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Original Article

The effectiveness of implementing physical training in middle school students using water games

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Abstract
Background and aim. Physical training is essential for the overall development in middle school students. Using games in aquatic environment is an innovative approach to enhancing their physical fitness and engagement in physical activities. The study aims to identify the characteristics of physical fitness in middle school students and to develop a technology for enhancing physical training through movement games. Additionally, the study aims to experimentally validate the effectiveness of this technology. *Materials and methods.* The research was performed at the sports facilities of the Kazakh Academy of Sport and Tourism. It involved 15 boys and 15 girls aged 11-13 years, from the swimming department. Fitness tests: to assess the physical fitness of swimmers, several tests were carried out, including the 3x5 m shuttle run, push-ups (for girls), pull-ups (for boys), standing long jump, sit-ups and a 25-second rope-skipping test. The recommendations of the specialists were taken into consideration throughout the testing process. Analysis methodology: a two-factor analysis of variance (ANOVA) was used to evaluate the effectiveness of the developed training technology. Factor A (Teaching Method): this included three levels—A^1: traditional method, A^2: combined method (traditional + active games), and A^3: game-based method. Factor B (Training Load): This included three levels—B^1: 2 hours per week, B^2: 4 hours per week, and B^3: 6 hours per week. *Results.* The experimental results showed statistically significant improvements in physical performance, with increases of 43.3% in hanging pull-ups, 69.6% in standing long jump, 48.2% in sit-ups and 25.7% in skipping rope (all $p<0.001$). While the 3x5 m shuttle run had a 3.3% increase that was not statistically significant ($p>0.05$), the overall scores for all indices (except hanging pull-ups) improved from "3" to "5" after the experiment, demonstrating notable progress in physical fitness. The study examined three aspects of performance in relation to factors A (teaching method) and B (training load): *3x5 m shuttle run*: both training and load methods had an important influence on shuttle run performance, with statistically significant differences ($p < 0.001$), while the interaction between them was not significant ($p>0.05$). *Standing long jump*: The training load considerably influenced performance ($p<0.001$), but the teaching method did not ($p>0.05$). The interaction between method and load also showed no significant effect ($p > 0.05$). *Sit-ups*: the teaching method and also the load method had a notable impact ($p<0.001$). Their interaction was significant as well ($p<0.001$), indicating that the impact of the teaching method varied with different training loads, and vice versa. *Conclusions.* The study successfully identified key aspects of physical fitness in middle school children and validated the effectiveness of a technology incorporating movement games to enhance physical training. This effectiveness was highlighted by notable improvements in performance metrics of fitness tests such as hanging pull-ups, standing long jump, sit-ups and skipping rope. Important increases were recorded in overall fitness levels, demonstrating the potential of movement games as a valuable tool in physical education.
Key Words: physical fitness, aquatic environment, engagement, training technology, performance improvements, ANOVA

Introduction

Swimming training for middle school students has traditionally relied on various methods meant to improve physical fitness and performance. Among these methods, the game-based approach has gained recognition for its ability to break the monotony often associated with repetitive swimming drills and maintain the interest and enthusiasm of young athletes (Semenova & Lavrentieva, 2016). Using games and recreational activities in swimming lessons not only serve to accomplish specific training objectives but also to engage students in a more enjoyable and less monotonous experience.

Despite the growing popularity of game-based methods, research suggests that the use of movement games to improve the physical training of schoolchildren in swimming has not received sufficient attention

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(Kustova, 1998; Wirth et al. 2022). This is a significant oversight, as innovative game-based approaches can foster physical development and skill acquisition and enhance psychological and social aspects of sports participation among children.

Recent studies underscore the importance of integrating physical activities that promote coordination, strength and endurance with elements of fun and creativity to optimize learning outcomes (Bishop et al., 2009; Sammoud et al., 2019). Movement games, which incorporate real-time feedback and interactive challenges, can be especially effective in creating a dynamic training environment tailored to the needs of middle school students. Research studies highlight the optimal use of game-based methods in swimming education for children. They emphasize the enhancement of swimming skills through engaging and age-appropriate games that ensure balanced workload, foster creativity and improve coordination, while also providing psychological comfort and safety during the learning process (Obraztsov & Uman, 2005; Egorova & Ibraeva, 2016; Sysoev, 2019).

