SOFIA UNIVERSITY "ST. KLIMENT OHRIDSKI"
FACULTY OF EDUCATIONAL STUDIES AND THE ARTS
DEPARTMENT "PRIMARY SCHOOL EDUCATION"

Nikolina Milkova Tankusheva

"DIDACTIC TECHNOLOGY FOR DEVELOPMENT OF COORDINATION ABILITIES OF PUPILS AT PRIMARY SCHOOL THROUGH GYMNASTICS"

AUTHOR'S SUMMARY

of dissertation
for acquiring an educational and scientific degree "Doctor of Phylosophy"
in professional field 1.3. Pedagogy of education in…
(Methods of physical education and sport at kindergartens and primary schools)

Director of studies:
prof. Elena Djambazova-Spasunina

Sofia, 2019

The dissertation was discussed at a meeting of department "Primary School Education" at Faculty of Educational Studies and the Arts at Sofia University "St. Kliment Ohridski" on 11. 06. 2019, and was approved for defence in front of a specialized scientific jury.

The dissertation is 258 pages long, of which: 207 pages – text-expose, 15 pages – references, and 36 pages – appendices. Its structure includes an introduction, three chapters, conclusions, and recommendations. The references include 199 titles, of which: 150 in Cyrillic, 37 in Latin, and 12 Internet sites. The dissertation includes 41 tables and 69 figures.

The introduction of the dissertation justifies the topicality of the issue; the concept of the research is presented. The first chapter views the theoretical treatment of the researched topic. The second chapter presents the aim, tasks, and methods of the research. The third chapter includes analysis of the results from the conducted sports-pedagogical research. The conclusions and recommendations, as well as the contributions of the dissertation, are formulated in the last chapter.

The public defence of the dissertation will be held on 24. 09. 2019, at……..in hall……of Faculty of Educational Studies and the Arts, at a meeting of the scientific jury with members:

prof. Rossitza Tsurova, PhD
ass. prof. Georgi Ignatov, PhD
prof. Angelina Yaneva-Prokopova, PhD
ass. prof. Nedialka Mavrudieva, PhD
ass. prof. Todor Marinov, PhD

SOFIA UNIVERSITY "ST. KLIMENT OHRIDSKI" FACULTY OF EDUCATIONAL STUDIES AND THE ARTS DEPARTMENT "PRIMARY SCHOOL EDUCATION"

Nikolina Milkova Tankusheva

"DIDACTIC TECHNOLOGY FOR DEVELOPMENT OF COORDINATION ABILITIES OF PUPILS AT PRIMARY SCHOOL THROUGH GYMNASTICS"

AUTHOR'S SUMMARY

of dissertation
for acquiring an educational and scientific degree "Doctor of Phylosophy"
in professional field 1.3. Pedagogy of education in…
(Methods of physical education and sport at kindergartens and primary schools)

Director of studies:
prof. Elena Djambazova-Spasunina

Sofia, 2019

INTRODUCTION

Nowadays the issue related to preserving and improving physical and psychic health of adolescents is getting much more topical. The penetration of science and technique in all areas of human activity releases us of the need to make physical efforts. Lack of movement combined with uncontrolled eating has led to permanent physiological changes in the young Bulgarian population. Over time, this physiological disbalance leads to cardiovascular and cancer diseases, psychic disorders, damages to the locomotory system, and so on.

Physical education and sport play a major role in restraining and eliminating the negative trends arising from this process. Physical development and improvement of children's organism, gaining health and increasing vitality, inurement, obtaining motor and hygiene habits are specific tasks of physical culture and sport among adolescents and are closely related to the other aspects of education: mental, labor, aesthetic, and moral.

The development of pupils' physical qualities from an early school age is a complicated and delicate process. Physical education teachers' knowledge is crucial both for the morpho-functional changes occurring in children's organisms and for the means and methods used for the development of the physical qualities at this age.

Although gymnastics exercises were an artificially created form of movement, they are the best way to improve 9-year-old pupils' motor abilities and their motor coordination. Their sequence helps differentiating the spatial, time, and strength parameters of the kinematic and dynamic structure of the movements.

The coordination of the movements is a premise for development of self-reliance which provides the opportunity to perform different activities in practice. Only when one possesses developed coordination abilities, one can achieve effective results in every activity.

At the elementary school, the basis needed for the development of coordination abilities is created together with the knowledge, skills and habits for performing coordination exercises. This age period, as regards the speed of development of these abilities, can be called "golden age" (Zamashkin, Tolstova, 2013).

CHAPTER ONE

1. Theoretical formulation of the issue regarding the nature and specifics of didactic technologies for creation of motor abilities of pupils from primary school.

1.1. Didactic technology

According to V. Georgieva (1995), each "system of work approaches and knowledge about operational approaches obtained as a result of scientific research can be called technology".

The term technology is viewed as a combination of the Greek words *τέχνη* (tehno) – art, mastery, skill and *λόγος* (logos) – knowledge, science, learning (Masleva, 2001) or of the Latin words *techno* (tehno) – able to and *logus* (logos) – science (Voinov & Milev, 1990).

D. Pavlov (2001) points out that each human activity aimed at achieving a particular result in the process of creation and development of a person, which is of technological character, can be called one or another kind of technology. The technological structure encompasses the interrelated elements: procedure, operations, steps. Certain technological operations and steps create procedures which determine their execution with the aim to solve some problem or achieve a certain result. The term **technology** was interpreted by J. Galbraith (1967) as a systematic implementation of science or any other knowledge oriented to and consisting of practical tasks. On this basis, it is said that "technology is the link between science and practice, between knowledge and practical activities" (Petrov, Atanaasova, 2001). Colloquially, the word technology is used to describe the technological process, the instructions for its execution, the technological requirements, etc. "In the historical development of the pedagogical reality, and in particular the educational one, two major aspects of educational technologies were formed: "technology in education and technology of education" (Bespalko, 1995). According to the author, technology of education includes technology in education as well as the subtle intellectual aspect. Therefore, technology of education is a kind of intellectual technology.

According to D. Pavlov (2001), a lot of pedagogues and organizations dealing with the problems of education have defined the term education technologies. According to the author: "educational technology is knowledge for taking scientifically grounded pedagogical decisions about preparation, realization and evaluation of the educational process consisting of various methods, forms and means and aims at increasing the efficiency of teaching and learning." When we view the process of education, not generally but in relation to a particular subject, to a certain topic, for a certain period of time, etc., then

we can talk about a technological description of the process of education (Ganchev, Ivanov, 1993). Then, the process of education in any subject can be defined as an arranged sequence of didactic technological situations which lead from a certain initial state to a final result according to the established target criterion.

1.2.Motor abilities

People's motor abilities are manifested in the form of certain motor actions with different complexity. They are part of everyday, labor, sports and other activities which people perform. H. Gundlach (1968) classified people's motor abilities into two big groups:

- conditional abilities;
- coordination abilities.

Conditional abilities are determined by the energetic processes undergoing in a human organism, and coordination abilities /CA/ - by the processes of management and regulation of the movements. Thus, the abilities for speed, strength, endurance, and agility are included in CA, and flexibility is viewed as a medial link between the conditional and coordination abilities.

1.2.1.Conditional abilities

One of the main tasks of physical education is to ensure an optimal development of physical qualities characteristic of humans.

In the theory of physical education, the different manifestations of people's motor abilities are conditionally defined as motor /physical/ qualities. In scientific-systematic literature, the perception for the existence of five basic motor qualities is widely accepted. These qualities are: speed, muscle strength, endurance, flexibility, and agility. They determine people's physical efficiency. There are common regularities in their development since all of them are a function of people's neuro-muscular system (Rachev, 1991).

1.2.2.Coordination abilities

The word "coordination" is of Latin origin. It means coherence, unification, arrangement, creation of purposeful interaction between different acts or phenomena (rechnik.info). As regards human motor activity, it is used to determine the degree of coherence of a person's movements with the real requirements of the environment. Coordination is an interaction between the central nervous system (CNS) and skeletal muscles during movements. Coordination is characterized by people's ability to manage their movements. The complexity of the management of the locomotory system arises from the fact that human body consists of a number of joints which have the freedom to move. According to Lyah (2003), CA are in the base of agility. A lot of studies

have been recently made on their study and manifestations. CA are part of people's motor abilities and are an important element of their physical efficiency. In the wide sports practice, CA are viewed as the ability for optimal regulation of a motor action, the exact, quick, rational solving of different motor tasks, performance of measured out movements in a limited time, and in relation to the requirements of sports activities (Hirtz, 1986; Lyah, 2006). The most exact definition of COORDINATION ABILITIES is given by Lyah (2006), namely – "these are individuals' abilities, determining their readiness for optimal management and regulation of a motor action". Human physical activities are various, and so are human's abilities. There are different CA with various specific aspects described in literature. One should focus one's attention on the most important CA.

R. Russev (2005), accepts Hirtz's classification (1985) and introduces the five main CA to be taught in physical education and sport classes (PES): ability for spatial orientation; ability for kinesthetic differentiation; balance ability; ability for reaction and rhythmical ability.

The highest speed of development of the kinesthetic ability for differentiation, reaction and rhythmical ability is achieved at the age of 7-10. There is a difference between the development of the parameters of spatial movement (7-9 years) and the time characteristics (9-13 years). As a whole, these abilities reach a high level of development between the age of 7 and 11.

Different motor actions (physical exercises) can be used as means for development of CA if they meet the following requirements (Lyah, 2003):

- to be related to overcoming coordination difficulties;
- to require accuracy, speed, rationality upon the execution of complex coordination motor activities;
- to be new or unusual for the performer;
- to be executed (despite being well known) with changes in the movements and motor actions according to conditions.

The identification of the different indicators of CA is possible only through testing, i.e. research with the help of control exercises – tests bearing information about the researched indicator and meeting the requirements for reliability, objectivity, and standard.

Hirtz (1985) has a great contribution in the theoretical development of the issue of CA. He researched the components of school curricula together with knowledge about psychic and neuro-physiological mechanisms for coordination of movements. The author made vast empirical research. On the basis of his findings, he presented a structural model of five basic abilities – for kinesthetic differentiation, for balance, for orientation, for rhythm, and for reaction. In 1985 Hirtz et al developed field tests for each of these skills for a school setting.

The test battery of Hirtz et al (1985) is quite applicable as it has led to

efficiency within a wide age range – from kindergarten children (Chang et al, 2013) to teenagers aged 13-16 years (Budde et al, 2008). The proven efficiency allows applying technologies related to the development of CA and investing in quality programs for physical education and sport (Gallotta, 2014).

One of the main tasks of physical education and sport at primary school is the complex development of pupils' motor qualities, efficiency and coordination of movements. Motor abilities, including CA, are a basic premise for future high results in the field of school physical education and sport (Gallotta, 2014).

1.3.Peculiarities in the development of pupils at primary school

At primary school pupils are aged between 7 and 11 years. During this age period their organisms continue to undergo complex anatomy-physiological changes in bone and muscle systems such as increasing their height, weight, chest measurement, vitality, etc. These changes in children's organisms are influenced by lots of factors – biological, social, and so on. Physical education is one of them, too, with its various physical exercises.

Children's cardiovascular system also develops irregularly in the different periods of children's early years.

Another important function which is influenced by the impact of physical exercises on organism is breathing. The respiratory system is fully built at the age of seven, but it is not flexible enough yet. Respiratory muscles are still weak, breathing is more frequent and shallower. The normal oxygen supply of an organism depends on proper breathing. Upon performing physical exercises, one's breathing gets deeper and more regular, and the respiratory system is perfected and develops better.

Physical education should be one of the main activities contemporary children are involved in. Lack of exercises could lead to weakening of muscles, exhaustion, and general ill health. The means of physical education affect positively not only anatomy-physiological but also psychic peculiarities of children: perceptions, notions, attention, memory, thinking, feeling, will.

1.4. Gymnastics' significance and place in the system of physical education and sport

Gymnastics takes one of the main places in the system of physical education. Its benefits human's general physical development, helps gain health, cultivates moral and will power, forms sense of beauty and harmony, and builds vital skills and habits. The leading role of gymnastics, being one of the main means of physical education, is a result of the following factors and peculiarities:

a variety of means which can purposefully influence all major functions of an organism in line with a person's motor abilities; a wide range of means and methods makes it accessible to all age groups regardless of gender and physical

preparation and it has great pedagogical influence on everybody who practices it; gymnastics with its artificially created forms of movement helps the development, correction, and improvement of a number of natural vital human motor abilities. The strict organization of the training sessions, the requirements for discipline, control, self-control and accuracy of each motion cultivate very important moral qualities and will-power; beauty and harmony of the movements especially when they are supported by a musical accompaniment which affect strongly the creation of children's aesthetic sense.

