers in the "lock" position of the hands;
- handshake of the right and left hands with an increase in squeezing force;
- exercise "Coupling" (nail phalanges of the fingers) - try to break the coupling of two hands with effort.

5. Stabilization of the state of the wrists:

- keyboard movements with your fingers in the air;
- make “splashes” in the air with the fingers of the wrists;
- make "sparklers" in the air with your fingers.

Depending on the age of the children and the characteristics of their psychophysical development, as well as taking into account the time of day and the ordinal number of the training, the volume and content of this warm-up will vary. In this case, it is advisable to observe the warm-up algorithm itself, indicated above: **warming up - relaxation - stretching - toning - stabilization.**

Means for the formation and correction of 9 basic wrists functions in preschoolers were specially developed complexes of physical exercises in manual subject-practical activity.

1. A set of exercises for the formation of the pushing function. **This complex was based on various pushes of relatively heavy objects or a partner with both hands from the chest:**

- Pushing a suspended 1 kg medicine ball from the chest with both hands.
- Pushing a suspended 2 kg medicine ball from the chest with both hands.
- Pushing a suspended 3 kg medicine ball from the chest with both hands.
- Pushing from the chest with both hands of a suspended small punching bag (up to 10 kg).
- Pushing from the chest with two hands of a suspended medium punching bag (up to 30 kg).
- Pushing from the chest with both hands of the partner, previously resting their palms on each other.

2. A set of exercises for the formation of a step function. **The basis for training this function should be based on the movement on the hands in the prone and/or on all fours:**

- Moving forward and backwards while lying on your stomach on various carts using step movements with your hands.
- Moving on a roller in a prone position back and forth, pushing off with your hands.
- Moving on the hands (on the forearms) on a relatively smooth (slippery) surface (for example, a laminate), while the legs are fixed with a bandage or hold (pinch) the ball with shins and feet.
- The same, but on a relatively rough (carpet) surface.
- Exercise "Cart" - a movement of the child in his arms (on the hands), while the adult holds him by the ankles (shins).
- Exercise "Rukokhod" - movement on the hands to the side with side steps, while the legs are located on the gymnastic bench.
- Various types of crawling on medium all fours.
- Various types of crawling on high all fours.
- Various types of crawling on rear low fours.
- Various types of crawling on the rear middle fours.

3. A set of exercises for the formation of the hang functions. **The basis for the performance of the hang functions on the hands should be made up of exercises in the hanging, performed defined in the recumbent-horizontal starting positions:**

- From starting position lying on your back - perform a grip and pull-up on two index fingers of an adult.
- The same, but now the adult lifts the child.
- Exercise "Volokusha" - an adult pulls the baby, who grabbed the adult's index fingers with his hands.
- From starting position sitting or standing perform or complete a task on two of an adult's index fingers.
- From starting position lying on your back, perform a half-hanging on the crossbar.
- The same, but on the trapeze.
- The same, but on the rings.
- The same, but on a horizontal rope.
- The same, but with the feet on the horizontal handrail.
- The same, but on a vertical rope.
- All of the above, but with pull-ups on the arms.
- From starting position lying on your back, move on your hands along a horizontal handrail.
- The same, but along a horizontal rope.

4. A set of exercises for the formation of a two-handed coordination function. **The formation of this function should go in the following direction:**

- Two-handed coordination actions without a subject, aimed at solving one common task.
- Two-handed coordination actions with the object (s), aimed at solving one common task (for example, tossing and catching the ball).
- Two-handed coordination actions aimed at the local solution of two tasks (each hand solves its own problem: the right hand does stuffing, and the left-hand makes circular movements; first without objects, but then with objects).

5. A set of exercises for the formation of a manipulative function. **The formation of this function should be based on the manipulation of each hand with small objects**:

A. Manipulation of small cubes.
B. Manipulation of balls.
C. Manipulation of pebbles.
D. Manipulation with plasticine.
E. Paper manipulation.
F. Manipulation of cereals, beans and nuts.
G. Button manipulation.
H. Manipulation with counting sticks.
I. Manipulation of plastic bottle caps.
J. Manipulation with clothespins.
K. Manipulation with "Magic gonzik" (funny "eyes" that are put on the finger and thus turn into a playable character - "Gonzik").