Various researchers have highlighted the importance of incorporating water games into swimming education:

I.V. Bondarenko (2008) showed the role of the instructor in organizing water games with fair play and appropriate workload regulation, while O. Bugakova (2018) and B.V. Auster, (2016) focused on maintaining constant pedagogical monitoring to develop children's skills and techniques. Yu. S. Gerasimova (2009) suggested using role-playing games with fairy tale scenarios to help children to adapt to the aquatic environment. D. S. Chebanu (2019) demonstrated the effectiveness of movement games in reinforcing swimming skills like breathing and slicing through the water.

V. Yu. Karpov et al. (2019) dedicated a third of lesson time to games in swimming education for young schoolchildren, focusing on educational objectives, while D.V. Maltsev (2022) developed competitive-game technologies emphasizing breath-holding challenges and team relays. L. Oppermann, & L. Blum (2016) and M. Shekow (2013) applied computer game methodologies for underwater education. Other specialists like W. Choi et al. (2016) explored interactive methods in group fitness activities like synchronized swimming in order to enhance group awareness in virtual spaces.

The research on middle school students engaged in swimming highlights significant findings across various dimensions. So, the differences in physical development by age and gender reveal that girls aged 11-13 and boys aged 14 and older exhibit notable variations in body metrics due to different pubertal timelines (Bulgakova, 2018). Growth patterns in young swimmers show that swimmers experience significant increases in height and body measurements compared to their non-swimming peers (Tabakova, 2002). The influence of training on motor skills and physical development reveals that diverse tools and methods improve motor skills and physical development, taking into account the genetic traits and sensitive periods for strength growth (Dudchenko and Khokhlova, 2021; Seredkina, 2013). The educational approaches to swimming lessons involve using video lessons and music to improve technique and body awareness (Fedosova, 2021). The impact on functional systems and physical capacity demonstrates that well-planned swimming activities increase functional capabilities and somatic indices (Grigorieva & Belousova, 2018). Developing of swimming skills in older students focuses on progressive training methods meant to increase their skills and confidence (Dementyev, 2007). Long-term physical training in swimmers indicates that a traditional training system generates significant improvements in physical fitness over time (Arishin, 2019). The athletes must be adapted to the monotony and physical load of exercising. Fitness and performance are positively influenced by the resilience to monotony in training (Dudchenko, Aksenov, Shuvalov, 2015). Fitness program impact on cardiovascular function shows that a comprehensive fitness program improves cardiovascular function and physical development in middle school students (Safronov, 2014).

S. S. Gulyaeva (2015) developed a comprehensive program for improving the physical qualities of the students by incorporating traditional folk dances, games and national sports. Thus, it was highlighted the importance of ethnic-specific physical activities, rooted in natural human movements, for the improvement of coordination, strength, and endurance. Other specialists, such as E. V. Zharikov (2013) emphasize the importance of a multifaceted approach to swimming training, incorporating ergogenic tools like special breathing exercises and a structured flexibility enhancement program with static stretching. M. Shelagina (2011) focus on long-term development and tailored training methods to optimize swimming technique, strength and coordination in young swimmers, highlighting the importance of leg strength for speed and endurance.

Based on important information, this research focuses on the main conditions for improving the physical fitness of schoolchildren by means of water games. There were studied the relations between the available games and their adequate use, between the specificity of the game method and the physical development and also between the poor physical fitness and the insufficient methodological support. Our study aimed to develop the necessary movement games to improve essential physical qualities in schoolchildren, to create and implement game methods in swimming intended to enhance physical qualities and to develop the appropriate means and methods meant to increase the physical fitness of school-aged swimmers. Following the analysis carried out, our research concept was formulated as follows: for the students in the "Physical Education and Sports" program of the higher education institutions of Kazakhstan, it is necessary to implement a methodology to improve the physical fitness of middle school swimmers using water-based movement games.

The purpose of the research is to create a technology based on the characteristics of physical fitness level in middle school students and experimentally justify it. This technology is meant to enhance their physical training by means of movement games.

