

Original Article

Using «Flipped Classroom» pedagogical technology in school physical education

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Abstract:

Research aim. The aim of our research was to test «flipped classroom» pedagogical technology in PE classes at school and evaluate its impact on improving the girls', aged 12, quality of life. **Materials and methods.** 30 girls aged 12 (experimental and control groups) took part in the study. In the control group, 3 PE lessons per week were conducted according to the traditional method. In the experimental group, two classes a week were conducted according to the traditional method, and in the organization and conduct of the third lesson (Wellness aerobics) in this group, the pedagogical technology «flipped classroom» was used. Blocks of thematic educational video materials were prepared for students' independent work, and cases of homework were formed. A progress check of all girls' body functional state was carried out according to Harvard step test and timed inspiratory capacity test indicators, heart rate at rest, and chest excursion. The girls' physical qualities were evaluated on the basis of motor tests results: running 30 m; shuttle running 3x10 m; running 6 minutes; standing long jump; bending forward while standing on a gymnastic bench; pull-up on a low crossbar. To determine the nature of girls' motivation for a school PE lesson, a survey was conducted. **Research results.** At the end of the experiment, all functional fitness tests values were significantly higher for girls in the experimental group: Harvard step test index increased by 21.9%, and in the control group by 0.4%. The heart rate decreased in the experimental group by 7.8%, in the control group by 2.4%, the chest excursion area of girls in the experimental and control groups increased by 33.3% and 11.3%, the timed inspiratory capacity test indicator value increased by 36.1% and 11.3%, respectively ($p < 0.05$). After the experiment, the physical qualities indicators values (speed, strength, coordination, endurance, speed-strength endurance, flexibility) were higher in the experimental group than in the control one ($p < 0.05$). Girls in the experimental group were more motivated to engage in physical education after the experiment. **Conclusions.** During the academic year, a pedagogical experiment was conducted to evaluate the effectiveness of various programs for organizing the educational process of physical education at school. The research results showed the effectiveness of innovative pedagogical technology «flipped classroom» use in organizing and conducting a school PE lesson, which is confirmed by the results of testing the experiment participants' functional fitness and motor qualities. At the research end, the girls in the experimental group showed significantly higher motivation for PE lessons and the indicators values of all test scores were significantly higher in the experimental group than in the control (engaged in traditional methods) one. Innovative pedagogical technology strengthens students' independent work skills, reduces the teacher's time to explain the educational material and increases the motor density of the lesson.

Key Words: physical education, school, pedagogical technology «flipped classroom», functional and physical fitness.

Introduction

One of the education system reform objectives in Russia is to improve the quality of teaching school subjects, including physical education (Schetina, 2014; Ulyanova, 2015).

Scientific research results indicate insufficient physical activity of schoolchildren and their significant health (Chekhovska et al., 2020; Bakiko et al., 2020) and physical fitness (Gerber et al., 2017; Zhamardiy et al., 2020) deterioration. There is a decrease in students' interest in PE classes and the need to maintain a healthy lifestyle (Cezary Kuśnierz, et al., 2020; Stepanov, 2019). Overweight is registered in 12-19% of children, 5% have high blood pressure, and 12% have hypercholesterolemia (Tikhomirova et al., 2019). The number of schoolchildren with spinal pathology is increasing (Metalnikov, et al., 2020). The level of inactivity among adolescents is 50-70% (Solodkov, 2011). The subject «physical culture» (Karol Görner, 2020; Kolokoltsev, 2020) plays an important role in improving students' quality of life and motor activity.

The key element of physical education at school is the school PE lesson structure and content, ways of organizing students' theoretical and practical activities. Methods of building an effective lesson are based on the teacher's different pedagogical technologies use and students' educational actions performance.

One of the forms of teaching at school effectiveness improving is the use of pedagogical technology «flipped classroom», aimed at involving students in active learning activities. American chemistry teachers Jonathan Bergman and Aaron Sams (2012) proposed in 2007 «flipped classroom» pedagogical technology for students who often miss classes. This technology provides for independent acquaintance and the theoretical material of the lesson study at home using Internet tools. Currently, this technology is effectively used in teaching other school subjects (Wulfovich, 2017). Using «flipped classroom» technology in the educational process develops students' cognitive abilities, activity, independence, creativity, critical thinking, communication skills, cooperation, leadership and responsibility.

The effectiveness of existing traditional physical education curricula in educational institutions remains low (Drachuk et al., 2018; Furman et al., 2018). Analysis of modern literature has shown that the system of school physical education requires innovative changes, mainly in the methodology of PE lessons building. One of the most effective ways to solve this problem can be considered the purposeful use of new means and methods of studying subjects in schools based on information and communication technologies.

