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RESEARCH OF THE RHYTHMICAL ABILITIES OF PUPILS OF PRIMARY SCHOOL AGE

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ABSTRACT

Coordination abilities are an important element of human physical ability. They are part of the motor abilities and represent relatively consolidated and generalized qualities of the course of specific processes for regulating movements. Well-developed coordination abilities are a prerequisite for correctly and quickly learning new movements. The aim of this study was to improve the rhythmical abilities of pupils at primary schools using exercises from basic gymnastics and folklore dances with musical accompaniment. The research was carried out with 92 students at a secondary school in the city of Sofia. We used a test battery containing information about the rhythmical abilities to realize it. The battery includes four tests: frontal kicking with legs and arms on the wall, jumps in four squares, crossover jumps in four squares, and kicking with legs and arms. The methods used in this study are the testing, pedagogical experiment, and mathematical-statistical methods (variation analysis, comparative analysis with t-criterion of Student). The analysis of the results showed that the differences observed in the pupils from the experimental group, obtained before and after the experiment, were statistically significant for all indicators of rhythmical abilities. Such a difference was also found between the two studied groups at the end of the experiment. The research showed that the program we applied had a positive effect on developing rhythmical abilities.

Keywords: rhythmical abilities, pupils, gymnastics, folklore dances

INTRODUCTION

The main tasks of physical culture and sports for adolescents are the physical development and improvement of the child's organism, the strengthening of health and the increase of vitality, and the acquisition of motor and hygiene habits.

Solving these tasks in physical education and sports classes in schools is a complex process in which both the morpho-functional changes in the adolescent organism of pupils and the sensitive periods in the development of motor qualities at this age must be considered (Krumova-Tsoncheva, 2016). According to some authors (Zamashkin & Tolstova, 2013; Pisarenkova, 2010), improving physical qualities at school age is an important task of the school process. At this age, the foundations necessary for the development of coordination abilities are

laid, and the most favorable in this respect is the primary school age. Enriching children's motor culture in terms of coordination allows them to manage and regulate their movements' direction, tempo, and rhythm (Krumova-Tsoncheva, 2016). Only in the presence of coordination abilities can they achieve an effective result in any activity (Lyah, 2006). The plasticity of the nervous system and the improvement of the functions of the motor analyzer in children of primary school age make this period optimal for developing motor coordination (Grozdeva, 2010; Bobkova & Pisarenkova, 2010).

Coordination abilities are part of motor abilities and represent relatively consolidated and generalized qualities of specific processes to regulate movements. Well-developed coordination abilities are a prerequisite for the correct and quick learning of new movements of

a complex nature (Dimitrova, 2010).

According to Zachopoulou, Tsapakidou, and Derri (2004), the acquisition of certain motor abilities, such as coordination and dynamic balance, are more central to developing quality motor skills than other abilities (such as endurance and flexibility). For this reason, the development of coordination should be addressed in programs that aim to support the performance of motor skills (Berg & Breslin, 2014). Coordination can be developed through the use of a rhythmic element in movement programs and can determine the level of motor skill proficiency achieved (Zachopoulou et al., 2004).

The structure of motor coordination includes quick reaction, quick and accurate execution of motor actions for a certain time, differentiation of the spatial, temporal, and force parameters of the motor action, accurate execution of prolonged actions, visual orientation, balance, and rhythmical ability (Lyah, 2003).

Hirtz (1985) reported that the highest growth rates in kinesthetic differentiation ability, balance ability, response-ability, and rhythmical ability were achieved at the age of 7-10 years. Rhythmical ability in girls strongly develops until the age of 11 years and in boys - until the age of 13 years. Boys then reach a higher level of rhythmicity than girls (Hirtz & Starosta, 2002).

Rhythmical ability, as a component of coordination abilities, represents consolidated skills for perceiving, storing, and reproducing a previously given or contained time-dynamic structure in the performance of the movement. This ability is a prerequisite for marked rhythmic performance and purposeful structuring of movements (Hirtz, 1985). According to Gancheva (2017), the sense of rhythm (or rhythmic ability) is the ability to sense and reproduce the elements of sound frequency, intensity, and tempo in the most accurate way possible. Mu-

sic has been found to have a beneficial effect on physical activity and the physiological and mental processes in children (Nikolova, 2012). Skillfully selected musical and rhythmic games and dances, tailored to the age and training of children, have a multifaceted effect (Alexiev, 2006).

In music, rhythm is the main element that creates the perception of time (Thaut, 2013). Rhythm helps organize actions into predictable and coherent patterns. According to Bonacina et al. (2019), having good rhythmic skills is essential not only for music or dance but also for language and communication skills. Rhythmical abilities are not simply inherited skills; they can be improved through training and an individual's performance can vary across different rhythm tests (Miendlarzewska & Trost, 2014; Moritz et al., 2013; Tierney & Kraus, 2015).