According to their purposefulness, specifics and aim, gymnastics exercises are divided into several groups: basic gymnastics; sport-oriented gymnastics – artistic gymnastics, acrobatics and rhythmic gymnastics; industrial gymnastics; remedial gymnastics; sport-helping gymnastics, and so on. The universality of gymnastics, its wide use in all age groups is determined by the easy gymnastics exercises, mainly from ***basic gymnastics*** (for general development, drills, curative, natural-applied, etc.) with expedient possibility of exact proportion and regulation of the physical load.

CHAPTER TWO
2. Aim, tasks and methods of sports-pedagogical research

Hypothesis

The design and practical implementation of specialized technology for development of the coordination abilities of pupils at primary school (aged 9-10) with the means of gymnastics will increase the level of their kinesthetic abilities and will allow building specific coordination abilities which are extremely important both for children's general development and for their successful participation in the other educational activities.

2.1.Aim and tasks of the research

The aim of this research is improvement of the coordination abilities of pupils at primary schools through implementation of didactic technology with the means of gymnastics.

Tasks of the research:

1. Researching the issue and selecting adequate indexes to be included in the test battery.
2. Determining the level of the Bulgarian third-grade pupils' coordination abilities - determining experiment
3. Establishing the influence of demographic environment on the coordination abilities of pupils at primary school.
4. Revealing the average levels and the variance of the indexes characterizing the researched pupils' coordination abilities.
5. Designing didactic technology for increasing the level of Bulgarian third-grade pupils' coordination abilities.
6. Conducting sports-pedagogical experiment to check the efficiency of the designed technology for development of coordination abilities.
7. Designing a normative database for evaluation of the third-grade pupils' physical development and coordination abilities.

2.2. Methods of the conducted sports-pedagogical research on establishing the level and development of 9-10-year-old pupils' coordination abilities.

2.2.1. Organization of the research

Subject of the research is the educational-pedagogical process in Physical education and sport classes at Bulgarian schools and the possibilities for development of young children's coordination abilities.

Object of research is the indexes characterizing third-grade pupils' coordination abilities.

The research was done among 1073 children aged between 9 and 10 years - 564 boys and 509 girls. They are third-grade pupils at 13 Bulgarian schools in

the towns and cities – Sofia, Plovdiv, Burgos, Veliko Turnovo, Targovishte, Svilengrad, Smolyan, Radomir, Kubrat, and the village of Smilian.

The scientific-research work was done in the following 4 stages:

First stage (March 2017 – July 2018)

1. Research of the literary sources and normative documents of the Ministry of Education and Science in relation to the topic of the dissertation.
2. Selection of sports-pedagogical tests for measurement of third-grade pupils' coordination abilities and design of the test battery of the research.

Second stage (September – December 2018)

1. Determining the level of development of third-grade pupils' (boys and girls) coordination abilities (determining experiment).
2. Revealing the influence of demographic environment on the pupils' coordination abilities.
3. Revealing the average levels and the variance of the researched indexes among both boys and girls.

Third stage (February – May 2019)

1. Design of a sample didactic technology for development of third-grade pupils' coordination abilities.
2. Conducting sports-pedagogical experiment for determining the efficiency of the designed technology for development of coordination abilities.
3. Processing the results from the conducted sports-pedagogical experiment.
4. Analyzing and drawing conclusions from the obtained results.
5. Formulation of the main conclusions and recommendations for practice.

Fourth stage (May 2019)

Overall arrangement of the dissertation and presentation for internal discussion.

2.2.2. Research methods and indexes

In order to fulfill the aims and tasks of the research we used the following methods:

1.Analysis of the specialized scientific-methodological literature

2.Anthropometrics – we used five indexes presented in **table 1.**

Table 1. Anthropometric indexes (from № 1 to № 5)

№	Indexes	Units of measurement	Accuracy of measurement	Direction of increase
1.	***Stature***	cm	1,0	**+**
2.	***Weight***	kg	0,500	
3.	***Body mass index (BMI)***	kg/m^2	0,01	
4.	***Chest measurement - pause***	cm	1,0	**+**
5.	***Chest measurement - breathing difference***	cm	1,0	**+**

3.Sports-pedagogical testing – after the analysis of the literature, we selected three tests for CA – index № 6, 7 and 8 (**table 2**) from a test battery for field evaluation. The test battery was confirmed by Hirtz et al. (1985) through administering a large representative sample consisting of pupils at primary school. The suggested tests are easily applied and evaluated in a school setting.

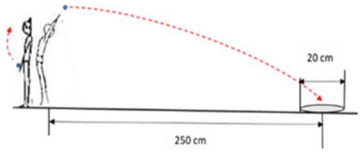
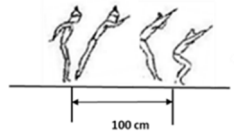
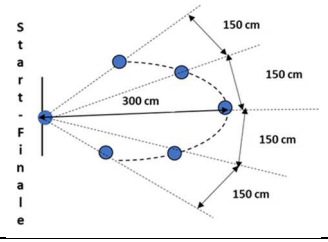
2.2.3. Sports-pedagogical experiment – "Didactic technology for development of third-grade pupils' coordination abilities"

In the work process, with the help of specialized tests which meet all requirements for reliability, objectivity and standard, third-grade pupils' coordination abilities were researched. On the basis of the observations made, a sample didactic technology for development of 9-10-year-old Bulgarian pupils' coordination abilities was designed. In this relation, two pedagogical experiments were conducted: **determining and main**.

The aim of the **determining experiment** was to establish the actual state of Bulgarian third-grade pupils' coordination abilities. The research was carried out in the period October-November 2018 after obtaining an official permission from the headmasters of 13 Bulgarian schools – 7 secondary schools with I to XII grade education, and 6 primary schools with I to IV grade education. The research was done among 1073 pupils - 564 boys and 509 girls studying at 48 third-grade classes.

In order to determine the efficiency of the suggested didactic technology for improvement of third-grade pupils' coordination abilities, we conducted a **main pedagogical experiment**.

Table 2. Indexes for coordination abilities - from № 6 to 8 (test battery of Hirtz et al., 1985).

Index №	Title and description of the test	Illustration of the test	Units of measuremen	Accuracy of measuremen	Direction of increase
6	**Test 1 – Backwards ball throw test (BBT)** The participants perform a single-hand backward throw of a tennis ball. They are instructed to aim the ball towards a target positioned 250 cm behind them. The diameter of the target is 20 cm. After a preliminary attempt the participants perform five consecutive attempts. 5 points are recorded for each hit of the target. The results 4, 3, 2, 1, and 0 are given for an increase in the distance to the target (from 30 to 50 cm; from 51 to100 cm; from 101 to150 cm; from 151 to 200 cm, and from 201 to 250 cm). The average score is calculated.		p.	0,2	+
7	**Test 2 – Low jump test (LJ) – 1 m** The participants jump forward with both feet from a marked line "start" to a marked line at a distance of 1 m. They are instructed to land with their heels behind the line. The test is performed twice and the distance from each heel to the line is measured. The average distance score of both heels is taken. The better achievement is recorded.		cm.	0,5	-
8	**Test 3 – Orientation shuttle run test (OSR)** The participants are instructed to move three times as fast as possible from the starting marker to one of the five numbered targets (balls) behind them. The balls are placed 3 m from them and 1.5 m from each other along an imaginary curve. The sequence of the targets to be reached is not known in advance. The next target is announced when the participants return to the starting ball and touch it so that the next running round can begin immediately. After a demonstration, the participants perform the test.		s	0,01	-

The main pedagogical experiment was conducted during the second term of the school year 2018/19 and lasted 12 weeks – from 11.02 to 03.05. 2019. On the basis of the results from the determining experiment four groups with quite similar results were formed: 2 experimental groups and 2 control groups. The research was done among 94 pupils at two schools – 96th Primary school "L. N. Tolstoy" in Sofia and primary school "V. Aprilov" in Burgas. The control group of third-grade pupils (class „C") from Sofia consisted of 21 children – 13 boys and 8 girls, and the experimental group of third-grade pupils (class „D") consisted of 19 children – 11 boys and 8 girls. The control group of third-grade pupils (class „B") from Burgas consisted of 28 children – 12 boys and 16 girls, and the experimental group of third-grade pupils (class „D") consisted of 26 children – 11 boys and 15 girls. The total number of the pupils in both the control groups and the experimental groups was the same – 47 children.

The pupils from the control and experimental groups, during the second school term, performed tasks according to the third-grade physical education and sport curriculum for the school year 2018/19.

We applied the suggested technology aimed at development of coordination abilities through the means of gymnastics in the experimental groups.

The technological description of the process of education aimed at development of coordination abilities includes: educational aims, technological structure, planning the suggested motor activities for improvement of coordination abilities and expected results from the training. The contents of the suggested didactic technology for development of coordination abilities in PE classes includes technological steps in the sets of the exercises for general development (SEGD), in the sets for physical preparation (PP), and in games. The suggested technological steps for building and development of CA through active and competitive games are in the form of the so-called drill-grounds for building skills, which will be performed at the beginning of the main part of the lesson and will improve the whole-body coordination. The drill-grounds for building skills can be used in different versions. The way of placing the hurdles is presented in **figures 1 to 4**. For teachers' information we provide a table of standards for evaluation of the skills from drill-ground № 1 and a detailed description of all drill-grounds, as in the following example:

Example: **Drill-ground** № 1 for building and developing skills **(fig. *1*):**

1. Start ..... 2,0 m
2. Jumping over balls with two feet..... 4,0 m
3. Forward roll from standing position.....7,0 m
4. Going under a vaulting table/hoop..... 9,0 m
5. Running along gymnastics bench ..... 12,0 m
6. Climbing (with abdomen) over a vaulting table /chest of drawers (h= 100 cm) …..... 16,0 m
7. Crossing the line..... 20,0 m

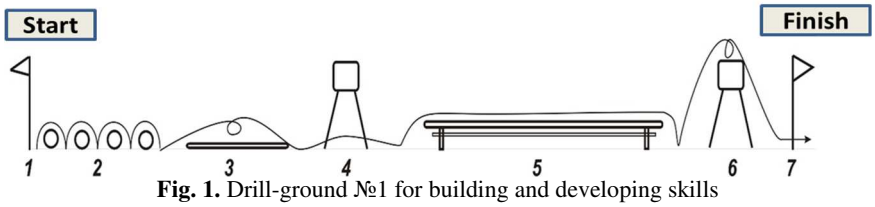


Fig. 1. Drill-ground №1 for building and developing skills

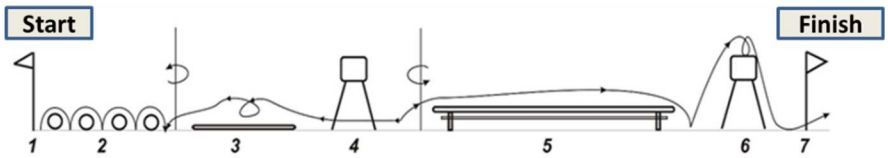


Fig. 2. Drill-ground №2 for building and developing skills

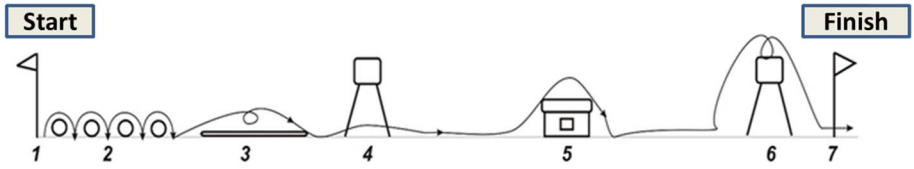


Fig. 3. Drill-ground №3 for building and developing skills

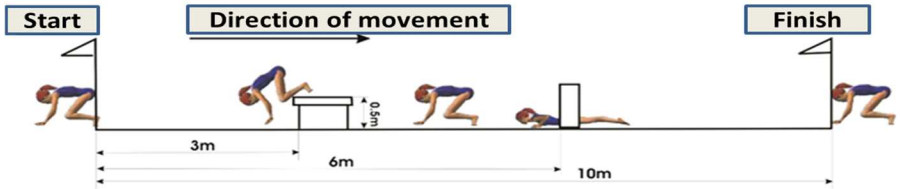
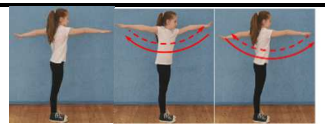


Fig. 4. Drill-ground №4 for building and developing skills

The technological steps in (SEGD) are presented in ***table 3.***

The technological steps for development of CA in the sets for PP are presented in **table 4**. We suggested 3 exercises and 1 relay game which are performed along a strict program. They unite the five main coordination abilities included in physical education: for spatial orientation; for kinesthetic differentiation; for balance; for reaction; for rhythm.