Currently, the interactive learning methods use in physical culture (Ashanin, et al., 2018) and sports (Philipp Born, et al., 2018; Karaulova, et al., 2018) increases the training process effectiveness. The multimedia training tools use motivates students to perform educational activities, improves educational, cognitive and informational competencies, and develops curiosity and thinking (Abramenko, 2018).

Physical education and sports have a positive impact on students' health and physical fitness. One of motor activity types that can be used in PE classes is Wellness aerobics (Mishchenko, 2019; Pesina & Mishchenko, 2019). The pace and rhythm of performing physical exercises in aerobics have a positive effect on the human cardio-respiratory system state (Cooper, 2013), especially if it is accompanied by music.

There are no materials in the literature about the use of «flipped classroom» pedagogical technology in the health-improving aerobics lesson at school. The study of this issue allowed us to form the aim of our work and conduct a pedagogical experiment, the results of which allowed drawing conclusions.

Research aim is to test «flipped classroom» pedagogical technology in PE classes at school and evaluate its impact on improving the girls', aged 12, quality of life.

Material & methods

The research work was carried out on the basis of secondary school № 13 in Chelyabinsk (Russia) in two stages: preparatory (May - August 2018) and experimental (September 2018 - May 2019).

Two groups of girls aged 12 took part in the research. There were 15 children (girls) in the experimental and control groups. In the training sessions plan, 102 hours per year were allocated for mastering the program material on «Physical culture» subject at the rate of 3 hours per week for 45 minutes. In the control group, lessons were conducted according to the traditional method, according to the comprehensive program of students' (1-11 grades) general physical training (Lyakh, Zdanevich, 2013).

In the experimental group, two classes a week were conducted according to the traditional method. The organization and conduct of the third lesson in this group, as a variable one, was carried out on the basis of «flipped classroom» pedagogical technology with health-improving aerobics use. We used a system of class-and-lesson classes with elements of distance learning. At the first stage of the pedagogical experiment (preparatory), we conducted a search and analysis of scientific and methodological materials on our research topic. For the experimental group, we prepared educational video materials blocks and Internet links for learning basic exercises in aerobics, formed cases of homework with teacher recommendations. Using visual content, students could learn about the history and types of aerobics, safety measures in the classroom, and the healthy lifestyle basics. At the second stage (experimental) in both observation groups, a progress check of the girls' physical and functional fitness was carried out. We studied the girls' interest in school PE lessons. They were offered to answer the question «For what purpose do you attend PE classes?» with different answer variants.

At the variable lesson of health-improving aerobics, the girls of the experimental group performed exercises continuously using the stream method in 4 approaches for 8 counts to music. The recommended heart rate during warm - up sessions is 100-130 beats/min, and during the aerobic part - 150 beats/min.

The motor density of the lesson using «flipped classroom» technology increased by reducing the time for explaining and showing exercises by the teacher. The experimental aerobics lesson structure is presented at Table 1.

Table 1. The experimental aerobics lesson structure

The section contents	Basic exercises	Organizational and methodical instructions
Preparatory stage		
<i>Direction – warming-up (5–10 min)</i>		
Body parts' local movements	Head turns, bends, circular movements of the shoulders, exposing the leg on the toe, foot movements	Movement rate - from low to medium, small range of motion
Combined movements for large muscle groups	Half-squats, lunges, torso movements, options for steps in place and with movements in combination with hand movements	Exercises on the coordination to perform at an average pace with the amplitude increase
Flexibility developing exercises	Stretching the lower leg muscles («stretch»), the front and back of the	Perform at a slow and medium pace in a standing position with hands on hips
Basic stage		
<i>Direction – aerobic (25-30 min)</i>		
Aerobic warming – up 3-10 min	Basic elements and complication of movements, walking options with hand movements	Learning dance combinations at a medium pace on the spot
«Aerobic peak» 15-20 min	Aerobic steps dance combinations and their variants, running, jumps in combination with hand movements	Performing blocks of exercises on the spot and with movements in different directions, increasing the load due to coordination complexity, amplitude and
Aerobic «cooling-down» 2-3 min	Basic elements, walking options with decreasing hand motions amplitude	Decreasing motions amplitude and tempo
<i>Direction – loading decrease, «first cooling-down» (up to 2 min)</i>		
Exercises for the whole body	Amplitude movements of the arms, flexion and extension of the torso with hands on hips support	Movements are performed in a leg apart stance, lunge and half-squat, combined with breathing, the pace of movements slows down
<i>Direction – exercises for strength developing, «callisthenics» (5–10 min)</i>		
Exercises for body muscles	Exercises in the supine position for strength and strength endurance of the abdominal and back muscles	Perform one to three series (sets) of 10-16 repetitions. You can use exercises with weights, expanders and on
Exercises for thigh muscles	Exercises in the supine position for the strength endurance of the adductor and abductor muscles of the thigh	simulators
Exercises for arms and shoulder girdle muscles	Options for arms flexion and extension from various starting positions	
End stage of the lesson		
<i>Direction – loading decrease, «second cooling-down» (2–5 min)</i>		
Exercises for flexibility developing («deep stretch»), general cooling-	Stretching the muscles of the front, back, and inner thighs, lower legs, chest, arms, and shoulder girdle	In different starting positions, slowly, with poses, fixation and subsequent relaxation