A number of authors have investigated rhythmical abilities and their influence on different domains of child development (Bolduc, 2008; Pollatou & Hatitaki, 2001; Zachopoulou et al., 2003; Hallam, 2010; Palatnik & Abrahamson, 2018; Bonacina et al., 2019; Ntomali et al., 2021; Laure & Habe, 2023, etc.).

Rhythmical ability manifests in gymnastic disciplines – rhythmic and artistic gymnastics, aerobics, and sports acrobatics, in which the routines are performed with musical accompaniment (Hadjiev et al., 2011).

To develop rhythmical abilities, specialists also use the means of folklore dance art and musical accompaniment, which correspond to the motor abilities of the participants (Zachopoulou et al., 2003; Zachopoulou et al., 2004; Gantcheva & Damjanovska, 2017).

The above-mentioned provoked our interest in researching the development of the rhythmical abilities of primary school-aged pupils using basic gymnastics and folklore dances within the regular classes in physical education and sports provided for the 4th grade.

We also considered that children aged 7-11 have weak and unstable attention. They are very mobile and energetic but get tired quickly, so the methods and means used to develop coordination abilities must be chosen very precisely.

The aim of our study was to improve the rhythmical abilities of pupils at primary schools using exercises from basic gymnastics and folklore dances with musical accompaniment.

In order to achieve the aim of the study, the following tasks were set:

- To establish the level of rhythmical abilities of pupils of primary school age.
- To design a program to develop pupils' rhythmical abilities.
- To conduct a pedagogical experiment to establish the effectiveness of the applied methodology.
- To process and analyze the obtained results.

METHODOLOGY

The study was carried out in January-February 2023.

Participants

Ninety-two children (sixty-two girls and thirty boys), students at a secondary school in the city of Sofia, were studied. The research was aimed at examining the rhythmical abilities of 4th-grade pupils aged 10-11 years.

Measurement and indexes

For the needs of the study, a sports-pedagogical test was conducted with the participants. A tested and standardized test battery was used, which includes four indicators bearing information on rhythmical abilities (Damjanovska et al., 2013; Damjanovska et al., 2015). The testing was carried out twice – once at the beginning and a second time after applying a program of musical-rhythmic exercises. The collected data were used to compare the level of rhythmical abilities of the pupils of the two groups before and after the implementation of the program.

Tests Description

Test 1 - Frontal kicking with legs and arms on the wall

A line is marked on the floor 20 cm away from the wall. The pupil stands behind it in an upright position, facing the wall. The pupil's arms are raised at right angles at shoulder height. Within 20 seconds, they should do the following actions: with their right foot, they should hit the wall above the line (drawn in advance), take down their right foot on the floor, and perform the same movement with their left foot. Then alternating hits with hands to the wall follow - right hand, then left, and again the right. That is one cycle of movement. The next movement cycle starts with a hit of their left foot on the wall and then with the right foot, continuing with alternating hits with their left, right, and left hand to the wall. The number of successfully executed cycles in 20 seconds is recorded.

Test 2 - Jumps in four squares

Four squares with the dimension of 40x40 cm are drawn on the floor. The pupil stands upright in the right lower square with relaxed arms beside the body. The movement starts with a jump off the right foot in the right upper square. Then, they perform a jump off the left foot in the left upper square. They continue jumping in the left lower square with the right foot, performing three steps (right, left, right foot). The movement continues to the left, jumping off the left foot in the left upper square, jumping off the right foot in the upper right square, and then jumping in the lower right square with the left foot, performing three steps (left, right, left foot). That is one cycle of movement. The number of successfully executed cycles in 20 seconds is recorded.

Test 3 - Crossover jumps in four squares

The test is the same as the previous one, but the movement starts with the left foot jumps in the left upper square and with the right foot in the right upper square. Then, the pupils jump

in the lower left square with their left foot, performing three steps (left, right, left foot). The movement continues with a jump off the right foot in the right upper square, a jump off the left foot in the left upper square, and a jump off the right foot in the lower right square, performing three steps (right, left, right foot). That is one cycle of movement. The number of successfully completed cycles in 20 seconds is recorded.

Test 4 - Non-rhythmic kicking with the legs and arms

The test is performed with the pupil facing the corner of a wall. There are two lines 20 cm away from the wall drawn on the floor on the right and left-hand sides. The pupils stand upright with their palms raised at shoulder height behind the drawn lines. With the right side of the body, the hits are performed to the right side of the wall, while with the left side of the body, they are performed to the left side of the wall. The movements are as follows: the pupils hit the wall to the left with their left foot above the line drawn 20 cm above the wall and then put their foot back to the floor. Then, they hit the wall to the right on their chest level with their right hand. Upon removing their hand from the wall, they hit the right part of the wall with their right foot, again at 20 cm height, and then place their foot on the floor. That is one cycle of movement. The next movement starts with their left foot hitting the wall to the left. The number of successfully completed cycles in 20 seconds is recorded.