Table 3. Exercises for coordination included in the sets of the exercises for general development (EGD) in PE classes

EXERCISES IN THE SET OF EGD		
№	**Terminological description**	**Illustration**
№ 1	Initial position (IP) – standing position 1 – jump to straddling position, right arm sideward; 2 – jump to standing position, arms sideward; 3- jump to straddling position, right arm down, left arm sideward; 4 – jump to initial position.	 **IP 1 2 3 4**
№ 2	IP – standing position, arms sideward 1 – jump to straddling position, right arm upward, left arm sideward; 2 – jump to standing position, arms upward; 3 – jump to straddling position, right arm sideward, left arm upward; 4 – jump to IP.	 **IP 1 2 3 4**
№ 3	IP – standing position 1 – jump to straddling position, right arm sideward; 2 – jump to standing position, arms sideward; 3- jump to straddling position, right arm upward, left arm sideward; 4 – jump to standing position, arms upward; 5 – jump to straddling position, right arm sideward, left arm upward; 6 – jump to standing position, arms sideward; 7 – jump to straddling position, right arm downward, left arm sideward; 8 – jump to IP.	 **IP 1 2 3 4 5 6 7 8**
№ 4	IP – standing position, right arm forward, left arm backward (palms down) 1-2 – lower arm swings in opposite directions (to right arm backward, left arm forward); 3-4 ≠ 1-2 to IP The same exercise from IP – left arm forward	 **IP 1 – 2 3 - 4**

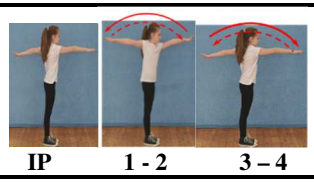
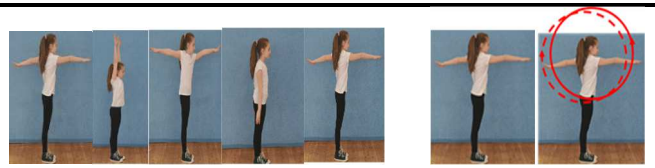
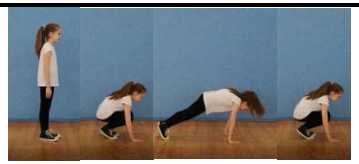
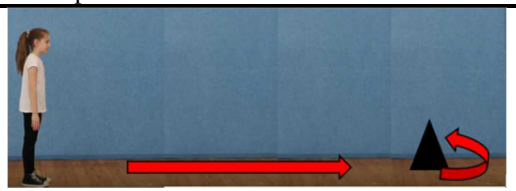
№ 5	IP – standing position, right arm forward, left arm backward (palms down) 1-2 – upper arm swing in opposite directions (to right arm backward, left arm forward); 3-4 ≠ 1-2 to IP. The same exercise, from IP – left arm forward	 **IP 1 - 2 3 – 4**
№ 6	IP – standing position, right arm forward, left arm backward 1–4 lower arm circles in opposite directions. The same exercise from IP – standing position, left arm forward, right arm backward.	 **IP 1 2 3 4 IP 1 - 4**
№ 7	IP – standing position, right arm forward, left arm backward 1–4 upper arm circles in opposite directions. The same exercises from IP – standing position, left arm forward, right arm backward.	 **IP 1 2 3 4 IP 1 - 4**
№ 8	IP – standing position, right arm forward, left arm backward 1 – lower arm swing in opposite directions, to right arm backward, left arm forward; 2 ≠ 1 3–4 - 1 and ½ lower arm circle in opposite directions, to right arm backward, left arm forward; 5 – lower arm circles in opposite directions, to right arm forward, left arm backward; 6 ≠ 5 7–8 - 1 ½ lower arm circle in opposite directions to IP.	 **IP 1 2 3 - 4 5 6 7 - 8**

Table 4. Exercises for development of coordination abilities included in the sets of exercises for physical preparation (PP)

EXERCISES IN THE SET FOR PP WORK			
№	**Terminological description**	**Illustration**	**Proportion**
№ 1	Consecutive jumps from IP – standing position, hands on the sides: 1-2 – forward-backward; 3-4 – backward-forward; 5-6 – to the right-to the left; 7-8 – to the left-to the right. Right/left standing position, one leg raised and flexed, arms sideward, holding the position for 5-6 sec. The balance /under the teacher's guidance/ is held after a certain number of executions of ex. 1. The jumps are performed with a change in: - the rhythm /at the teacher's signal/; - the sequence of the directions.	 IP 1 2 3 4 5  6 7 8 hold	4 - 6 times
№ 2	`IP – standing position 1 – squatting support; 2 – support; 3 = 1; 4 = IP 5 – jump to right cross straddling position, hands to the sides; 6 ≠ 5 7 – jump to straddling position, hands to the sides; 8 – jump to IP. From 5-8 the sequence of the jumps can be changed	 IP 1 2 3  4 5 6 7 8	4 – 6 times

№ 3	IP – standing position 1 – squatting support; 2 – support; 3 = 1; 4 – straightened jump with ½ (180°) turn to standing position. Complication of the 4th attempt – straightened jump with 1/1 (360°) turn to standing position.	 IP 1 2 3 4  Option of 4	4 - 6 times
№ 4	Relay: running with going around a reference point /a cone/ placed at the 5th meter, returning with running and touching the shoulder of the next participant. IP – standing position (squatting support, support, sitting position, sitting backwards to the direction of the run, lying on the back). At the teacher's signal "Start" the first participants in the lines start running.		2 - 3 times

2.2.3.Math-statistical methods

Upon processing the results from the sports-pedagogical testing, we used the following *math-statistical* methods: *Variation analysis* – for determining the average levels and variances of the researched indexes; *Hypotheses check (with the help of comparative t-criterion of Student); One-factor dispersion analysis* - for checking the hypothesis for equality of the mean values of the researched indexes along demographic criteria; *Factor analysis* – for revealing the factor structure and establishing the major factors for physical development and coordination abilities; *Sigma method for evaluation* – for designing a normative database for evaluation of physical development and indicators characterizing third-grade pupils' coordination abilities; *Body mass Index – BMI* – for determining the degree of obesity of the researched individuals.

CHAPTER THREE

3. Analysis of the results

3.1. Comparative analysis of 9-10-year-old pupils' coordination abilities along demographic indicator

In order to determine the influence of demographic environment, we made the so called one-factor dispersion analysis. This research was done among children from 10 Bulgarian cities. In order to ensure the validity of the research we selected schools both from the capital city Sofia and from towns and cities from all the other classification groups **(table 5).** The data presented in the table were taken from the National Statistical Institute of republic of Bulgaria and were valid on 12 April 2018 (0).

Table 5. Classification of the towns and cities included in the research according to their population number

Code/group	Cities	Population	Classification according to population number
1.	***Sofia***	1 238 438	Capital
2.	***Plovdiv***	345 213	Cities
	Burgas	202 694	
3.	***Veliko Turnovo***	168 428	Towns
	Targovishte	35 446	
4.	***Smolian***	27 851	Small towns
	Svilengrad	17 598	
	Radomir	13 110	
5.	***Kubrat***	6 488	Very small towns
	Village of Smilian	1 569 (от 2015 г.)	

The results from the one-factor dispersion analysis, which can help to check the hypothesis for equality of the mean values of the researched variables along a demographic indicator among 9-10-year-old boys and girls, are presented in **tables 6 and 7**.

Table 6. One-factor dispersion analysis of the researched variables among 9-10-year-old boys

Variables	*Source of dispersion*	SS	df	MS	F	Sig.
1. Backwards ball throw test (BBT)	*Among the group*	19,12	4	4,78	8,78	,000
	In the group	304,26	559	0,54		
	Total	323,38	563			
2. Low jump test (LJ) – 1 m	*Among the group*	546,638	4	136,66	8,21	,000
	In the group	9301,46	559	16,64		
	Total	9848,09	563			
3. Backwards ball throw test (BBT)	*Among the group*	132,40	4	33,104	19,96	,000
	In the group	926,98	559	1,66		
	Total	1059,39	563			

The tables show that the empirical value of F-criterium of Fisher for test 1 (backward throw of tennis ball at target) is F_{emp}= 8,78 for the boys and F_{emp}= 23.86 for the girls, at degrees of freedom df_1 = k-1= 4 and df_2 = n-k-1= 559 for the boys and df_2 = n– k- 1 = 504 for the girls, and the critical value of the criterium $F_{0.05;\ 2;21}$ = 2,37. This shows that $F_{emp} > F_{0.05}$, which means that the observed differences in the children's abilities to throw at a target without having any visual contact with it are statistically reliable. Therefore, with high guarantee probability (Sig. = 0,000) we can claim that the demographic environment (the different categories of towns and villages) is a factor for the development of children's accuracy, which is an extremely important part of coordination abilities.

Table 7. One-factor dispersion analysis of the researched variables among 9-10-year-old girls

Variables	*Source of dispersion*	SS	df	MS	F	Sig.
1. Backwards ball throw test (BBT)	*Among the group*	55,32	4	13,83	23,86	,000
	In the group	292,20	504	0,580		
	Total	347,53	508			
2. Low jump test (LJ) – 1 m	*Among the group*	405,66	4	101,42	7,13	,000
	In the group	7168,29	504	14,22		
	Total	7573,95	508			
3. Backwards ball throw test (BBT)	*Among the group*	98,34	4	24,58	14,98	,000
	In the group	826,97	504	1,64		
	Total	925,31	508			

Table 8. Variation analysis of the researched variables among third-grade pupils

Variables	**City code**	**Number**		**X**		**S**	
		Boys	Girls	Boys	Girls	Boys	Girls
1. Backwards ball throw test (BBT)	1,00	118	101	3,88	3,90	0,59	0,54
	2,00	189	193	3,45	3,11	0,88	0,87
	3,00	129	106	3,47	3,24	0,66	0,79
	4,00	84	76	3,75	3,77	0,70	0,61
	5,00	44	33	3,42	3,59	0,72	0,78
	Total	***564***	***509***	***3,59***	***3,42***	***0,76***	***0,83***
2. Low jump test (LJ) – 1 m	1,00	118	101	7,87	7,60	4,05	4,28
	2,00	189	193	7,22	6,52	4,28	3,73
	3,00	129	106	7,20	7,07	3,19	3,30
	4,00	84	76	9,43	8,59	4,21	3,33
	5,00	44	33	10,02	9,42	5,20	4,65
	Total	***564***	***509***	***7,90***	***7,35***	***4,18***	***3,865***
3. Orientation shuttle run test (OSR)	1,00	118	101	11,70	11,62	1,44	1,50
	2,00	189	193	10,52	10,58	1,24	1,21
	3,00	129	106	10,74	10,64	1,23	1,15
	4,00	84	76	11,34	11,35	1,38	1,36
	5,00	44	33	10,42	10,52	0,99	1,12
	Total	***564***	***509***	***10,93***	***10,91***	***1,37***	***1,35***

The analysis of the results shows that the mean values of the deviation from the target in test 1 were higher among the pupils from Sofia (3.88) and the small towns Smolian, Svilengrad and Radomir (3.75) – ***table 8***. In comparison, the pupils from the cities Plovdiv and Burgas (3.45), the towns of Veliko Turnovo and Targovishte (3,47) and the very small towns Kubrat and the village of Smilian (3,42) had lower achievements which can be clearly seen in **figure 5**. The observed significant dispersion in the cities and small towns can be explained with the different possibilities for practicing sports (in the cities) and the good natural coordination and the attitude towards sport in the towns. As for the girls, we can observe a better level of the kinesthetic differentiation of the upper limbs in the capital (3.90) and the towns of Smolian, Svilengrad and Radomir (3.77), compared to the pupils from the very small towns and villages Kubrat and the village of Smilian (3.59), the towns of Veliko Turnovo and Targovishte (3.24) and the cities of Plovdiv and Burgas (3.11) (**table 8, figure 5).**