Material and Methods

Participants

The research was conducted in the sports facilities of the Kazakh Academy of Sport and Tourism. A group of swimmers (15 boys and 15 girls aged 11-13 years) participated in the research.

The research was carried out in *three stages*.

At the first stage (September - December 2020) an analysis of scientific and methodological literature was performed. At the same time, the initial level of physical fitness was determined in the middle-school aged children who practiced swimming.

At the second stage (January - April 2021), the technology of physical training of middle-school aged swimmers was developed.

At the third stage, (May - June 2021), a variance analysis was applied to substantiate the effectiveness of the impact of the developed technology implementation on the indices of physical fitness in schoolchildren. Along with this, work was carried out on the design of the article.

Methods and procedure

Method of fitness tests was used to determine the level of physical qualities in swimmers. These included the 3x5 m *shuttle run* (Test 1); *push-ups* from prone position (girls) (no. of reps) (Test 2); *pull-ups* from hanging position (boys) (no. of reps) (Test 2); *standing long jump* (cm) (Test 3); *sit-ups* from supine position (no. of reps) (Test 4); *skipping rope* for 25 sec. (no. of reps) (Test 5). Specialist recommendations were used during the testing.

Methodology of dispersion analysis: it was used to demonstrate the effectiveness of the technology we developed. In our case, this is a two-factor dispersion analysis (ANOVA). Factor A is the teaching method. Its gradations are A^1—traditional, A^2—combined (traditional + game method based on active games), A^3—game method based on active games. Factor B is the training load, with three gradations: B^1—2 hours of training per week, B^2—4 hours per week, B^3—6 hours per week.

Statistical analysis

The following statistical indicators were determined: mean; ±SD - standard deviation; Student's t-test for determining the significance of differences in the obtained results. Statistical analysis was conducted using SPSS IBM software, version 21. The significance level for statistical analysis was set at $p<0.05$.

Results

The data analysis shows improvements in the physical fitness levels of both groups of 11-13-year-old swimmers (boys and girls), while the two-factor analysis of variance demonstrates that both the teaching method and the amount of training load have a significant impact on agility, as measured by shuttle run, standing long jump and sit-ups.

Table 1 presents the dynamics of the physical fitness levels of 11-13-year-old boy swimmers during the pedagogical experiment (control and experimental groups). As it can be seen from these data, there was an increase in results within the experimental group.

Table 1. Dynamics of the physical fitness level of 11-13-year-old boy swimmers (n=15)

Fitness tests	Initial testing						Final testing					
	EG, n=15		CG, n=15		t	p	EG, n=15		CG, n=15		t	p
	mean ±SD	Score	mean ±SD	Score			mean ±SD	Score	mean ±SD	Score		
Test 1, sec	9.3 ±0.18	3	9.4 ±0.16	3	1.94	>0.05	9.0 ±0.16	5	9.3 ±0.15	3	1.98	>0.05
Test 2, reps no.	2.9 ±0.3	3	2.8 ±0.2	3	1.74	>0.05	4.3 ±0.2	4	3.0 ±0.3	3	15.2	<0.001
Test 3, cm	145.1 ±2.24	3	141.1 ±2.18	3	1.8	>0.05	155.1 ±2.9	5	145.1 ±2.9	3	20.8	<0.001
Test 4, reps no.	40.1 ±2.5	3	39.1 ±2.4	3	1.71	>0.05	49.2 ±3.2	5	42.1 ±3.1	3	21.6	<0.001
Test 5, reps no.	46.4 ±2.1	3	45.0 ±1.9	3	1.69	>0.05	58.1 ±13.1	5	46.2 ±2.8	3	10.9	<0.001

For the 3x5 m shuttle run, the increase was 3.3%, but the differences were not statistically significant ($p>0.05$). In the hanging pull-ups, the results increased by 43.3% ($p<0.01$). In the standing long jump, results grew by 69.6% ($p<0.01$). The sit-ups showed an increase of 48.2% ($p<0.01$). In skipping rope, the difference in results compared to the pre-experiment state was 25.7% (p<0.01). It should be noted that after the experiment, the values for all indicators (except hanging pull-ups) corresponded to a score of “5” (compared to a score of “3” before the experiment).