Each test was performed three times consecutively, with a short break between the trials. The best result was taken. Test practice was not allowed.

Limits of the research

Regardless of the research team's desire to cover a more significant number of children in the respective age group, due to the refusal of some teachers, we had the opportunity to study only four classes.

Research methods and indicators

In order to fulfill the set tasks and aims of the research, we used the following methods: study of the specialized literature, sports-pedagogical testing, and sports-pedagogical experiment.

Procedure

We conducted the research at the school within the regular physical education and sports classes. Prior to the study, informed consent was provided by the parents. Pupils' anonymity was guaranteed because all of them were recorded under different numbers. All of them participated voluntarily in the research and received no monetary or financial compensation for their contribution. None of the participants refused to take part. Only those who were unwell did not participate in the study. Prior to testing, brief instructions and a demonstration of the test battery were provided. The testing was carried out in the school gym by our research team, with the active participation of physical education and sports teachers. We used the following equipment to perform the tests: a stopwatch, a meter, and a tape. The participants performed each test three times. In the analysis of the data, the best results were used.

Based on the data from the first test, two approximately equal groups were formed – an experimental group consisting of forty-eight pupils and a control group – consisting of forty-four pupils.

Study design

The control group's classes were conducted according to the physical education and sports curriculum for the 4th grade in the school year 2022/2023. For 4 weeks, a previously prepared program of musical and rhythmic exercises was applied to the experimental group. We studied whether the performance of basic gymnastics exercises and folklore dances performed with musical accompaniment would improve the level of pupils' rhythmical abilities.

Description of the program (Author program) – for developing rhythmical abilities

The program included 10 exercises and 4 folklore dances, divided into 2 sets. The first set was performed during the 1st and 2nd week. It consisted of 5 exercises from the basic gymnastics performed with musical accompaniment (Table 1) and two folklore dances – Straight

Horo (2/4 equal part size) and Ruchenitza (7/8 unequal part size). The second set was performed during the 3rd and 4th week. It included five exercises from the basic gymnastics performed with musical accompaniment (Table 2) and two folklore dances – the Danube dance (2/4 equal part size) and the Samokovsko dance (9/8 unequal part size).

Table 1. Description of set No.1 for developing rhythmical abilities

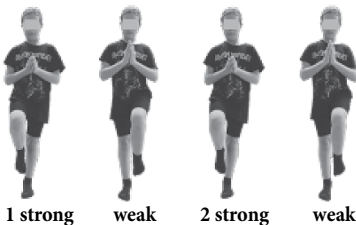
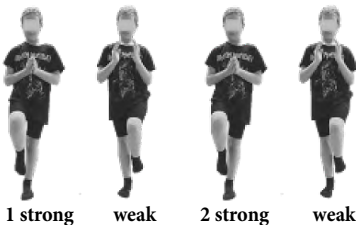
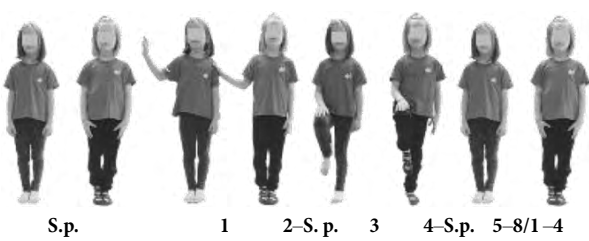
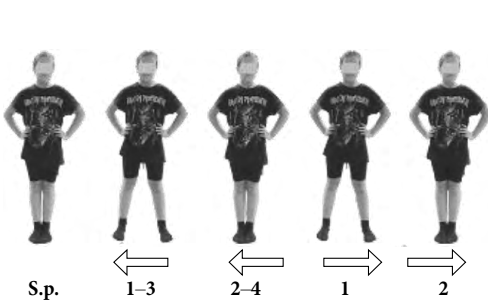
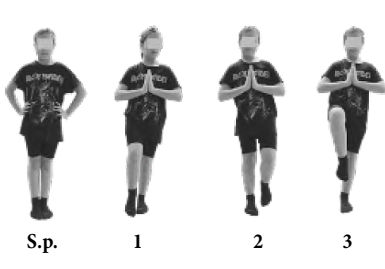