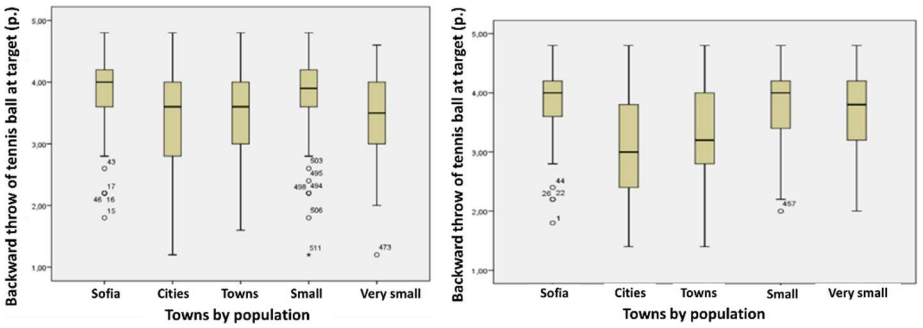


Fig. 5. Box-plot chart of Test 1 "Backwards ball throw" – 9-10-year-old boys and girls

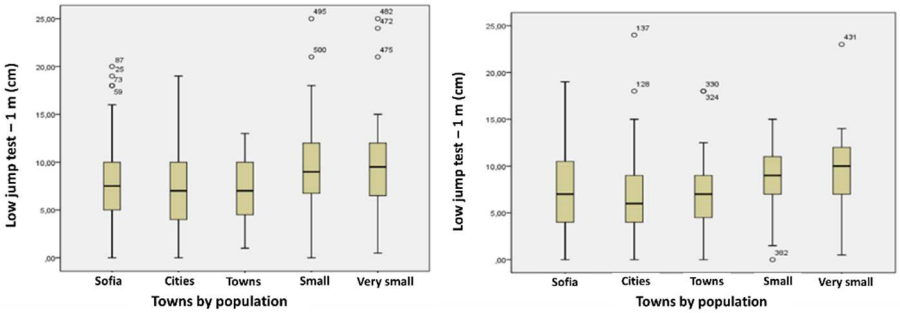


Fig. 6. Box-plot chart of Test 2 "Low jump test" (cm) – 9-10-year-old boys and girls

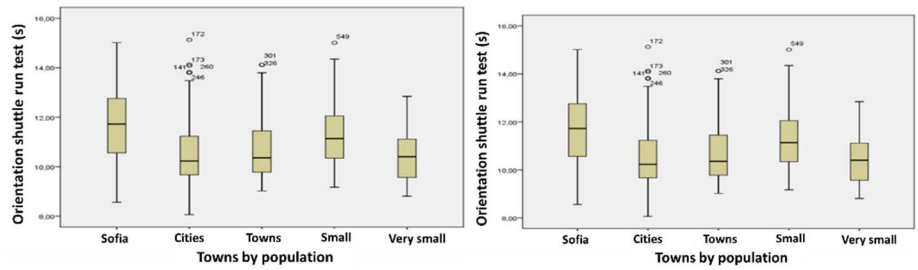


Fig. 7. Box-plot chart of Test 3 "Orientation shuttle run test" (s) – 9-10-year-old boys and girls

The mean values of dispersion measured in centimeters show a better level of the kinesthetic abilities of the lower limbs, in synchronized muscle effort in horizontal plane for the boys from the towns (7.20), cities (7.22) and the capital (7.87) in comparison with the very small towns (10.02) and towns (9.43), and for the girls from the cities of Plovdiv and Burgas, the towns of Veliko Turnovo and Targovishte and the capital, compared with the values of the small towns of Smolian, Svilengrad and Radomir and very small towns and villages – Kubrat and the village of Smilian. This can be explained with the better qualification of the teachers as well as with the participation of the boys from the cities in additional extracurricular sports activities under the guidance of specialists (**table 8, figure 6**).

The analysis of the level of abilities for spatial orientation, revealed on the basis of the results from test 3, measured in seconds, shows that the observed difference in these abilities was in favor of the pupils from the very small towns of Kubrat and the village of Smilian (10.42), cities – Plovdiv and Burgas (10.52) and towns – V. Turnovo and Targovishte (10.74). Compared to them, their peers from the capital (11.70) and small towns of Smolian, Svilengrad and Radomir (11.34) experience bigger problems with their spatial orientation (**table 8, figure 7**). For the same test, the advantage was for the girls from the very small towns (10.52), cities (10.58) and towns (10.64), compared to their peers from the capital (11.62) and small towns (11.35) **(table 8 and figure 7).**

On the basis of the results from the multi comparisons with the criterion of Tukey $B^{a,b}$, for test 1 and test 3, two homogeneous subsets were formed among the researched boys and girls, presented in **table 9** with their mean values. Two subsets were formed for test 2 among the boys, too. For test 2, three subsets were formed among the boys.

All this proves that the number of the people in towns and villages can be a differentiating factor for the manifestation of the different motor abilities, including coordination abilities.

During the coordination training, we should use such didactic technology which is based on the strength of the pupils' nervous system. This will help using children's reserve and improving their coordination abilities.

Table 9. Homogeneous subsets on the basis of Tukey's test B[a,b] for Test 1 – Backwards ball throw

Boys

№	Towns by population	N	α= 0.05	
			1	2
1.	***Very small***	44	3,42	
2.	***Cities***	189	3,45	
3.	***Towns***	129	3,47	
4.	***Small***	84		3,75
5.	***Sofia***	118		3,88

Girls

№	Towns by population	N	α= 0.05	
			1	2
1.	***Very small***	193	3,11	
2.	***Cities***	106	3,24	
3.	***Towns***	33		3,59
4.	***Small***	76		3,77
5.	***Sofia***	101		3, 90

Table 10. Homogeneous subsets on the basis of Tukey's test B[a,b] for Test 2 – Low jump test – 1m

Boys

№	Towns by population	N	α= 0.05	
			1	2
1.	***Very small***	129	7,20	
2.	***Cities***	189	7,22	
3.	***Towns***	118	7,87	
4.	***Small***	84		9,43
5.	***Sofia***	44		10,02

Girls

№	Towns by population	N	α= 0.05		
			1	2	3
1.	***cities***	193	6,52		
2.	***Towns***	106	7,07	7,07	
3.	***Sofia***	101	7,60	7,60	
4.	***Small***	76		8,59	8,59
5.	***Very small***	33			9,42

Table 11. Differentiating similar groups on the basis of Tukey's test B[a,b] for Test 3 – Orientation shuttle run

Boys

№	Towns by population	N	α= 0.05	
			1	2
1.	***Very small***	44	10,42	
2.	***Cities***	189	10,52	
3.	***Towns***	129	10,74	
4.	***Small***	84		11,34
5.	***Sofia***	118		11,70

Girls

№	Towns by population	N	α= 0.05	
			1	2
1.	***Very small***	33	10,52	
2.	***Cities***	193	10,58	
3.	***Towns***	106	10,64	
4.	***Small***	76		11,35
5.	***Sofia***	101		11,62

3.2. Mean values and variability of the researched indicators characterizing 9-10-year-old pupils' coordination abilities

The results from the applied variation analysis of the raw data from the conducted sports-pedagogical testing among the boys and girls are presented in **tables 12 and 13**.

The tables show that the groups of the boys and girls are relatively homogeneous as regards the kinesthetic abilities of the upper limbs, shown in throwing at target, as well as the speed of reaction, concentration, the distribution and flexibility of attention, and the kinesthetic abilities of the lower limbs in running – "shuttle" towards unknown target. This is proven by the values of the coefficient of variance V, which were within the area of relative stability (boys - V_1 = 21,12 % and V_{12} = 12,55 %), girls - V_1 = 24,16 % and V_{12} = 12,37 %) (**figure 4**).

Table 12. Mean values and variability of the researched indicators – *boys* (n = 564)

№	Indexes	X	S	V	min	max	As	Ex
1.	***Backwards ball throw test***	3.59	0.76	21.12	1.20	4.80	-0.73	0.10
2.	***Low jump test (1 m)***	7.90	4.18	52.94	25.00	0.00	0.67	0.97
3.	***Orientation shuttle run test***	10.93	1.37	12.55	15.13	8.06	0.72	0.01

Table 13. Mean values and variability of the researched indicators – *girls* (n = 509)

№	Indexes	X	S	V	min	max	As	Ex
1.	***Backwards ball throw test***	3.42	0.83	24.16	1.40	4.80	-0.59	-0.53
2.	***Low jump test (1 m)***	7.35	3.86	52.55	24.00	0.00	0.48	0.59
3.	***Orientation shuttle run test***	10.91	1.35	12.37	16.86	8.18	0.89	0.96

We cannot say the same about the observed dispersion for index 2 (measured long jump 1m). As **tables 12 and 13 and figure 8** show, here the coefficient of variance for the boys was 52,95% and for the girls - 52,55 %, which ensures a high guarantee probability ($P_t \geq 95$ %) and we can claim that the researched subsets are not homogeneous as regards the kinesthetic abilities of the lower limbs, related to the execution of exercises for accuracy.

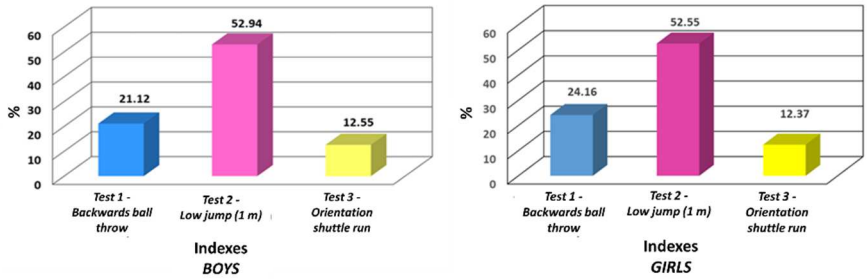


Fig. 8. Dispersion of the researched indicators characterizing 9-10-year-old boys and girls' coordination abilities

The calculated relative shares of the researched third-graders with different degree of accuracy upon throwing at target are presented in **figure 9**.

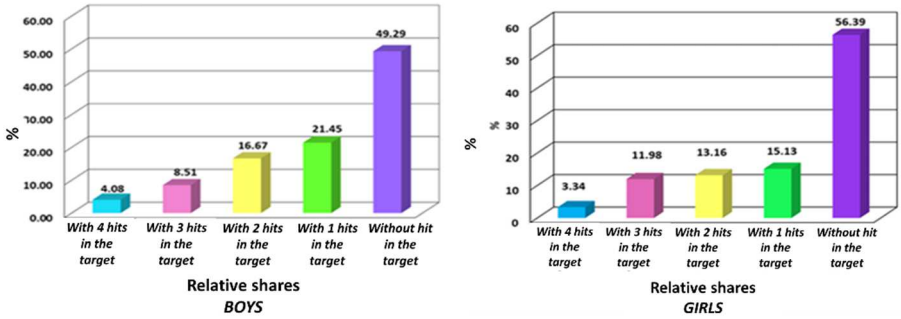


Fig. 9. Relative shares of the achieved accuracy of the researched pupils in Test 1

The analysis of the figures shows that the relative share of the children who did not manage to perform any hit in the target was the highest. They were 49,29 % of the boys and 56,39 % of the girls, which means that half of the boys and more than half of the girls have a very low level of development of the kinesthetic abilities of the upper limbs. If we add 21,45 % of the boys and 15,13 % of the girls, which is the relative share of those with one hit in the target which can be regarded as accidental, it turns out that over 70 % of the Bulgarian 9-10-year-old pupils have serious problems related to the coordination of motor activities.

The results presented in figure 10 give information about the kinesthetic abilities of the lower limbs, assessed through execution of a measured long jump (1m). The relative share of those who had a diversion within only 5 cm was significantly higher - 30,50 % of the boys and 31,43 % of the girls (**figure 10**). This allows us to draw a conclusion that a little over ⅓ of the Bulgarian third-graders have low level of development of the kinesthetic abilities of the lower limbs as regards the execution of measured jumps in space. The figure also

shows that the relative share of the pupils who had a diversion within 5 to 10 cm was the highest (41,84 % of the boys and almost 45 % of the girls), which indicates an average level of development of the researched abilities.