An indicative training algorithm can be as follows:

- handful (grasping with fingers) scattering of objects;
- picking up items;
- folding items into a relatively compact place;
- folding objects into a given shape or space;
- the formation of any objects from objects;
- connection of objects into a single whole due to the coupling;

- disconnection of objects using uncoupling;
- stringing objects onto a rod;
- stringing objects on a string or wire;
- "juggling" objects in the hand.

6. A set of exercises for the formation of the instrumental function. **To form this function, it is necessary to take as a basis the manipulation of some tool for transforming material space, creating new forms, objects, etc.**

Labor instrumental manipulations:

- Manipulation with a hummer.
- Manipulation with a screwdriver.
- Manipulation with a wrench.
- Manipulation with a socket wrench (hexagon).

7. A set of exercises for the formation of a keyboard function. **The basis for the formation of this function should be based on keyboard movements with the fingertips on hard supporting surfaces and special sounding (musical) instruments:**

A. Keyboard movements on a solid supporting surface (table type):

- tapping one hand with each finger with light effort and at a slow pace;
- tapping with each finger of one hand with a medium effort at a slow pace;
- sequential tapping of one hand with each finger in the direction from thumb to the little finger (with light effort and at a slow pace);
- sequential tapping of one hand with each finger in the direction from the little finger to the thumb (with light effort and at a slow pace);
- sequential tapping of one hand with each finger in the direction from thumb to the little finger (with light effort and at an average pace);
- etc.

B. Keyboard movements on special percussion instruments (drum type).
C. Keyboard movements on keyboard musical instruments (such as a children's piano).
D. Keyboard movements on wind instruments (flute, pipe, sopilka, etc.).
E. Keyboard movements on lever devices.
F. Keyboard movements on string instruments.

8. A set of exercises for the formation of the winding function. **The formation of this function should be based on various winding movements performed both with one hand and with the participation of two hands:**

- Winding movements with one hand in a direction convenient for the child.
- Winding movements with one hand in the direction uncomfortable for the child.
- Winding movements with both hands at the same time in a direction convenient for the child.
- Winding movements with both hands at the same time in the direction uncomfortable for the child.
- Winding movements with both hands simultaneously in opposite directions.

  It is advisable to first use an ordinary rope when winding, and then use various types of rubber bands, which will complicate the implementation of the winding actions.

9. A set of exercises for the formation of the rotational function.

The formation of this function should be based on the following rotational movements:

- rotation-tightening of bolts, screws, "lambs" with the fingers of the leading hand;
- rotation-tightening of bolts, screws, "lambs" with the fingers of the other hand;
- rotation-tightening of the screw nuts with the fingers of the leading hand;
- rotation-tightening of the screw nuts with the fingers of the other hand;
- simultaneous rotation-tightening of bolts, screws, "lambs" with the fingers of both hands;
- rotation-unscrewing of bolts, screws, "lambs" with the fingers of the leading hand;
- rotation-unscrewing of bolts, screws, "lambs" with the fingers of the other hand;
- simultaneous rotation-unscrewing of bolts, screws, "thumbs" with the fingers of both hands;
- swinging movements with 1-3 fingers of a wheel, spinner or other similar object held in the other hand with the increasing speed of movement.

The results of the study of hand functions before the beginning of the pedagogical experiment and after its completion were recorded in the universal testing protocol (Table 1).

ANALYSIS

The obtained data were analyzed using the “Statistica-13.3” software. The mean value of the sample results, standard deviation, etc. were calculated. The significance level for all comparisons was set at 5%.

RESULTS

The analysis of the data obtained after the pedagogical experiment made it possible to reveal the following dynamics of indicators of the main wrist functions in children aged 5-7 years.