Before and after the experiment, all the girls' body functional state was studied using Harvard step test, and the heart rate at rest, chest excursion, and hypoxic timed inspiratory capacity test were determined.

The girls' physical qualities were evaluated on the basis of motor tests results: running 30 m (sec); shuttle running 3x10 m (sec); running 6 minutes (min); standing long jump (cm); bending forward while standing on a gymnastic bench; pull-up on a low crossbar (number of times).

The study does not infringe on the rights or endanger the girls' well - being in accordance with the ethical standards of the Human Rights Committee of the Helsinki Declaration of 2008 (WMA Declaration of Helsinki-Ethical Principles for Medical Research Involving Human Subjects).

The parents' consent to the examination of the children was obtained. Mathematical statistics methods were used in the work. The assessment of the significance of differences was determined by the Student's t-test.

Results

A comparative assessment of girls' aged 12 functional fitness before and after the pedagogical experiment is presented in Table 2.

Table 2. The girls' functional state indicators values before and after the experiment (M±m)

Functional indicators	Control group (n=15)		Experimental group (n=15)	
	Before the experiment	After the experiment	Before the experiment	After the experiment
Cardio-vascular system				
Harvard step test index (points)	65,6±0,9	67,2±1,0	64,8±0,8	79,0±1,2*
Heart rate at rest (bpm)	75,9±1,1	75,6±1,2	74,4±1,2	68,6±1,4*
Respiratory system				
Chest excursion (%)	13,9±0,3	14,3±0,4*	14,4±0,4	19,2±0,3*
Timed inspiratory capacity test (sec)	34,4±1,9	38,3±2,0	34,9±1,9	47,5±3,0*

Note. * significant difference of tests indicators values after the experiment ($p < 0,05$)

As can be seen from Table 2, the indicators values of all functional fitness tests of girls in the experimental and control groups increased at the end of the experiment. These indicators values were significantly higher in girls in the experimental group: physical performance according to the Harvard step test index increased by 21.9%, in the control group by 0.4%. The heart rate decreased in the experimental group by 7.8%, in the control group by 2.4%, the chest excursion area of girls in the experimental and control groups increased by 33.3% and 11.3%, respectively, and the timed inspiratory capacity test value increased by 36.1% and 11.3%, respectively.

After the experiment (Table 3) there was a significant increase in the indicators values of all girls' in the experimental group physical fitness tests ($p < 0.05$).

Table 3. The girls' physical fitness indicators values before and after the experiment (M±m)

№	Motor tests	Control group (n=15)		Experimental group (n=15)	
		Before the experiment	After the experiment	Before the experiment	After the experiment
1.	Running 30 m (sec)	5,8±0,3	5,6±0,2	5,9±0,3	5,1±0,2*
2.	Shuttle running 3x10 m (sec)	8,4±0,2	8,8±0,3	8,5±0,2	7,8±0,4*
3.	Running 6 minutes (min)	987±92	1110±103	975±88	1240±119*
4.	Standing long jump (cm)	169,5±1,4	172,0±1,6	170,2±1,2	189,0±1,7*
5.	Bending forward from a standing position (cm)	1,2±0,3	1,8±0,2*	1,4±0,4	2,2±0,3*
6.	Pull-up on a low crossbar (number of times)	3,8±1,1	5,0±1,7	3,9±1,0	6,4±1,8*

Note. * significant difference of tests indicators values after the experiment ($p < 0,05$)

In the girls from the control group, a statistically significant increase in the indicators values was noted only in one test for flexibility – «bending forward from a standing position».

The results of the girls', aged 12, physical qualities study indicate a higher indicators value of speed (test 1), coordination ability (test 2), endurance (test 3), speed and strength endurance (test 4), flexibility (test 5) and strength (test 6) in the experimental group, compared with the results of testing girls in the control group (Fig.1).