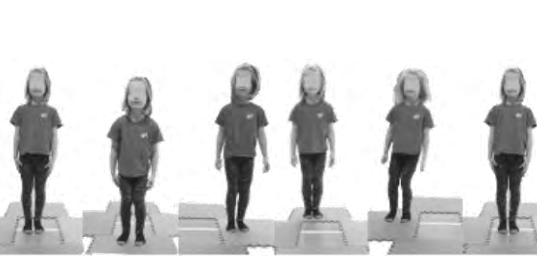
Exercise	Illustration
Marching in place – clap your hands on each beat on a strong and weak time – left and right foot (1 to 8). Performed in the tempo of the song “ <i>Musician’s March</i> ”.	
Marching in place – clap your hands on each beat on a solid time – left foot (1 to 8). Performed in the tempo of the song “ <i>Musician’s March</i> ”.	
Starting position – standing, the pupils are in a circle. 1–raise your right hand bent to the side and touch the shoulder of the pupil on the right; 2–s.p.; 3–raise your right bent leg to 90° and touch the knee with your right hand; 4–s.p.; 5–8≠1– 4. Performed in the tempo of the song “ <i>Crocodile Song</i> ”.	
Starting position – standing, hands on hips. Steps with movement to the right: 1-step with the right foot to the right; 2-step with the left foot to the right; 3-step with the right foot to the right; 4-retract the left leg to the right foot. Steps with movement to the left: 1-step with the left foot to the left; 2-retract the right leg to the left foot. Performed in the tempo of the song “ <i>Boriano-Borjanke</i> ”.	
Starting position – standing, hands on hips. 1-step on the right foot and bend with the left; 2-step on the left foot and bend with the right; 3-step on the right foot and raise left bent leg to 90° with a slight hold, clap your hands on each beat. The same is repeated, starting the step with the left foot. Performed in the tempo of the “ <i>Thracian ruchenitza</i> ”.	

Table 2. Description of set No.2 for developing rhythmical abilities

Exercise	Illustration
<p>Marching in place – clap your hands on every odd beat on a solid time – left foot (1, 3, 5, 7). Performed in the tempo of the song “<i>Musician’s March</i>”.</p>	 <p>1 strong weak 2 strong weak 3 strong weak 4 strong weak</p>
<p>Marching in place – clap your hands on every even beat on a solid time – left foot (2, 4, 6, 8). Performed in the tempo of the song “<i>Musician’s March</i>”.</p>	 <p>1 strong weak 2 strong weak 3 strong weak 4 strong weak</p>
<p>Starting position – standing, the pupils are in a circle. 1-raise your right hand bent to the side and touch the shoulder of the pupil on the right; 2-s.p.; 3-raise your left bent leg to 90° and touch the knee with your right hand; 4-s.p.; 5-8≠1-4. Performed in the tempo of the song “<i>Crocodile Song</i>”.</p>	 <p>S.p. 1 2-S.p. 3 4-S.p. 5-8/1-4</p>
<p>Starting position – standing. 1-jump on the right foot and bend with the left; 2- jump on the left foot and bend with the right; 3- jump on the right foot and lift the left lower leg back and touch the foot with your left hand. The same is repeated, starting the jump with the left foot. Performed in the tempo of the “<i>Shopska ruchenitza</i>”.</p>	 <p>S.p. 1 2 3</p>
<p>Jumps with two legs and movement in four directions – Starting position – standing, hands on hips. 1-jump forward; 2- jump back to s.p.; 3-jump to the left; 4-jump to the right to s.p.; 5- jump back; 6-jump forward to s.p.; 7-jump to the right; 8-jump to the left to s.p. Initially, jumps are performed in 2 beats (1-2 forward, 3-4 backward) at a slower pace, then the jump is in each beat. Performed in the tempo of the song “<i>Crazy Frog</i>”.</p>	 <p>S.p. 1 2-S.p. 3 4-S.p. 5 6-S.p. 7 8-S.p.</p>

Data analysis

The study results were subjected to mathematical-statistical processing with SPSS 20 and illustrated with Excel 2013. Depending on the tasks of the research, the following statistical methods were applied:

- *variation analysis* – for defining average values, normality of distribution, and variety of indicators under study;
- *comparative analysis with t-criterion of Student for independent samples* – or checking the reliability of differences

between average levels of indicators under study between experimental and control groups. The critical value of the t -criterion, at high statistical reliability ($P \geq 95\%$), is $t_{\text{critical}} = 1.98$ (Gigova, 2019);

- *comparative analysis with t -criterion of Student for dependent samples* – or checking the reliability of differences between average levels of indicators under study between the same populations. The critical value of the t -criterion for both populations, with high statistical

reliability ($P \geq 95\%$), was determined according to Gigova (2019).

RESULTS

The results from the variation analysis of the indicators of the rhythmical abilities of the pupils of both groups showed that the distribution of the values was normal and close to normal.

Table 3 presents the results of the applied variation analysis of pupils from the experimental group.