Strength functions. In the **push function** ("Push" test) in the experimental group, the result of pushing a ball weighing 1 kg at a distance improved by an average of 65.8 cm. In the control group, the results in this test improved by an average of 61.6 cm. In both cases, the increased results were statistically significant (P <0.05). In **the step function** ("Cart" test), the results of time walking on hands improved by an average of 2.2 sec (P <0.05), while in the control group the improvement was only 0.8 sec (P> 0, 05). According to the **function of hanging** (test "Hanging pear"), the children of the experimental group showed an improvement in the results by an average of 7.7 seconds (P <0.05), while in the control group the improvement was 6.9 seconds (P <0, 05).

Coordination functions. In the **two-handed coordination function** (test "Knots"), the results in the experimental group improved by an average of 7.6 seconds (P <0.05). In the control group, there was also an improvement in indicators, but not so pronounced - by 4.8 seconds (P> 0.05). On the **manipulative function** (tests "Pyramid", "Big buttons" and "Small buttons"), the results in children from the experimental group improved on average: "Pyramid" - by 2.9 seconds (P <0.05), "Big buttons" - for 8.4 sec (P <0.05). In children from the control group, the improvement was respectively: "Pyramid" - by 1.6 seconds (P> 0.05), "Big buttons" - by 8.2 seconds (P <0.05). Indicators of **instrumental function** (tests "Screwdriver", "Wrench ", "Hammer") in children of the experimental groups improved on average: according to the test "Screwdriver" - by 2.3 seconds, according to the test "Wrench " - by 6.2 seconds, according to the Hammer test - by 5.6 sec. The increase in results for all three tests was statistically significant (P <0.05). The results of children from the control groups also improved: according to the "Screwdriver" test - by 1.4 seconds (P> 0.05), according to the "Wrench " test - by 2.8 seconds (P> 0.05), according to the "Hammer" - by 5.0 sec (P <0.05). The only statistically significant increase was the increase in the results in manual actions with a hammer.

Wrist functions related to the speed of movement. Consider the results of the children of the experimental groups. As for the **keyboard function** ("Chicken" test), the indicators improved by an average of 7.0 movements in 10 seconds (P <0.05). In terms of the **winding function** (tests “Spindle-1,2,3,4”), the duration of the standard winding of a string on a stick (for all tests) decreased by an average of 2.1 seconds (P <0.05). As for the **rotational function** of the hands, the results improved in the following way: according to the “Winch” test - by 3.4 sec (P <0.05), according to the “Screw-nut” test - by 1.2 sec (P <0.05), according to the “Bolt” test - by 0.8 sec (P> 0.05), according to the “Bolt+ Screw-nut” test - by 2.3 sec (P <0.05), according to the “Spinner” test - by 6.8 movements (P <0.05).

In children from the control groups, the results also slightly improved, but their gain was not statistically significant (P <0.05), except for one indicator: in the “Spinner” test, they began to do on average 5, 9 more movements (P <0.05).

DISCUSSION

As expected, the purposeful formation of the main wrist functions of 5–7 years old children in the experimental groups led to their noticeable improvement in comparison with the results obtained in the control groups. Children of the experimental groups had a statistically significant increase in indicators for almost all wrist functions (P<0.05), which confirmed the effectiveness of the method proposed by the authors. We assumed such a positive outcome of the experimental research because we knew that in most preschool educational institutions such work of the purposeful formation of basic wrist functions had never been carried out. Children from the control groups also showed progress, but it was statistically insignificant (P>0.05). First of all, this can be explained by the fact that in the traditional methodology for the formation of hand subject-practical activity, it was not customary to differentiate the components of this activity, i.e. the level of formation of the main wrist functions. Basically, the work was focused on the following: in the cognitive development of children, they were introduced to various objects of the world around them, its properties and purpose; in the artistic and aesthetic development, constructive and modelling activities were assumed with paper, plasticine, clay, fabric, etc.; in physical development, the task was to develop fine motor skills of the hands. There was no classification of wrist functions in children, as well as a systematic approach to their purposeful formation and correction.