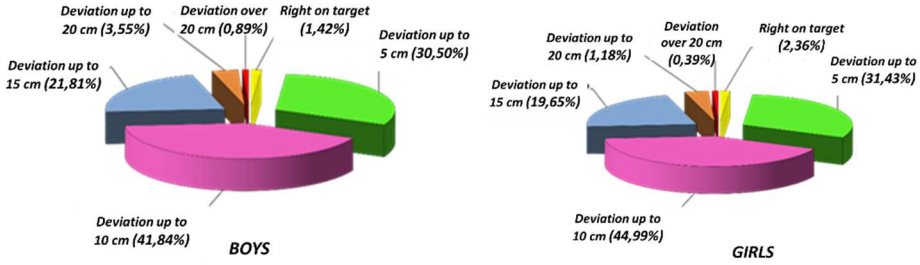


Fig. 10. Distribution of the researched pupils as regards accuracy in Test 2

Although the relative shares are not very big, the fact that among the Bulgarian children there are some who have serious coordination problems is alarming.

A distribution of the researched individuals according to their achievements in the shuttle running was made for the purposes of the survey (**figure 11**).

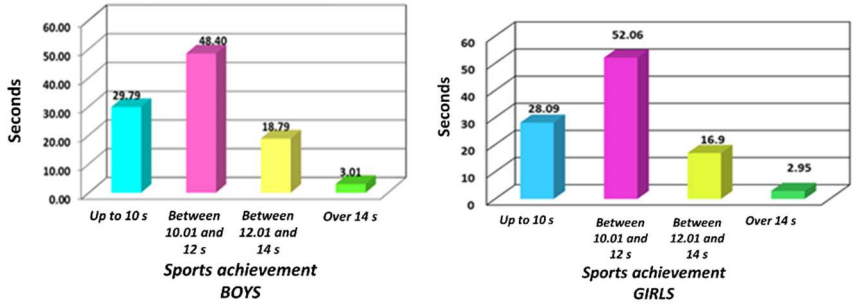


Fig. 11. Distribution of the researched pupils as regards achievement in Test 3

The analysis of the figures shows that the relative share of the pupils whose achievements were within 10.01 and 12.00 s, i.e. within the zone of the arithmetical mean was the highest (48,40 % of the boys and 52,06 % of the girls). The relative share of those whose results were within 10 s was much lower (29,79 % of the boys and 28,09 % of the girls). The relative share of the children who were rather slow (over 14 s) and did not manage to meet the time norm was the lowest (as few as 3,01% of the boys and 2,95 % of the girls). The comparison in **figure 11** shows that the relative shares are very close, therefore, the speed of reaction, the parameters of attention, and the kinesthetic abilities of the third-grade pupils do not depend on their gender.

3.3. Analysis of the results from the conducted sports-pedagogical experiment

3.3.1. Mean values and variability of the indicators of physical development at the beginning of the sports-pedagogical experiment

As explained in the Method Section, in order to determine the level of physical development of the participants in the sports-pedagogical experiment, we recorded data along 5 indexes (from № 1 to № 5), including the calculated Body Mass Index (index 3). The results from the variation analysis of the initial data for the whole experimental group (boys and girls), recorded at the beginning of the research period, are presented in **table 13**.

We can see that the mean stature of the participants in the experiment is 143,17 cm, and their mean weight - 38,00 kg. The calculated on this basis Body Mass Index, which bears information about the degree of obesity of the children from the researched age group, is 18,43 kg/m^2.

The comparison of these results with the results obtained from a survey of the Bulgarian population of the same age (Slanchev et al., 1992; Toteva, 1992) shows that the pupils we researched are taller – 2.27 cm taller than the sample researched by P. Slanchev et al., and 2.02 cm taller than the pupils researched by M. Toteva (**table 25**).

Table 13. Mean values and variability of the indicators of physical development of the experimental group at the beginning of the sports-pedagogical experiment

№	Indexes	X	S	V	min	max	As	Ex
1.	***Stature***	143,17	7,95	5,56	126,00	158,00	-0,20	-0,78
2.	***Weight***	38,00	6,94	18,28	23,90	54,10	-0,04	-0,67
3.	***Body Mass Index (BMI)***	18,43	2,45	13,29	14,27	26,76	0,74	1,33
4.	***Chest measurement (pause)***	71,06	8,18	11,51	58,00	95,00	0,72	0,37
5.	***Chest measurement – breathing difference***	4,70	1,20	25,54	2,00	7,50	-0,20	0,05

Table 14. Comparative analysis with the results from a survey of the population in Bulgaria

№	Indexes	N. Tankusheva (2019)	P. Slanchev (1992)		M. Toteva (1992)	
			X	D	X	D
1.	*Stature*	143,17	140,90	2,27	141,15	2,02
2.	*Weight*	38,00	35,20	2,80	35,87	2,13
3.	*Body Mass Index (BMI)*	18,43	17,73	0,70	18,00	0,43
4.	*Chest measurement (pause)*	71,06	67,50	3,56	-	-
5.	*Chest measurement – breathing difference*	4,70	7,10	-2,40	-	-

In our opinion, this is due to the process of acceleration of the Bulgarian population which can be observed in the recent years. Quite naturally, higher stature means greater weight. The table shows that the mean weight, determined from the survey of the Bulgarian population of this age, is within 35-36 kg, while the mean weight in our research is 38 kg.

The BMI we calculated is a little higher than the results obtained by the abovementioned authors –18,43 kg/m^2 and 17,73 kg/m^2 respectively, reported by P. Slanchev, and 18,00 kg/m^2 – by M. Toteva. Despite being higher, however, BMI of the participants in our experiment is within the "zone of normal body weight" which, according to P. Salnchev (1992) for the 10-year-old is within 14,9 and 19,2kg/m^2.

Despite the fact that, as a whole, the children in our research have a normal degree of obesity, the more detailed analysis of table 13 shows that among them there are some who are underweight (X_{min} in index 3 is 14,27 kg/m^2), and overweight (X_{max} in index 3 is 26,76 kg/m^2).

Meanwhile, as many as 36,17 % of the children in the group are overweight (19,3 kg/m^2<BMI< 22,8kg/m^2), and another 2,13 % are with different degree of obesity (BMI is over 22,8kg/m^2). Therefore, 4 in 10 Bulgarian third-grade pupils have serious body weight problems.

Figure 12 is a good visualization of the proportion of the indicators of physical development of the researched boys and girls in the experimental group at the beginning of the research period.

The comparative analysis shows that the average levels of the indicators of physical development of boys and girls, as a whole, are very close, despite the higher values of arithmetical means for the boys.

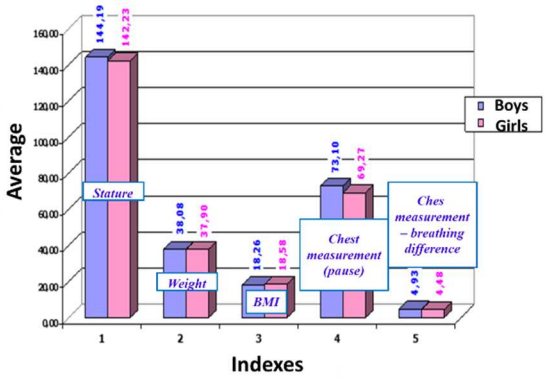


Fig 12. Comparative analysis of the indicators of the physical development at the beginning of the sports-pedagogical experiment – experimental group

The observed differences, however, cannot guarantee the real proportions between the two researched groups. That is why, according to the norms of sports statistics, the zero hypothesis has to be checked. The results from the applied comparative t-criterion of student are presented in **figure 13**.

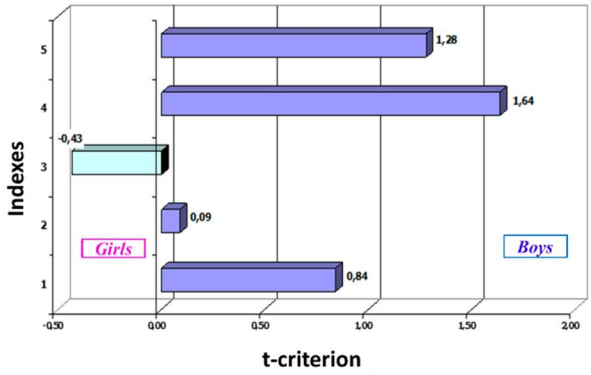


Fig. 13. Significance of the differences between the average levels of the indicators of physical development of the experimental group – beginning

The analysis of the figure shows that the values of t-criterion range from 0,09 (in index 2 "weight") to 1,64 (in index 4 "chest measurement - pause"). We can see that all values of this criterion are lower than the critical value (t_{tabl} = 1,99). The comparative analysis of the dispersion of the two researched samples (boys and girls) shows that generally the variability of the researched indicators of physical development at the beginning of the experiment does not depend on the children's gender (**figure 14**).

As we can see in **table 15**, the mean stature of the boys and girls included in the control group is 140,83 cm at the beginning of the experimental period, and the mean weight for the whole sample is 35,76 kg. The calculated on this basis

Body Mass Index (17,90 kg/m^2) is within the normal zone for the researched age group.

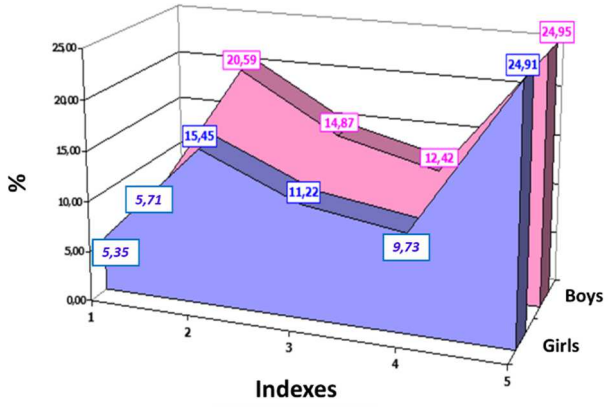


Fig. 14. Dispersion of the indicators of physical development of the experimental group - beginning

Table 15. Mean values and variability of the indicators of physical development of the participants in the control group at the beginning of the sports-pedagogical experiment

№	Indexes	X	S	V	min	max	As	Ex
1.	***Stature***	140,83	6,80	4,83	128,00	154,00	0,00	-0,74
2.	***Weight***	35,76	5,73	16,03	26,70	45,20	0,15	-1,23
3.	***Body Mass Index (BMI)***	17,90	2,00	11,18	14,58	22,94	0,54	-0,57
4.	***Chest measurement (pause)***	70,55	8,48	12,01	54,00	93,00	0,53	0,54
5.	***Chest measurement – breathing difference***	4,72	1,33	28,08	1,50	8,00	0,13	-0,06

The comparative analysis of these results with the results of the children from the experimental group allows us to think that at the beginning of the research period:

- the relative share of the participants with normal body mass in the control group is significantly higher than that of the participants in the experimental group - 72,34 % vs. 59,57 %;
- there is a significantly lower percentage of children who are overweight in the control group than that of the children in the experimental group - 23,40 % vs. 36,17 %;
- the relative shares of the children who are overweight or underweight are equivalent for the two groups.

The analysis of **figure 15** shows that the mean values for the boys and girls along four of the researched five indexes are very close (the differences are about 0,57 cm as regards stature, 0,320 kg as regards weight, 0,25 kg/m^2 as regards the

Body Mass Index, and 0,36 cm as regards the breathing difference). Only along index 4 (chest measurement – pause) the difference is about 8 cm.

The check of the significance of the observed differences between the mean levels of the researched indicators of physical development among the children of both genders was made with the comparative t-criterion of Student (**figure 16**).

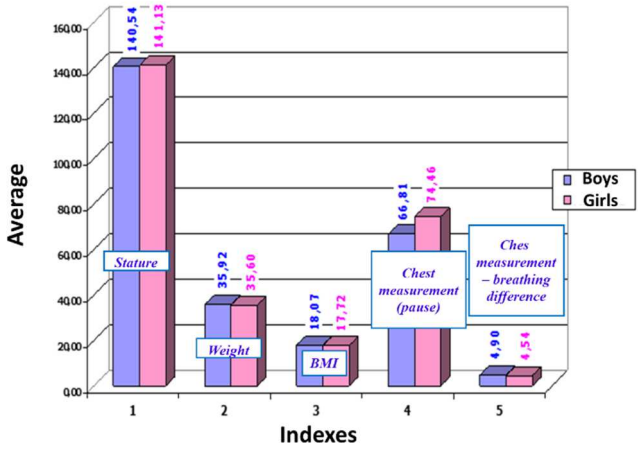


Fig. 15. Comparative analysis of the indicators of physical development at the beginning of the sports-pedagogical experiment – control group

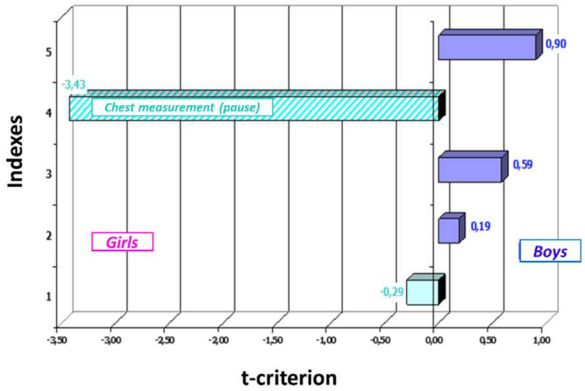


Fig. 16. Significance of the differences between the average levels of the indicators of the physical development of the control group – beginning

Therefore, as regards the children from the control group at the beginning of the sports-pedagogical experiment, with high guarantee probability ($P_t \geq 95$ %), we can accept the zero hypothesis as the right one along all indexes except for index 4 – chest measurement. As we can see in **figure 13**, its value of the t-criterion (t4 = 3,43) is higher than the critical value (tcr. = 2,01). This allows us

to reject the zero hypothesis and accept the alternative one as regards the chest measurement. According to the alternative hypothesis the third-grade girls from the control group had a significantly more developed chest than that of the boys from the same group at the beginning of the experiment.