Table 3. Variation analysis of the indicators of rhythmical abilities of pupils from the experimental group

Indicators	N	X min	X max	R	Mean	SD	V	As	Ex
Test 1									
<i>pre-intervention</i>	48	2	8	6	4.96	1.69	34.04	0.232	-0.423
<i>post-intervention</i>	48	3	10	7	6.63	1.67	25.22	0.058	-0.236
Test 2									
<i>pre-intervention</i>	48	1	10	9	5.35	2.88	53.73	-0.03	-1.663
<i>post-intervention</i>	48	4	12	8	7.81	2.67	34.19	0.042	-1.501
Test 3									
<i>pre-intervention</i>	48	1	8	7	4.25	1.90	44.62	0.327	-0.584
<i>post-intervention</i>	48	4	11	7	7.25	1.98	27.37	0.354	-0.777
Test 4									
<i>pre-intervention</i>	48	1	7	6	4.46	1.46	32.70	0	0.04
<i>post-intervention</i>	48	4	10	6	7.17	1.67	23.27	0.012	-0.985

Table 3 shows that in the first measurement, the values of the coefficient of variation were very high, between 32.70% and 53.73%. This means that the group was heterogeneous in terms of rhythmical abilities. The minimum value in the first test was 1 cycle in test 2 “Jumps in four squares”, test 3 “Crossover jumps in four squares”, and test 4 “Non-rhythmic kicking with the legs and arms”. A maximum value of 10 cycles was recorded in test 2. In the second measurement, the analysis showed that the studied group was relatively

homogeneous in three of the tests. These were test 1 – $V_1 = 25.22\%$, test 3 – $V_3 = 27.37\%$, and test 4 – $V_4 = 23.27\%$. The biggest difference between the minimum and maximum values in separate indicators was observed in test 2 – $R = 8$ cycles. The best result was reported in test 2 (12 cycles), and the weakest was in test 1, “Frontal kicking with legs and arms on the wall” (3 cycles).

Table 4 presents the results of the applied variation analysis of pupils from the control group.

Table 4. Variation analysis of the indicators of rhythmical abilities of pupils from the control group

Indicators	N	X min	X max	R	Mean	SD	V	As	Ex
Test 1									
pre-intervention	44	2	10	8	5.43	2.43	44.81	0.016	-1.04
post-intervention	44	2	10	8	5.55	2.41	43.39	0.073	-1.106
Test 2									
pre-intervention	44	2	7	5	4.93	1.37	27.79	-0.156	-0.932
post-intervention	44	2	8	6	5.02	1.41	27.99	0.042	0.666
Test 3									
pre-intervention	44	2	6	4	4.30	1.09	23.39	-0.065	-0.577
post-intervention	44	2	6	4	4.45	1.04	23.45	-0.002	-0.611
Test 4									
pre-intervention	44	2	7	5	4.45	1.28	28.83	-0.033	-0.081
post-intervention	44	2	7	5	4.59	1.34	29.08	0.011	-0.430

In the control group, three indicators were observed at the beginning of the study, according to which the group was relatively homogeneous – the coefficient of variation was between 12% and 30% (Table 4). These were test 2 “Jumps in four squares”, test 3 “Crossover jumps in four squares”, and test 4 “Non-rhythmic kicking with the legs and arms” – $V_2 = 27.79\%$, $V_3 = 23.39\%$, and $V_4 = 28.83\%$. In test 1, the group was heterogeneous – the coefficient of variation had a value of $V_1 = 44.81\%$. Minimum values of 2 cycles were reported for all the studied indicators. The largest range was observed in test 1 –

$R = 8$ cycles, both at the beginning and the end of the study. In the second measurement, the coefficient of variation remained unchanged for the studied indicators.

At the pre-intervention, the average values of the pupils of both groups were close for all the studied indicators (Figure 1). Results of the comparative analysis with Student’s t -criterion for independent samples showed that these differences were not statistically significant. The empirical values of the t -criterion were lower than the critical value $t_{critical} = 1.98$ (Table 5). This sets both groups in equal conditions and gives the experiment validity.

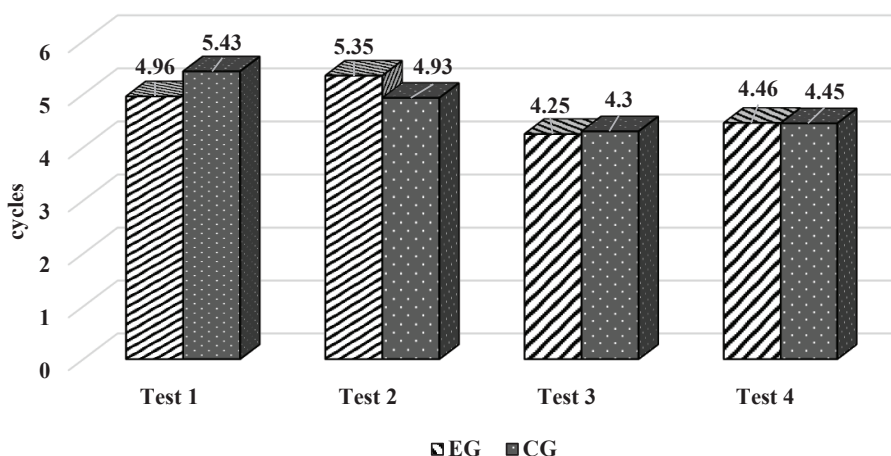


Figure 1. Average values of pupils of both groups at the pre-intervention

Table 5. Significance of the differences between the average levels of the indicators of pupils of both groups at the pre-intervention