Table 2. Dynamics of the physical fitness level of 11-13-year-old girl swimmers (n=15)

Fitness tests	Initial testing						Final testing					
	EG, n=15		CG, n=15		t	p	EG, n=15		CG, n=15		t	p
	mean ±SD	Score	mean ±SD	Score			mean ±SD	Score	mean ±SD	Score		
Test 1, sec	9.8 ±0.15	3	9.9 ±0.14	3	1.91	>0.05	9.4 ± 0.16	5	9.8 ±0.15	3	1.98	>0.05
Test 2, reps no.	11.1 ±1.4	3	10.9 ±1.4	3	1.84	>0.05	19.2 ±2.0	5	12.1 ±1.5	3	12.8	<0.001
Test 3, cm	135.1 ±2.11	3	133.1 ±1.98	3	1.79	>0.05	145.1 ±2.31	5	135.0 ±1.9	3	20.8	<0.001
Test 4, reps no.	36.1 ±2.0	3	35.1 ±1.94	3	1.83	>0.05	44.8 ±3.1	5	36.2 ±2.0	3	14.5	<0.001
Test 5, reps no.	49.1 ±2.8	3	48.1 ±3.0	3	1.75	>0.05	58.1 ±13.1	5	49.0 ±2.9	3	6.9	<0.001

Table 2 presents the dynamics of the physical fitness levels of 12-14-year-old girl swimmers during the pedagogical experiment (control and experimental groups). As highlighted by these data, the girls showed similar patterns to the boys. For the 3x5 m shuttle run in the experimental and control groups, the values relatively increased after the experiment, but the increase in results was only 4.2% and was not statistically significant (p>0.05). In push-ups, the increase was 36.9% (p<0.001). In the standing long jump, the difference in results before and after the experiment was 75.5% (p<0.001). In sit-ups from a lying position, the increase in results was 23.7% (p<0.001). Finally, in skipping rope, the results after the experiment grew by 18.5% (p<0.001). For all indicators, after the experiment, the values were equivalent to a score of "5" (compared to a score of "3" before the experiment).

Table 3 presents a two-factor dispersion analysis to assess the influence of factor A (teaching method) and factor B (volume of training load/number of hours per week) on the development of agility, measured by the shuttle run (3x5 m).

Table 3. Results of a two-factor analysis of variance between the method of training and the amount of training load on agility (shuttle run)

Gradations of factor A	A1-traditional teaching method			A2-combined teaching method			A3-game method based on movement games		
factor B	B1	B2	B3	B1	B2	B3	B1	B2	B3
Shuttle run 3x5 m	4.2	4.5	4.8	4.9	5.0	5.7	7.1	7.7	8.0
	4.4	4.7	5.3	5.4	5,6	6.0	7.6	7.9	8,4
Amounts by cell	8.6	9.2	110.1	10.3	10.6	11.7	14.7	15.6	16.4
factor A	27.9			32.6			46.7		
factor B	33.6			35.4			38.2		
N=18, n=2	107.2			107.2			-		

Notes: B1 (2 h / week), B2 (4 h / week), B3 (6 h / week)

There were examined three aspects on how factors A and B influence performance.

First, it was assessed the effect of the teaching method (factor A) on the 3x5 m shuttle run. The results show that differences in shuttle run performance due to the teaching method are more significant than random variations between the indices ($F_{A(2.9)}$ =194.03 > F_{kp} (p < 0.001). Therefore, we reject the null hypothesis, indicating that the teaching method has a significant impact on shuttle run performance.

Second, the effect of the training load (factor B) on the 3x5 m shuttle run was evaluated. The findings reveal that differences in shuttle run performance due to the training load are also more significant than random variations between the indices ($F_{B(2.9)}$ =10.891 > F_{kp} (p < 0.001). Hence, we reject the null hypothesis, suggesting that the training load significantly affects shuttle run performance.