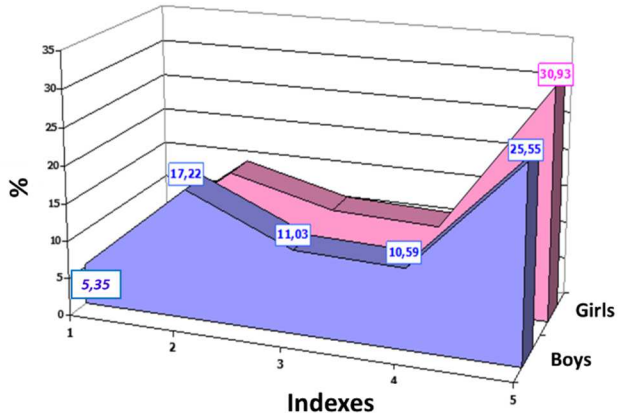


Fig. 17. Dispersion of the indicators of the physical development of the control group - beginning

The analysis of **figure 17**, which presents the zones of dispersion of the indicators of physical development of the boys and girls from the control group at the beginning of the experiment, shows that both samples, as a whole, were homogeneous as regards the children's stature, and relatively homogeneous as regards all the other indicators of physical development. The figure shows that the highest variation was observed in the last index (№ 5 – breathing difference) for both genders. The boys' coefficient of variation V was 25,55 % and this, as we already have mentioned, means that this sample is relatively homogeneous as regards the functional capacity of the chest. The girls' coefficient, however, V was higher than 30 % (V_{5girls}= 30,93 %). According to the norms of the sports statistics, with high guarantee probability ($P_t \geq 95$ %), we can say that at the beginning of the sports-pedagogical experiment the researched sample of girls in the control group was not homogeneous as regards index 5.

3.3.2. Mean values and variability of the indicators characterizing the coordination abilities at the beginning of the sports-pedagogical experiment

The results from the variation analysis of the initial data from the sports-pedagogical testing of the boys from the experimental group at the beginning of the research period are presented in **table 16**, and of the girls - in **table 17**. The initial data for the control group of the girls and boys are presented in **tables 18** and **19** respectively.

Table 16. Mean values and variability of the indicators characterizing the coordination abilities of the boys from the experimental group at the beginning of the sports-pedagogical experiment

№	Indexes	X	S	V	min	max	As	Ex
6	*Test 1 – Backwards ball throw*	3,44	0,61	17,61	2,20	4,20	-0,83	-0,33
7	*Test 2 – Low jump 1 m*	6,71	2,93	43,65	12,00	1,50	-0,02	-0,87
8	*Test 3 – Orientation shuttle run*	10,60	1,22	11,49	13,81	9,02	1,04	0,94

Table 17. Mean values and variability of the indicators characterizing the coordination abilities of the girls from the experimental group at the beginning of the sports-pedagogical experiment

№	Indexes	X	S	V	min	max	As	Ex
6	*Test 1 – Backwards ball throw*	3,36	0,70	20,95	2,20	4,20	-0,23	-1,52
7	*Test 2 – Low jump 1 m*	6,87	3,15	45,86	15,00	1,50	0,54	0,48
8	*Test 3 – Orientation shuttle run*	10,24	1,33	13,00	14,73	8,42	1,48	4,01

Table 18. Mean values and variability of the indicators characterizing the coordination abilities of the boys from the control group at the beginning of the sports-pedagogical experiment

№	Indexes	X	S	V	min	max	As	Ex
6	*Test 1 – Backwards ball throw*	3,63	0,71	19,59	2,20	4,80	-0,43	-0,80
7	*Test 2 – Low jump 1 m*	7,54	4,01	53,18	19,00	2,00	1,08	1,47
8	*Test 3 – Orientation shuttle run*	10,60	1,28	12,08	13,76	8,56	0,89	0,39

Table 19. Mean values and variability of the indicators characterizing the coordination abilities of the girls from the control group at the beginning of the sports-pedagogical experiment

№	Indexes	X	S	V	min	max	As	Ex
6.	*Test 1 – Backwards ball throw*	3,31	0,72	21,68	2,20	4,80	0,14	-0,52
7.	*Test 2 – Low jump 1 m*	7,00	4,03	57,55	19,00	0,50	0,87	2,32
8.	*Test 3 – Orientation shuttle run*	10,19	1,03	10,11	12,12	8,43	0,05	-0,86

3.3.3. Verification of the efficiency of the experimental methods for development of third-grade pupils' coordination abilities

The next research task is related to the necessity to verify the efficiency of the applied experimental methods for development of third-grade 9-10-year-old children's coordination abilities. The analysis of the results, presented in **figure 18**, shows that the values of the calculated comparative criterion are lower than the critical value of t (t_{tabl} = 1,99) and range between 0,09 and 1,64.

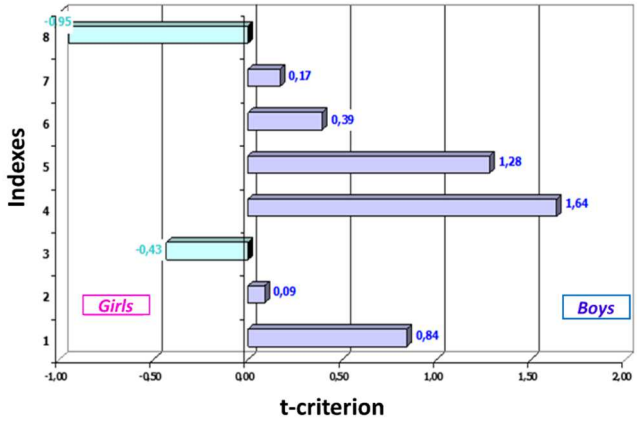


Fig. 18. Significance of the differences between the average levels of the researched indicators among the boys and girls at the beginning of the sports-pedagogical experiment

According to the standards of artistic gymnastics, this means that at the beginning of the research period there were no statistically significant differences between the boys and girls participating in the experiment as regards their physical development and the level of development of their coordination abilities. This conclusion is extremely important because it allowed the boys and girls' working together during the experiment.

At the beginning of the experiment, we also made a comparative analysis of the level of the researched indexes of the participants of the two genders, both from the experimental and from the control groups.

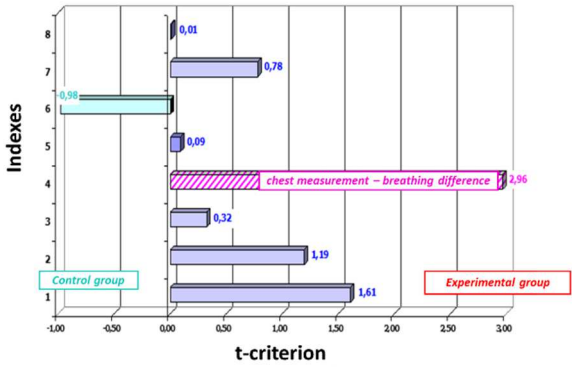


Fig. 19. Significance of the differences between the average levels of the researched indicators among the boys at the beginning of the sports-pedagogical experiment

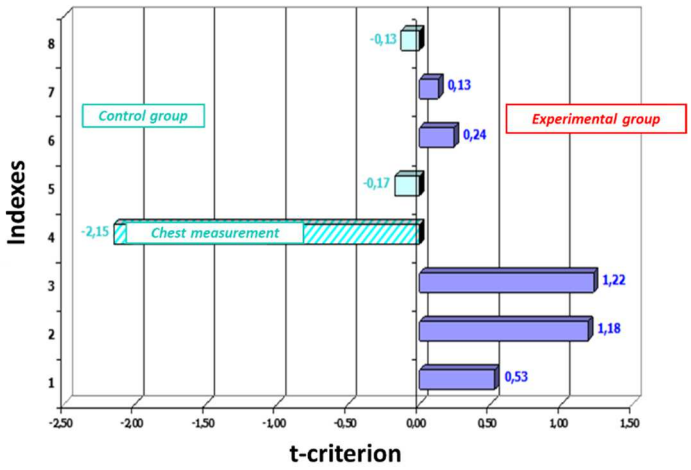


Fig. 19. Significance of the differences between the average levels of the researched indicators among the girls at the beginning of the sports-pedagogical experiment

Figure 19 shows that at the start of the experiment, as a whole, the boys from the experimental group had higher results than the boys from the control group. As we can see, however, here the values of the comparative criterion are also very low, which justifies the zero hypothesis, according to which there are no significant differences as regards the researched indicators of physical development and coordination abilities between the boys from the two groups at the beginning of the experiment . The only exception is observed in index 4 (chest measurement – breathing difference). Despite this, however, we can say there are no significant differences between the two groups of boys at the beginning of the research period which guarantees correctness at the start of the experiment.

As we can see in the figure, like the boys, the greater part of the indexes is in favor of the girls from the experimental group. The observed differences, however, are too small and cannot be considered significant.

The only exception here is related to the chest measurement, too. Unlike boys, however, the significant advantage is in favor of the girls from the control group.

As indicated in the Method Section, at the end of the period, after the applied experimental influence with the means of gymnastics, a second sports-pedagogical testing was carried out.

The results from the variation analysis of the initial data for the boys from the experimental group are presented in **table 20**, and for the girls – in **table 21**.

Table 20. Mean values and variability of the indicators of the physical development and coordination abilities of the boys from the experimental group at the end of the sports-pedagogical experiment

№	Indexes	X	S	V	min	max	As	Ex
1.	Stature	144,62	7,61	5,26	131,00	155,0	-0,31	-0,94
2.	Weight	38,37	5,95	15,50	30,00	47,70	-0,13	-1,35
3.	Body Mass Index (BMI)	18,29	2,05	11,23	14,46	20,92	-0,34	-1,26
4.	Chest measurement (pause)	73,55	6,94	9,44	59,50	84,5	-0,08	-0,71
5.	Chest measurement – breathing difference	4,90	1,07	21,77	3,00	7,00	0,21	-0,54
6.	Backwards ball throw test	3,93	0,41	10,43	3,00	4,60	-0,76	0,27
7.	Low jump test 1 m	4,69	2,48	52,92	9,00	0,00	-0,13	-0,82
8.	Orientation shuttle run test	9,97	0,66	6,59	11,39	9,18	0,63	-0,42

Table 21. Mean values and variability of the indicators of the physical development and coordination abilities of the girls from the experimental group at the end of the sports-pedagogical experiment

№	Indexes	X	S	V	min	max	As	Ex
1.	Stature	142,54	7,96	5,58	127,00	158,00	-0,01	-0,59
2.	Weight	38,18	7,86	20,58	23,50	55,20	0,03	-0,49
3.	Body Mass Index (BMI)	18,63	2,74	14,69	14,57	26,21	0,81	0,82
4.	Chest measurement (pause)	69,62	8,48	12,18	59,00	95,00	1,44	2,45
5.	Chest measurement – breathing difference	4,50	0,86	19,12	2,50	6,00	-0,20	-0,04
6.	Backwards ball throw test	3,73	0,57	15,38	2,60	4,60	-0,44	-0,93
7.	Low jump test 1 m	5,21	2,64	50,67	10,00	0,00	-0,03	-0,68
8.	Orientation shuttle run test	9,89	1,01	10,22	12,73	8,51	0,98	1,21

These results were subjected to comparative analysis with the results for the same sample obtained from the initial testing, again with the help of the abovementioned t-criterion of Student.