In this article, we have summarized only the first stage of promising comprehensive research devoted to the study of the relationship between the purposeful formation of wrist functions in 5–7 years old children with their physical, speech and cognitive development. We see positive dynamics in terms of strength, coordination and speed functions in this category of children, which greatly increased the efficiency of their physical development and, in particular, subject-practical activity. This applies only to the motor component of children's development. The obtained research data allow us to recommend the methodology of the formation of basic hand functions in children of older preschool age in preschool institutions of various types. However, we assume that the improvement of the motor component of hand functions can increase the efficiency of not only their object-practical activity but also have a positive impact on the speech and cognitive development of preschoolers. This will be the focus of the next stages of the research.

LIMITATIONS

The findings of this research have some tentative limitations. Children without any problems in psychophysical development took part in the pedagogical experiment. We can talk about practically healthy children. For children with disorders of the musculoskeletal system or mental development, additional research will have to be carried out.

IMPLICATIONS FOR PRACTICE

The developed algorithm of the formation of the main hand functions in children can be used by employees of various types of preschool institutions: kindergarteners, physical education instructors, speech therapists, and parents of children. The article presents complexes of special exercises for the development of the main wrist functions in children, which can be included in various types of activities in kindergarten and at home.

CONCLUSION

1. Analysis of the available literature revealed the lack of classification and systematization of wrist functions in preschool children. Our own long-term practical experience has made it possible to identify more than 40 wrist functions in humans: supporting, spring, balancing-lower, balancing-upper, rowing (fin), blocking, jerking, shock, stepping, roll-over, protective, safety, contact, exciting, hanging, dropping, throwing, keyboard, manipulative, rolling, rotating, winding, fiddling, instrumental, tactile, scratching, massage, searching, kinesthetic, thermal sensor, pulling, dowsing, charging, reflexogenic, plastic, iconic, visual-shaped, two-handed coordination, constructive praxis, informational, brushing, shaking off. Such a multitude of wrist functions speaks of the evolutionary significance of the wrist in human life. In the program documents and teaching materials, we did not find developments devoted to the purposeful formation and correction of the actual wrist functions in preschool children to increase the effectiveness of their psychophysical development and social adaptation.
2. The algorithm developed by us for the purposeful formation and correction of the main wrist functions includes special sets of exercises for training each of the 9 studied functions. They were implemented in the following forms: **basic training** (30 minutes) (during which no more than three wrist functions are trained) – **supportive training** (training one of the wrist functions at the teacher's choice (usually the most problematic for a specific subgroup of children) (up to 10 minutes)) – **homework** on weekends and/or holidays (including training one of the wrist functions at the choice of the parents (it is advisable to choose the most problematic function for a given child) (up to 10 minutes).

All these forms must necessarily begin with a **standard warm-up of the wrists** (which is an integral part of the training), which includes the following components: improving the trophism of the wrists; relaxation of muscles, joints and ligaments of the wrists; stretching of the muscular-ligamentous apparatus of the wrists; toning the muscles of the wrists; stabilization of the condition of the wrists.

3. The conducted pedagogical experiment made it possible to make the following conclusion - for all 20 tests, the results of children from the experimental groups in their values exceeded the results of children from the control groups. At the same time, the average increase in the results in the experimental groups for almost all tests was statistically significant ($P < 0.05$), while in the control group the absolute majority of the results had an insignificant increase not confirmed by the methods of mathematical statistics.

Thus, the results of the comparative study proved the effectiveness of the methodology developed by the authors of the article for the formation and correction of the main wrist functions in preschool children in comparison with the existing standard method for the formation of subject-oriented practical activity in preschoolers.

AUTHOR CONTRIBUTIONS

Nikolai Efimenko developed the concept of the research, organized it on the basis of preschool institutions, and wrote the basis of the article. Nikolai Moga collected and statistically processed the obtained experimental data. Vitaliy Kantarzhi has developed a set of special exercises for the formation of basic hand functions in preschoolers. Nikolai Suprun designed and edited the manuscript. All authors made some intellectual contribution to the study, read the manuscript, and approved the final version of the article for publication.

SUPPORTING AGENCIES

No funding agencies were reported by the authors.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

ACKNOWLEDGEMENTS

To teachers of preschool institutions and parents of children who agreed to take part in the research.

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