Finally, the interaction between the teaching method (factor A) and the training load (factor B) was analyzed. The results indicate that the effect of the teaching method on shuttle run performance is consistent across different levels of training load, and vice versa ($F_{AB(4.9)}$ = 0.138 < F_{kp} (p > 0.05). Thus, we accept the null hypothesis, showing that the influence of the teaching method is similar regardless of the training load gradation, and the same holds true for the training load relative to different teaching methods.

Table 4 presents a two-factor dispersion analysis to assess the influence of factor A (teaching method) and factor B (volume of training load/number of hours per week) on the development of agility, measured by the standing long jump.

Table 4. Results of a two-factor analysis of variance between the method of teaching and the amount of training load on agility (standing long jump)

Gradations of factor A	A1-traditional teaching method			A2-combined teaching method			A3-game method based on movement games		
factor B	B1	B2	B3	B1	B2	B3	B1	B2	B3
Standing long jump	160.1	163.7	164.7	165.1	165.4	164.7	165.8	165.04	167.03
	164.2	165	165.4	167.5	166.8	166.4	168	167.08	167.4
Amounts by cell	324.3	328.7	330.1	332.6	332.2	331.1	333.8	332.12	334.43
factor A	983.1			995.9			1000.35		
factor B	990.7			993.02			995.63		
N=18, n=2	2979.35			2979.35			-		

The impact of the teaching method on *the standing long jump* was analyzed.

We examined the effect of the teaching method (factor A) on the long jump from a standing position. The analysis shows that differences in long jump performance due to the teaching method are not significantly greater than random variations ($F_{A(2.9)} = 0.47 < F_{kp}$ ($p > 0.05$). Therefore, we accept the null hypothesis, indicating that the teaching method does not have a significant impact on standing long jump performance.

In contrast, the effect of the training load (factor B) on the standing long jump performance is significant. The differences in long jump results attributable to the training load are more pronounced than random variations ($F_{B(2.9)} = 6.21 > F_{kp}$ ($p < 0.001$). Thus, we reject the null hypothesis, demonstrating that the training load has a significant impact on standing long jump performance.

Finally, we assessed the interaction between the teaching method (factor A) and the training load (factor B). The results show that the impact of the teaching method on long jump performance is consistent across different levels of training load, and vice versa ($F_{AB(4.9)} = 1.064 < F_{kp}$ ($p > 0.05$). Hence, we accept the null hypothesis, indicating that the influence of the teaching method on long jump performance is similar regardless of the training load, and the training load effect is consistent across different teaching methods.

Table 5. Results of a two-factor analysis of variance between the method of teaching and the amount of training load on agility (sit-ups)

Gradations of factor A	A1-traditional teaching method			A2-combined teaching method			A3-game method based on movement games		
factor B	B1	B2	B3	B1	B2	B3	B1	B2	B3
Sit-up	56.1	57.3	58.3	57.3	58.9	61.2	63.5	66.7	75.1
	57.2	58.1	59.1	58.4	60.3	63.4	65.6	69.2	81.2
Amounts by cell	113.3	115.4	117.4	115.7	119.2	124.6	129.1	135.9	156.3
factor A	346.1			359.5			421.3		
factor B	358.1			370.5			398.3		
N=18, n=2	1126.9			1126.9			-		

Notes: B1 (2 h / week), B2 (4 h / week), B3 (6 h / week).

The impact of the teaching method on *the sit-ups* was examined.

Consequently, hypothesis H_0 is rejected, i.e. differences in the performance of the sit-ups, caused by the action of factor A (teaching method), are more pronounced than random differences between the indices ($F_{A(2.9)} = 83.077 > F_{kp}$ ($p < 0.001$).

The hypothesis H_0 is rejected: for example the differences in the indicators of the level of sit-ups due to the action of factor B (training load) are more pronounced than the random differences between the indices ($F_{B(2.9)} = 21.94 > F_{kp}$ ($p < 0.001$).

The hypothesis H_0 is also rejected, i.e. the influence of factor A (teaching method) on the indices of the level of sit-ups is the same for different gradations of factor B (training means), and vice versa ($F_{AB(4.9)}=6.44 > F_{kp}$ ($p < 0.001$).