The analysis of **figure 20** allows us to establish the significance of the observed growth in the levels of the researched indexes. As we can see, during the experiment positive changes in almost all researched indexes occurred. The observed growth in the indexes characterizing the boys' physical development was very small and therefore – insignificant. We believe that this is quite logical due to the fact that the indicators of physical development are rather

conservative, and it is impossible to observe any significant changes in them for the short duration of the experiment. The figure shows that the values of the comparative t-criterion of Student were higher than the critical value. This allows with a high guarantee ($P_t \geq 95$ %) to reject the zero hypothesis and accept the alternative hypothesis, according to which under the influence of the applied gymnastics means some significant positive changes as regards the kinesthetic abilities of both the upper and lower limbs of the boys from the experimental group occurred during the experiment.

We cannot say the same about the indicators characterizing the kinesthetic abilities of the researched girls. The comparative analysis of these results with the results obtained from the initial testing show that, like the boys from the experimental group, some positive changes were observed in all researched indexes.

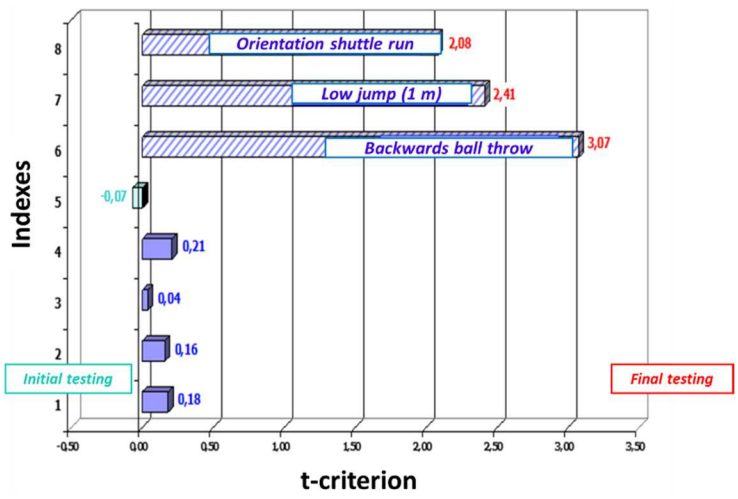


Fig. 20. Significance of the growth in the average levels of the researched indicators among the boys from the experimental group

As we have already mentioned, however, the duration of the experiment is rather insufficient to lead to significant changes in the indicators of the physical development. This is justified by the values of the comparative t-criterion which range between 0.07 and 0.15 in the first 5 indexes which are, of course, lower than the critical value which is 2,01 (**table 21, figure 21**). The analysis also shows that, like the boys from the analogical group, during the experiment and under the influence of the applied methods some positive changes in the level of development of the researched indicators characterizing the kinesthetic abilities of both upper and lower limbs occurred, as regards the control over the dynamic and kinematic characteristics of the movement upon execution of measured jumps in space. At the same time, however, we should point out the fact that the

value of the comparative criterion in the last index (№ 8) is lower compared to the critical value, which shows that the change in the level of the development of the indicator this index gives information about is insignificant and can be explained by accidental reasons. This means that when the experimental methods are applied, some mechanisms which ensure additional means and increase in workload should be envisaged in the work with the girls for the complex development of the kinesthetic abilities of their lower limbs, the speed of the complex motor reaction, and the parameters of attention.

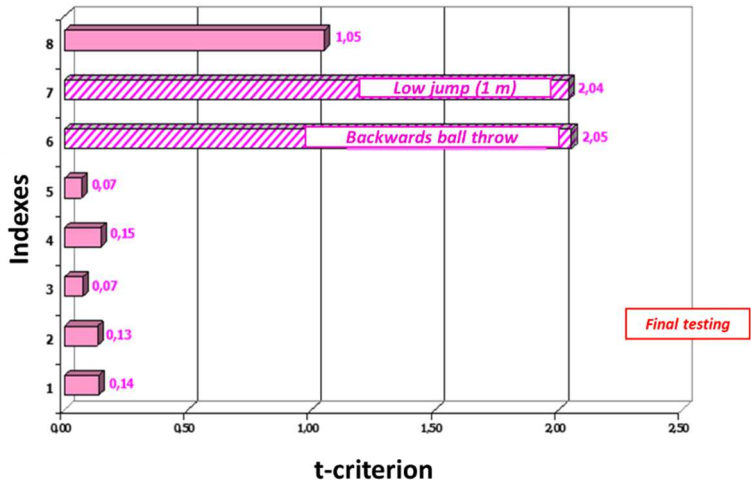


Fig. 21. Significance of the growth in the average levels of the researched indicators among the girls from the experimental group

The results from the variation analysis of the initial data from the final testing of the girls from the control group are presented in **table 22**.

The comparison of these results with the results obtained from the initial testing of the girls in this group (**figure 22**) shows that as a result of the education-training work during physical education and sports classes, some positive changes in the level of development of all researched indexes occurred.

Table 22. Mean values and variability of the indicators of the physical development and coordination abilities of the boys from the control group at the end of the sports-pedagogical experiment

№	Indexes	X	S	V	min	max	As	Ex
1.	Stature	140,96	7,53	5,34	128,00	153,00	-0,07	-0,91
2.	Weight	36,23	6,18	17,04	27,20	45,50	-0,18	-1,43
3.	Body Mass Index (BMI)	18,20	2,09	11,46	15,35	22,94	0,68	-0,08
4.	Chest measurement (pause)	67,27	7,11	10,57	54,00	82,00	-0,06	-0,46
5.	Chest measurement – breathing difference	4,96	1,00	20,15	3,00	7,00	0,05	-0,56
6.	Backwards ball throw test	3,71	0,54	14,49	2,60	4,80	0,21	-0,44
7.	Low jump test 1 m	7,48	3,54	47,37	18,00	3,50	1,26	2,04
8.	Orientation shuttle run test	10,46	1,22	11,70	14,15	9,20	1,36	2,09

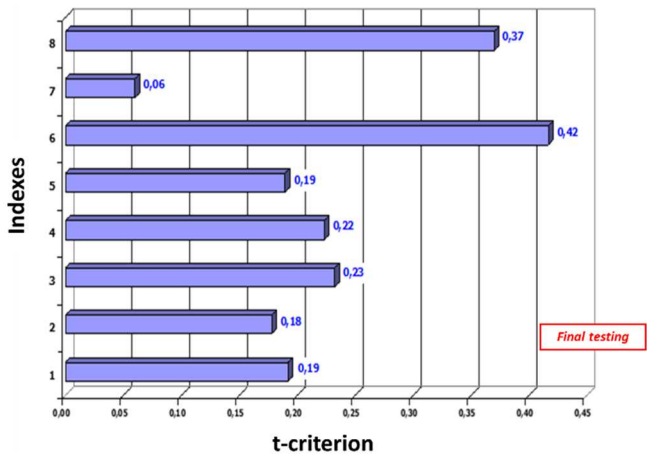


Fig. 22. Significance of the growth in the average levels of the researched indicators among the boys from the control group

As we can see, however, the values of t-criterion of Student range from 0,06 and 0,42, which means that the zero hypothesis can be applied here, according to which the positive changes which occurred during the experiment among the boys from the control group are insignificant and can be explained with accidental reasons.

The same conclusion can be drawn as regards the changes which occurred in the researched indicators of the physical development and coordination abilities among the girls from the control group (**table 23 and figure 23**).

Table 23. Mean values and variability of the indicators of the physical development and coordination abilities of the girls from the control group at the end of the sports-pedagogical experiment

№	Indexes	X	S	V	min	max	As	Ex
1.	Stature	141,57	5,96	4,21	132,00	154,00	0,11	-0,74
2.	Weight	35,93	5,35	14,88	28,70	46,00	0,69	-0,77
3.	Body Mass Index (BMI)	17,87	1,99	11,12	15,34	21,87	0,80	-0,64
4.	Chest measurement (pause)	74,67	8,19	10,96	63,50	93,50	0,89	0,43
5.	Chest measurement – breathing difference	4,63	1,22	26,29	3,00	7,00	0,72	-0,33
6.	Backwards ball throw test	3,49	0,49	14,14	2,40	4,40	-0,13	-0,36
7.	Low jump test 1 m	6,98	3,03	43,45	15,50	2,50	0,92	1,56
8.	Orientation shuttle run test	9,98	0,89	8,87	11,74	8,43	0,06	-0,56

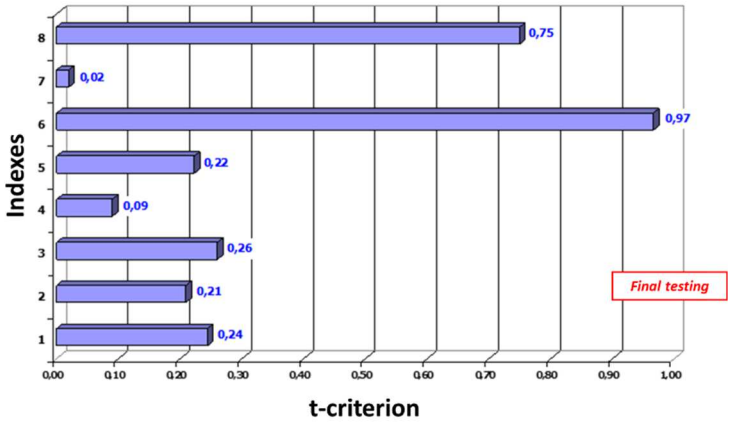


Fig. 23. Significance of the growth in the average levels of the researched indicators among the girls from the control group

In *conclusion*, the comparative analysis of the results obtained from the conducted sports-pedagogical testing (initial and final) of the boys and girls from the experimental and control groups shows that under the influence of the specific means of gymnastics envisaged in the applied experimental methods, during the research period, some positive changes in the levels of the researched indicators characterizing third-grade children's coordination abilities occurred among the participants in the experimental groups. Due to the limited duration of the experiment, the positive changes in the physical development are not significant. The effect of the actual curriculum on the children from the control groups is positive but insignificant.

All this proves the high efficiency of the applied experimental program for

development of coordination abilities (through the means of gymnastics) of third-grade 9-10-year-old pupils in Bulgarian schools.

3.3. Factor structure of the physical development and coordination abilities of 9-10-year-old pupils

The factor structure of the physical development and coordination abilities of 9-10-year-old pupils consists of 4 main factors (**table 24**) which explain the high percentage (76,13 %) of the initial dispersion of the researched phenomenon (**figure 24**). As we can see, all factors explain over 10 % of the initial dispersion, but quite naturally, the first factor has the highest percentage – 26,27 %. At the same time, the figure shows that the initial dispersion which cannot be explained by the established factors is 23,87 %. This is quite logical in view of the number of indicators included in the test battery.

Table 24. factor structure of 9-10-year-old pupils' physical development and coordination abilities

	Initial dispersion α^2 (%)				**h^2 (%)**	**1 - h^2(%)**
№	**I**	**II**	**III**	**IV**		
1.	0.460	0.748	-0.233	-0.175	0.857	0.143
2.	0.913	0.358	-0.112	-0.009	0.974	0.026
3.	0.929	-0.115	0.019	0.148	0.899	0.101
4.	-0.058	0.910	0.098	0.139	0.860	0.140
5.	0.103	0.054	0.840	-0.077	0.725	0.275
6.	-0.398	-0.136	0.621	0.151	0.585	0.415
7.	-0.138	-0.028	0.311	-0.643	0.530	0.470
8.	-0.034	0.017	0.255	0.770	0.660	0.340
Σα	**26.27 %**	**19.39 %**	**16. 63 %**	**13.84 %**	**76.13 %**	

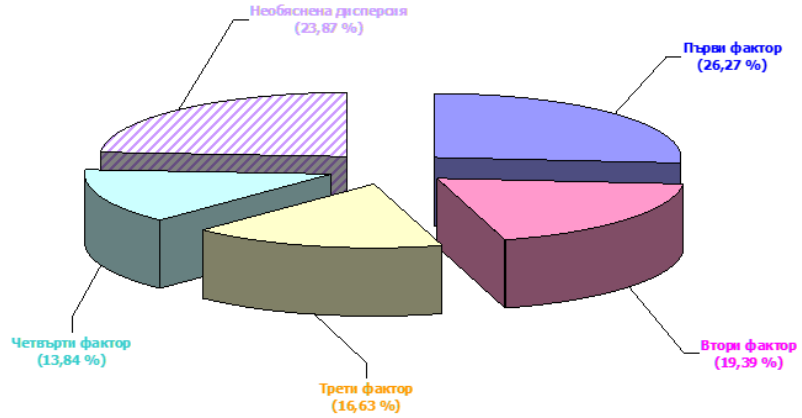


Fig. 24. Relative shares of the explained by the established factors initial dispersion of the physical development and coordination abilities

The first and most important factor is determined by two main indicators with highest factor weights (**figure 25**).