Indicators	Experimental			Control			Difference		Statistical significance	
	n_1	\bar{X}_1	SD_1	n_2	\bar{X}_2	SD_2	d	Cohen's d	t	Sig.
Test 1	48	4.96	1.69	44	5.43	2.43	-0.47	0.230	1.02	.277
Test 2	48	5.35	2.88	44	4.93	1.37	0.42	0.190	0.89	.378
Test 3	48	4.25	1.90	44	4.30	1.09	-0.05	0.030	0.14	.889
Test 4	48	4.46	1.46	44	4.45	1.28	0.01	0.000	0.01	.989

Note. $t_{critical} = 1.98$

For the needs of the research, a comparative analysis of the average values for the separate indicators of the pupils of both groups was applied.

The increase of the indicators in the experimental group is presented in Figure 2. It can be seen that in all indicators there was a difference in the average values at

the pre-intervention and post-intervention. The highest increase was observed in test 3 “Crossover jumps in four squares” – 3 cycles and test 4 “Non-rhythmic kicking with the legs and arms” – 2.71 cycles. The lowest increase of 1.67 cycles was in test 1 “Frontal kicking with legs and arms on the wall”.

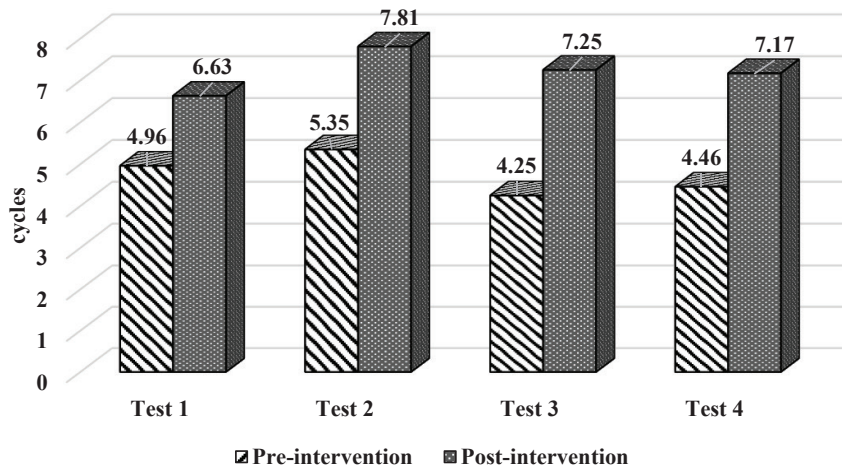
**Figure 2.** Increase in the results of pupils from the experimental group

Figure 3 shows the increase in the indicators of the control group. It shows an improvement in the indicators but with a lower value than that of the experimental group. The highest increase was again observed in test 3

“Crossover jumps in four squares” – 0.15 cycles, and test 4 “Non-rhythmic kicking with the legs and arms” – 0.14 cycles. The increase was lower for the remaining two indicators – from 0.09 to 0.12 cycles.

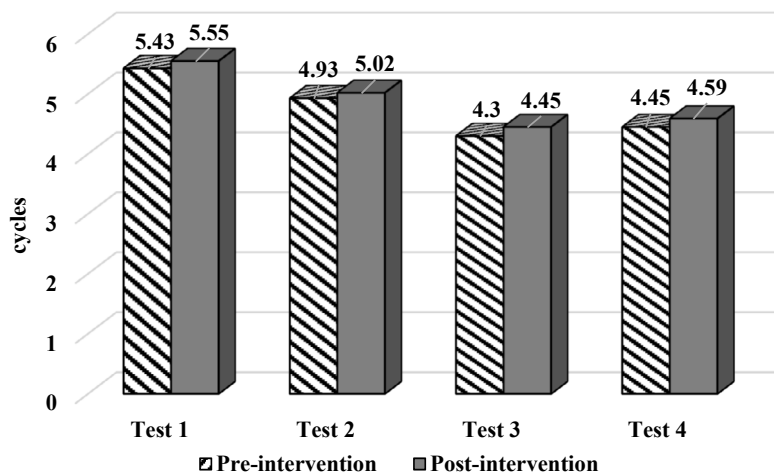


Figure 3. Increase in the results of pupils from the control group

To establish the statistical significance of the increase in the results between the two studies in both groups, we applied a comparative analysis with Student’s *t*-criterion for

dependent samples.