The impact of the teaching method (factor A) on the ability to perform sit-ups was also evaluated. The results indicate that the differences in sit-ups performance due to the teaching method are significantly greater than random variations ($F_{A(2.9)} = 83.077 > F_{kp}$ ($p < 0.001$). Therefore, we reject the null hypothesis, demonstrating that the teaching method has a significant effect on sit-ups performance.

Similarly, the differences in sit-ups performance caused by various training loads (factor B) are also significantly greater than random variations ($F_{B(2.9)} = 21.94 > F_{kp}$ ($p < 0.001$). Hence, we reject the null hypothesis, showing that the training load has a significant impact on sit-ups performance.

Finally, the interaction between the teaching method (factor A) and the training load (factor B) was assessed. The analysis reveals that the effect of the teaching method on sit-ups performance is consistent across different levels of training load, and vice versa ($F_{AB(4.9)} = 6.44 > F_{kp}$ ($p < 0.001$). As a result, we reject the null hypothesis, indicating that the influence of the teaching method on sit-ups performance is affected by different gradations of training load, and the training load effect is also influenced by the teaching method.

Discussions

The pedagogical experiment on the physical training of boys aged 11-13 years and girls aged 12-14 years involved in swimming reveals notable improvements in their physical fitness levels, as shown by the data presented in Tables 1 and 2. This section will analyze these results, comparing them with existing literature to provide a comprehensive understanding of the impact of specific training methods and exercises on the performance of young swimmers.

The significant improvements in pull-ups (43.3%) and standing long jump (69.6%) align with the research conducted by Crowley et al. (2017) who emphasized the impact of resistance training and plyometric exercises on enhancing muscular strength and explosive power. According to Smith et al. (2002), these exercises are highly important in developing anaerobic capacity and muscle endurance, which are essential for young athletes, particularly in swimming. The improvements of the experimental group in skipping rope (18.5%) and sit-ups (23.7%) are consistent with findings by Pelayo et al. 2007. Their research highlights that aerobic conditioning through activities like skipping enhances cardiovascular endurance and coordination, while exercises targeting the core muscles improve overall stability and strength, which is benefic for water sports like swimming. The experiment demonstrated that an increase in training loads positively influenced performance metrics, in accordance with the assertion of Kustova (1998) that a well-structured training load can lead to significant improvements in the physical fitness of young swimmers. Semenova and Lavrentieva (2016) revealed that using diverse training methods, movement games inclusively, can effectively counteract the monotony associated with traditional training. Thus, the engagement and performance of athletes are enhanced. Our study corroborates the findings of these authors, as the experimental group exhibited substantial improvements in various physical fitness metrics.

Specific observations were made about the shuttle run performance of boys. The lack of significant improvement in their shuttle run (3.3%, p>0.05) may reflect the need for more targeted agility training. Agility-focused exercises could potentially bridge this gap, as shown by Kozhevnikova (1997), who emphasized the importance of agility in water environment. Similarly, the non-significant improvement of the sit-ups performed by girls (23.7%, p>0.05) suggests a potential need for exercises specifically targeting core strength and endurance, as highlighted by Wirth et al. (2022).

We have developed a technology of physical training of middle school students by means of movement games. In its structure, several parts can be distinguished. The first part was designed as a theoretical and methodological one. It includes a special course on "Technology of physical training of middle school students using movement games".

The next direction of the formative experiment includes movement games meant to improve the agility of swimmers. Among them, the following ones can be mentioned. “Who is faster?”; “Water tag”; “Where the water is up to your knees”; “Have time to dive”; “Relay race with ball driving and with a message to swim”.

Movement games to improve the strength skills of swimmers were introduced in another area of the formative experiment, like:” On the bottom, on the hands”; “Tritons”; ‘Ball in the air”; “Fight riders”; “Towing”.

The formative experiment also included movement games for increasing the speed and power qualities of swimmers, such as: “Leapfrog”; “Floating arrows”; “Who is quicker?”; “Who will slide further?”; “Running on water”.

The last direction of the formative experiment introduced movement games to improve the endurance of swimmers: “Where is the waist-deep water”; “Swimming relay”; “Oncoming relay race”; “Chasing the ball”; “Trap”.