As we can see, these are indexes 3 and 2, "Body Mass Index" and "weight" respectively, with factor weights 0,929 and 0,913. Both indicators are related to the morph-functional development of children. This allows us to identify this factor as "morphological factor revealing the significance of the normal body weight" for the proper physical development of children at this age.

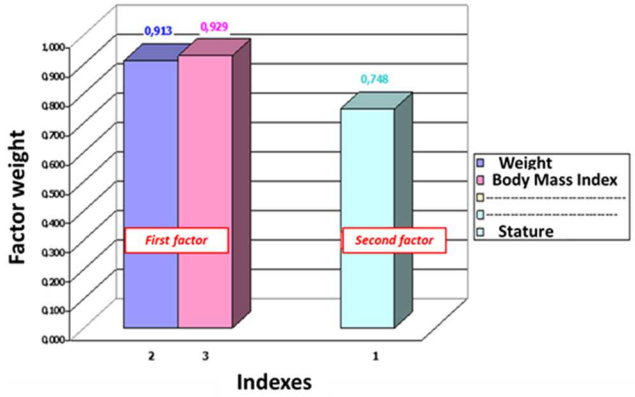


Fig. 25. Factor structure of the physical development and coordination abilities – 1st and 2nd factors

The second factor explains 19,39 % of the initial dispersion of the physical development and coordination abilities and consists of only one index. It reveals the significance of the height and its leading place in the factor structure of 9-10-year-old pupils (**figure 25**).

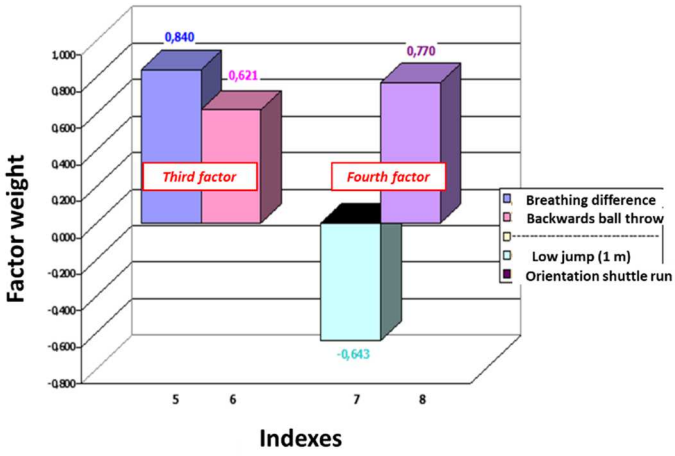


Fig. 26. Factor structure of the physical development and coordination abilities – 3rd and 4th factors

The third factor (16,63 %), like the first one, is also determined by two indexes (**figure 26**). It reveals the contribution of the functional capacity of the chest and the kinesthetic abilities of the upper limbs to the factor structure of the physical development and coordination abilities of the children from the researched age group.

The fourth factor (***figure 26***) explains the smallest percentage of the initial dispersion (13,84 %). Here, indexes 8 and 7 – running "shuttle" and "measured long jump 1 m" have high factor weights (0,770 and 0,643). The factor can be identified as "kinesthetic abilities of the lower limbs".

3.5. Standards for evaluation of the Bulgarian third-grade students' physical development and coordination abilities.

In order to fulfill the aim and tasks of the research, on the basis of the above made analysis and conclusions, with the help of modern math-statistical methods, we designed Standards for control and evaluation of third-grade pupils' physical development and coordination abilities (boys – **table 25**, and girls – **table 26**).

Table 25. Table of standards 1 – for evaluation of the physical development and coordination abilities of third-grade 9-10-year-old boys

Mark (points)	BMI		Breathing difference	Backwards ball throw test	Backwards ball throw test	Backwards ball throw test
	3		5	6	7	8
6,00	18,20		7,50	4,85	0,43	8,42
5,75	17,93	18,47	7,18	4,70	1,21	8,67
5,50	17,66	18,74	6,86	4,55	1,99	8,92
5,25	17,39	19,01	6,53	4,41	2,77	9,17
5,00	17,13	19,28	6,21	4,26	3,55	9,42
4,75	16,86	19,54	5,89	4,12	4,33	9,67
4,50	16,59	19,81	5,57	3,97	5,11	9,92
4,25	16,32	20,08	5,24	3,82	5,89	10,17
4,00	**16,05**	**20,35**	**4,92**	**3,68**	**6,67**	**10,42**
3,75	15,78	20,62	4,50	3,49	7,95	10,87
3,50	15,51	20,89	4,08	3,31	9,23	11,32
3,25	15,24	21,16	3,66	3,12	10,51	11,77
3,00	14,98	21,43	3,23	2,93	11,79	12,22
2,75	14,71	21,69	2,81	2,75	13,07	12,67
2,50	14,44	21,96	2,39	2,56	14,35	13,12
2,25	14,17	22,23	1,97	2,38	15,63	13,57

This approach enables teachers to gain notion about the state of the researched indicators among third-grade children at the beginning of a school year, as well as at every consecutive moment of their education and improvement. The evaluation of each observed index allows to establish the poorly developed indicators and, on this basis, to develop individual programs influencing **each child through the specific means of gymnastics**.

We should point out that the tables with Standards do not include indexes 1, 2, and 4, stature, weight, and chest measurement (pause) respectively. These indexes are too conservative and depend on children's genetic peculiarities.

Table 26. Table of standards 1 – for evaluation of the physical development and coordination abilities of third-grade 9-10-year-old girls

Mark (points)	BMI		Breathing difference	Backwards ball throw test	Backwards ball throw test	Backwards ball throw test
	3		5	6	7	8
6,00		18,23	7,98	4,84	0,48	8,11
5,75	17,95	18,48	7,55	4,67	1,23	8,36
5,50	17,68	18,75	7,12	4,50	1,98	8,60
5,25	17,40	19,02	6,69	4,33	2,73	8,85
5,00	17,14	19,28	6,26	4,16	3,48	9,09
4,75	16,86	19,54	5,83	3,99	4,23	9,34
4,50	16,59	19,81	5,40	3,82	4,98	9,58
4,25	16,32	20,08	4,97	3,65	5,73	9,83
4,00	**16,05**	**20,35**	**4,54**	**3,48**	**6,48**	**10,07**
3,75	15,78	20,62	4,11	3,28	7,70	10,49
3,50	15,51	20,89	3,68	3,08	8,92	10,91
3,25	15,24	21,16	3,25	2,88	10,14	11,33
3,00	14,98	21,43	2,82	2,68	11,36	11,75
2,75	14,71	21,69	2,39	2,48	12,58	12,17
2,50	14,44	21,96	1,96	2,28	13,80	12,59
2,25	14,17	22,23	1,53	2,08	15,02	13,01

The suggested 6-point system, where the step between two adjacent marks is 0.25, gives the opportunity to record the exact growth even over shorter periods of time, which in turn allows for timely corrections in the influence. The point system used allows to compare the achievements of differently measured tests and indexes (we measured in cm, kg, s, and points).

The average level of the researched sample is marked 4.00. for achievements better than the average one, the marks range from 4,25 to 6,00 and vice versa – for poorer results, the marks range from 3,75 to 2,25. For the indexes where the lower values of the result correspond to higher quality (e.g. running a certain distance, diversion from a target), the scales are reversed. In our research this is applicable for the following indexes: 7 (measured long jump 1m) and 8 (running "shuttle").

The recording of the results from the practical tests, as well as their evaluation, is made by the teacher, and the anthropological data are taken at the medical office of the school.

Sports-pedagogical tests should be done in standard settings.

A good warm-up of the pupils (organized by the teacher) is a must before the beginning of the testing.

When working with Standards tables, one should be aware of the following:

- the evaluation of a certain result is made by finding the index of interest in the table and the result is compared with the values in the corresponding column. Opposite this value (or the closest value) on the line in the first column ("mark") the pupil's point for a certain index is taken;
- if the result falls between two values, it is equal to the lowest (in quality) value; .
- in cases when the evaluated result goes out of the defined borders (from 2.25 to 6.00), it is evaluated with 6.00 if it is higher in quality, and with 2.00 if it is lower in quality.

CONCLUSIONS AND RECOMMENDATIONS

The analysis of the results from our research, as well as the conclusions made in the text, allow to draw the following ***conclusions***:

1. Bulgarian children's physical preparation, coordination abilities in particular, is in direct dependence on the place they were born in and the place they live and study in. The number of the people living in a certain town or village can be a differentiating factor for the manifestation of different motor skills, including coordination abilities among 9-10-year-old pupils.
2. The variability of the researched indexes does not depend on children's gender. Both researched samples, as a whole, are homogeneous as regards the boys and girls included in them, and relatively homogeneous as regards all the other indicators of physical development and coordination abilities. Lack of homogeneity is observed only as regards children's abilities to exercise control over the dynamic and kinematic characteristics of the movement of lower limbs upon execution of measured jumps in space.
3. Over 70 % of the representative sample, consisting of 564 boys and 509 girls, allows us to claim that it bears the characteristics of the general population (9-10-year-old pupils). There is high and very low development of kinesthetic abilities of the upper limbs, and almost one fifth of the children face problems in the level of development of their coordination abilities of the lower limbs.
4. At the beginning of the research period there were no significant differences between the boys and girls from both the experimental and the control groups, which guarantees the correctness at the start of the sports-pedagogical experiment and allows the children of both genders to work in common groups.
5. Under the influence of the specific means of gymnastics envisaged in the applied experimental methods, during the research period some significant positive changes in the levels of the indicators characterizing the coordination abilities occurred among the 9-10-year-old participants.
6. Due to the limited duration of the experiment the observed positive changes in the children's physical development are insignificant.
7. The effect of the current curriculum on the children from the control groups is

positive but insignificant.
8. We can claim with high guarantee probability that the applied experimental program for development of Bulgarian third-grade 9-10-year-old pupils' coordination abilities through the means of gymnastics is highly efficient.

Recommendations:

1. An adequate didactic technology should be used during the classes for development of children's coordination abilities and it should be based on the strength of pupils' nervous system. This will allow using children's additional abilities and will improve their coordination abilities.
2. Teachers, together with parents and children with abnormal body weight should invest efforts through rational diet and motor activities in their daily routine in order to achieve a reduction in children's weight and create lasting habits for a healthy lifestyle. Some serios measures should be taken for those children who are underweight as well.
3. The experimental methods can be altered in the direction of including additional means for increasing the workload for development of speed of motor reaction, concentration, distribution and flexibility of attention of the 9-10-year-old boys and girls.
4. The designed didactic technology for development of 9-10-year-old pupils' coordination abilities has to be presented to the management bodies of schools and implemented in physical education and sport teachers' work.

CONTRIBUTIONS

For the first time in Bulgaria, for this dissertation, research on 9-10-year-old pupils' coordination abilities was carried out with the test battery of Hirtz et al. (1985) for determining the level of this type of abilities and the positive changes which occurred in it.

The theoretical significance of the research consists in enriching and increasing the knowledge about the scientific-methodological and age peculiarities in the development of CA of 9-10-year-old pupils.

The practical significance of the research consists in the design and implementation of didactic technology with detailed description of the educational process, including: educational goals, technological structure and contents (technological steps and operations), and expected results. The efficiency of the didactic technology for building and development of 9-10-year-old pupils' coordination abilities was proven with conducted experiments.

Tables with standards for both boys and girls were designed for evaluation of the state of the coordination abilities with the test battery of Hirtz et al. (1985) with the help of the so-called sigma method.

PUBLICATION RELATED TO THE DISSERTATION

N. Tankusheva, Research of 9-10-year-old girls' coordination abilities, Sport and Science, issue:1-2,ISSN (online):1310-3393, Sofia,2019, p.163-175

N. Tankusheva, of 9-10-year-old boys' coordination abilities, Scientific-practical conference "Actual problems of physical education" - 05-06.04.2019, Department "Theory of Physical Education", NSA "V. Levski", Sofia, 2019

N. Tankusheva, Physical development of 9-10-year-old Bulgarian pupils, "European standards in sports education", ISBN: 978-619-7281-52-1, Publishing house: I&B, Veliko Turnovo,2019