Table 6 shows the statistical reliability of the increase in pupils from the experimental group.

Table 6. Reliability of the increase of the indicators of pupils from the experimental group

Indicators	n	Pre-intervention		Post-intervention		Statistical significance of differences			
		\bar{X}_1	SD_1	\bar{X}_2	SD_2	d	d%	t	Sig.
Test 1	48	4.96	1.69	6.63	1.67	1.67	33.61	15.33	.000
Test 2	48	5.35	2.88	7.81	2.67	2.46	45.91	20.67	.000
Test 3	48	4.25	1.90	7.25	1.98	3.00	70.59	22.53	.000
Test 4	48	4.46	1.46	7.17	1.67	2.71	60.75	17.52	.000

Note. $t_{critical} = 2.01$

The table analysis shows that for all the indicators studied, the empirical values of the Student’s *t*-criterion were higher than the critical one – $t_{critical} = 2.01$, which proves that the observed differences before and after the experiment were statistically significant. In terms of the level of development of rhythmical abilities, the alternative hypothesis

was confirmed, at significance level $\alpha \leq .05$. According to it, the observed average values differences were due to the effectiveness of the applied program.

The reliability of the increase in the average values of the indicators of the control group is presented in Table 7.

Table 7. Reliability of the increase of the indicators of pupils of the control group

Indicators	n	Pre-intervention		Post-intervention		Statistical significance of differences			
		\bar{X}_1	SD_1	\bar{X}_2	SD_2	d	d%	t	Sig.
Test 1	44	5.43	2.43	5.55	2.41	0.12	2.09	1.95	.058
Test 2	44	4.93	1.37	5.02	1.41	0.09	1.84	1.43	.159
Test 3	44	4.30	1.09	4.45	1.04	0.15	3.70	2.01	.051
Test 4	44	4.45	1.28	4.59	1.34	0.14	3.06	1.96	.056

Note. $t_{critical} = 2.02$

Table 7 shows that for all indicators studied, the empirical values of the Student's t -criterion were lower than the critical one – $t_{critical} = 2.02$. This indicates that the difference in the indicators of the rhythmical abilities in the control group was not statistically significant and confirmed the null hypothesis, according to which the observed improvement in the results was due to random reasons.

To establish the significance of the differences between the average levels of the studied indicators in both groups at the post-intervention, a comparative analysis with Student's t -criterion for independent sam-

ples was applied.

At the post-intervention, significant differences were observed in the mean values of the indicators between both groups (Figure 4). The highest difference of 2.80 cycles was found in test 3 "Crossover jumps in four squares" and in test 2 "Jumps in four squares" – 2.79 cycles. In test 1 "Frontal kicking with legs and arms on the wall", the difference was lower – 1.08 cycles. However, the comparative analysis showed that the obtained differences between the Experimental and Control groups were statistically significant in all studied indicators at a significance level $\alpha \leq .05$.

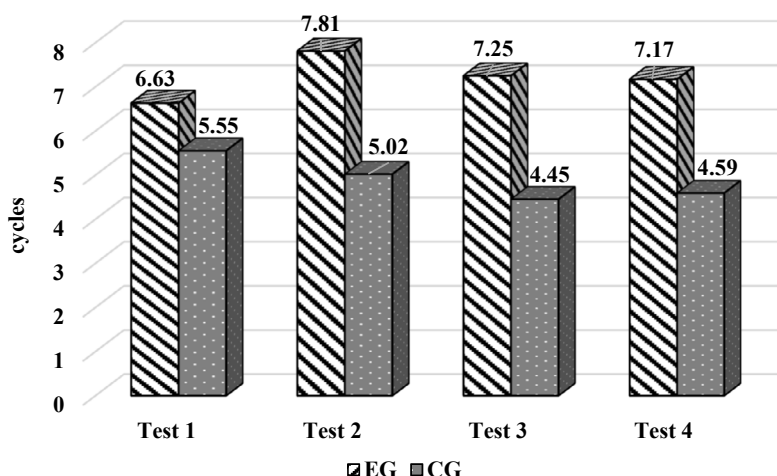


Figure 4. Average values of pupils of both groups at the post-intervention

The analysis shows that the empirical values of the t -criterion were higher than the critical one – $t_{critical} = 1.98$ (Table 8). This gives reason to reject the null hypothesis and accept the alternative hypothesis as true, according to

which the obtained differences in the empirical data between the two populations were due to factors acting regularly. In our case, this was the applied program, resulting in better results for the experimental group.