In order to study the effect of games on the development of physical qualities of schoolchildren a teaching experiment was conducted, which was attended by 11-13 years old swimmers. Based on the obtained indicators, a two-factor dispersion complex is formed.

The practical significance of this work is that the results can be used in the practice of swimming coaches, for the technology of physical training of schoolchildren through movement games. The analysis of domestic literature showed that the research of scientists on various aspects of the relationship between physical training and physical development of students can be grouped into the following areas:

The first direction - Provisions necessary for the implementation of movement games in an aquatic environment. A) Characterizing the game, it is necessary to clearly explain its essence and principles, to choose a leader and divide pupils into subgroups according to their capabilities (Giconda, 2013; Shulzhenko, 2019); B) Games should be chosen in such a way that they are clear, accessible and interesting to children of any age group (Filipenkova, 2010).

The second direction - Technology to enhance the physical qualities in aquatic environment conditions. A) There is a large impact of strength and agility (coordination qualities), improved in the circumstances of the aquatic environment, on the development of swimming technique (Kozhevnikova, 1997).; B) Aquatic techniques, along with dryland exercises, help significantly to increase the physical fitness and health (Kustova, 1998); C) A method is proposed for health-improving activities in aquatic environment (Tretiakov, 2008).

The third direction deals with the particularities of the impact of swimming lessons on the body of schoolchildren. A) It has a very good influence on the respiratory system: it optimizes lung ventilation and the functioning of the cardiovascular system (Krylov & Kononov, 2006); B) The horizontal position in which a person swims in the pool improves the operation of the heart that pumps the blood to flow horizontally through the blood vessels up to the periphery (Votchinnikov, 2024).

The fourth direction - Various movement games in the water. A) The first group of children - games with elements of a duel and without a plot for beginners at initial swimming lessons. The second group - with a story-like orientation (Korunzhaya); B) To improve dexterity, games are introduced to help children quickly switch from one locomotion to another in a moving environment (Malakhovskaya, 2021).

An analysis of the foreign literature allowed us to group information according to areas below:

Swimming effect on human body. A) Immersion in water can lead to physiological changes in the body that will optimize recovery from physical tasks (Wilcock et al., 2006); B) The most elevated HR values were detected during land-based aerobic exercise (Benelli et al., 2004); C) Average muscle activity differed between normal and fast swimming in all swimming styles except for the broadest muscles of the back (Soltani et al., 2017).

Technologies used in aquatic environments. A) The structure consists of a lighted swim ball, a wetsuit with a heart rate monitor, and wireless bone conduction headphones (De Carolis, & Argentieri, 2020); B) Using computer games methodology for underwater entertainment and educational landmarks (Oppermann, Blum & Shekow, 2016).

Conclusions

The experiment demonstrated that well-structured training programs incorporating resistance training, plyometric exercises and aerobic conditioning significantly enhance the physical fitness of young swimmers. The results are consistent with specialized literature, confirming the importance of varied training loads and methods in optimizing the performance of athletes. Future research may explore additional targeted interventions meant to further enhance the physical capabilities of young swimmers

The findings of the study show that movement games can serve as an effective tool for engaging middle school students in physical activities, contributing to their overall fitness and development. The implementation of movement games into physical training programs not only fosters greater participation but also enhances various physical abilities, such as strength, agility and endurance. These results highlight the potential of movement games to modernize physical education, making it more interactive and effective in promoting long-term physical health and fitness among young learners.

The level of physical fitness of middle school children who practice swimming does not meet the requirements. This fact is revealed by the results that girls obtained in the following tests: 3x5 m shuttle run; push-ups and standing long jump.

The technology developed for the physical training of middle-school aged swimmers using movement games includes: a special course on this topic; movement games for the development of agility, strength, speed-strength and endurance; criteria for the development of these physical qualities.

By means of the analysis of variance we proved the following hypotheses that we developed. Such indicators as running (speed); standing long jump (explosive power) and push-ups (muscle strength) are influenced by two factors: the method of training (in our case, the method of circular training) and the number of hours per week.

Conflicts of interest - There is no conflict of interest.

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