Table 8. Significance of the differences between the average levels of the indicators of pupils of both groups at the post-intervention

Indicators	Experimental			Control			Difference		Statistical significance	
	n_1	\bar{X}_1	SD_1	n_2	\bar{X}_2	SD_2	d	Cohen's d	t	Sig.
Test 1	48	6.63	1.67	44	5.55	2.41	1.08	0.510	2.52	.013
Test 2	48	7.81	2.67	44	5.02	1.41	2.79	1.090	6.19	.000
Test 3	48	7.25	1.98	44	4.45	1.04	2.80	1.310	8.34	.000
Test 4	48	7.17	1.67	44	4.59	1.34	2.58	1.300	8.13	.000

Note. $t_{critical} = 1.98$

At the post-intervention, the effect size between the two groups was compared. The analysis showed that it was *significant* in test 1, “Frontal kicking with legs and arms on the wall” – Cohen’s $d = .510$, and *large* in the other three tests – Cohen’s $d > .800$. This proves that the program in the Experimental group had a more significant impact on the development of the rhythmical abilities of the pupils.

DISCUSSION

This study has documented the impact of music-movement activities on developing rhythmic abilities in primary school-age children aged 10-11 years. It was found that the program based on basic gymnastics and folklore dances with musical accompaniment, improved the performance of the experimental group on the post-test measure compared to the control group. This indicates that the applied program is suitable for improving rhythmical abilities. Numerous previous studies have also suggested that music-movement programs might help children develop complicated motor abilities (Pollatou & Hatitaki, 2001; Zachopoulou et al., 2004). From a developmental point of view, children must experience rhythm in their bodies before they can successfully hear the rhythm in their minds (Levinowitz, 1998). The body must learn to respond to different kinds of music in early childhood, and this experience should be gained in real situations.

According to Gallahue (1996), using movement as a way to develop the elements of rhythm reinforces fundamental movement skill development and fosters an understanding and feeling for rhythm. Zachopoulou, Tsapakidou, and Derri (2004) point out that by practicing certain fundamental movements, children begin to understand the structural elements of rhythm and are able to express this understanding through coordinated move-

ments because moving to rhythm is an essential element of all coordinated movements. A number of authors (Palatnik & Abrahamson, 2018; Zachopoulou et al., 2003; Ntomali et al., 2021) are of the opinion that rhythmic activities can enhance student performance, support the curriculum, and promote a positive learning environment.

The study’s results correlate with those in the publications of other researchers working in this field. Similar findings were reported by Kazakova (2002) and Kuzmenko (2002), who emphasized the beneficial influence of gymnastic means on improving preschool children’s rhythmical abilities and coordination. Maksimova (2002) stated that the level of development of coordination abilities had the most significant influence on the course of mental processes. It was pointed out that during the experiment, using the means of gymnastics, fine motor coordination, the sense of rhythm, the ability to maintain balance, the coordination of movements, and a number of psychomotor manifestations had significantly improved.

Shoval et al. (2018) and Ismail, Chiat, and Farhana (2021) stated that classes with movement elements were more emotional, students had fun while learning, and thus improved their achievement. Other authors also believe that music-based activities support early childhood learning and development (Hallam, 2010; Hennessy et al., 2019), especially in the social and emotional domains (Bolduc, 2008; Ritblatt et al., 2019; Kirby et al., 2022).

In their study, Laure & Habe (2023) found that children attending rhythmic-motor activities synchronized their bodies with the rhythm better than their peers. According to them, the choice of music is particularly important; the more emphasized the rhythm, the easier it is for children to cope. It is of great importance for educators to consider the cultural and social environment in which

young children reside and to adapt musical-motor activities to it sensibly.

Gantcheva (2018a, 2018b), Gantcheva & Damjanovska (2017), Gantcheva, Videv, and Grigorov (2018), in the studies with the same test battery we used, concluded that people engaged in sports in which performance is associated with musical accompaniment, such as gymnastic disciplines, had better developed their rhythmical abilities than others.

CONCLUSIONS

The research aimed to study the effects of a musical-movement program with the means of basic gymnastics and folklore dances with musical accompaniment on the development of rhythmical abilities of primary school-aged pupils. We found that the activities had a positive effect on the development of the pupils' rhythmical abilities. The experimental group progressed more significantly in developing rhythmical abilities than the control group.

We can conclude that our study also supports the argument that activities in which the participants' actions are dictated by musical accompaniment play an essential importance in developing their rhythmic abilities. When we interpret the results, the positive effect can be attributed to both the choice of exercises and the choice of appropriate music.

Musical-movement activities play an essential role in the motor performance of primary school-age children. In the school education system, these are primarily classes with folklore dances and classes based on the movements and exercises of basic gymnastics. The positive effect of the developmentally appropriate music and movement program on rhythmical abilities could be implemented in primary school-age pupils' programs. Future studies should examine if the developmentally appropriate music-movement program can also positively influence other areas of children's development.

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