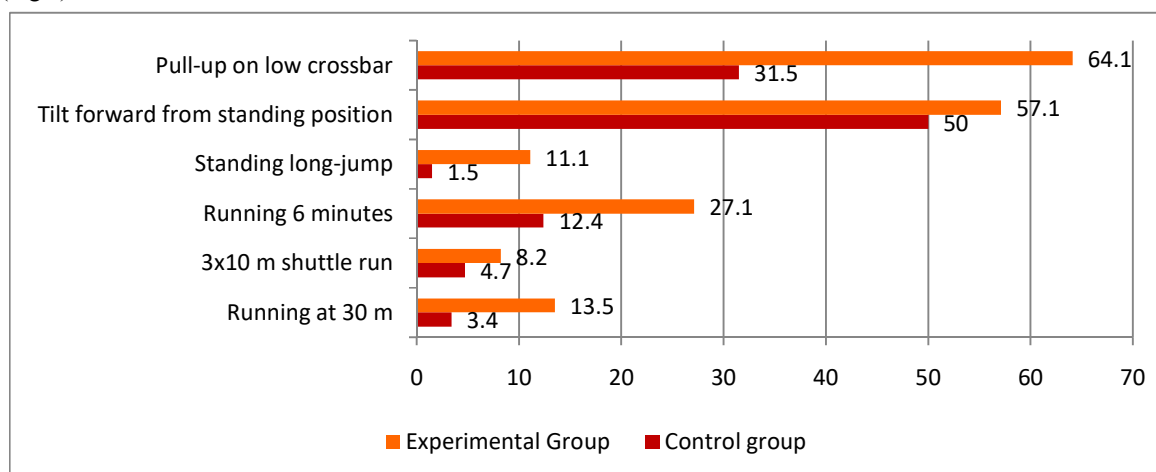
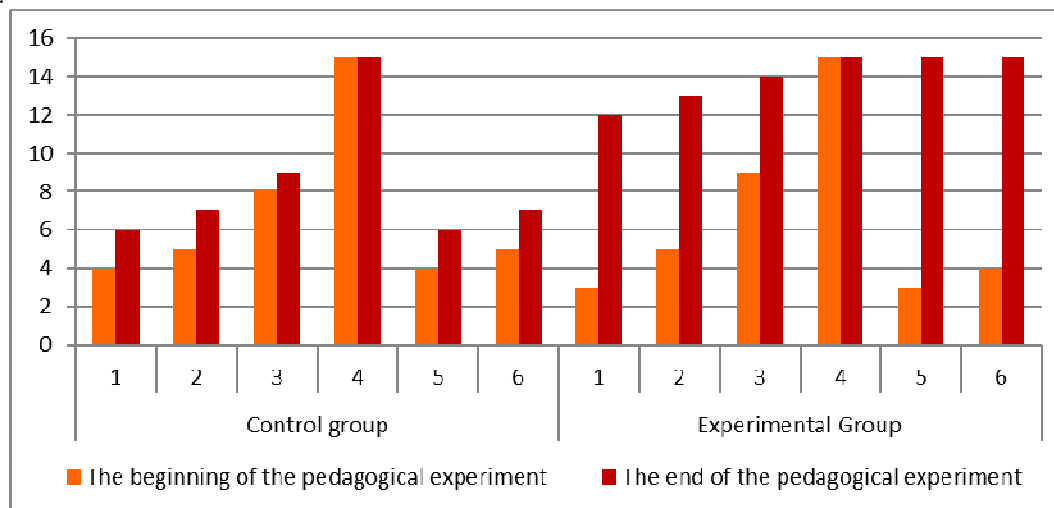


Fig. 1. Increase in the physical fitness of girls EG and CG of the experiment (%)

At the end of the experiment, the greatest increase in physical fitness indicators values was observed in girls from the experimental group: 64.1% in test 6, 57.1% in test 5, and 27.1% in test 3.

In order to identify interest and motivation for PE lessons, a mid-term survey of the girls, aged 12 was conducted. It was suggested to choose the answers to the question «For what purpose do you attend PE classes?» (Fig.2).



Note: 1, 2, 3, 4, 5, 6 - answer numbers: 1. Develop your physical qualities; 2. Becoming healthy, getting less sick; 3. Relax, have fun; 4. So that there are no missing lessons; 5. Have slender and beautiful body; 6. The lesson is interesting

Fig. 2. Results of the girls' questionnaire (number of girls)

As can be seen from Figure 2, the girls in the experimental group were more motivated to engage in physical education after the experiment. We believe that the use of «flipped classroom» pedagogical technology in the aerobics lesson had a positive impact on increasing the students' interest.

Dicussion

PE classes system effectiveness improving perfection in educational institutions continues to be relevant (Kolumbet, & Dudorova, 2016), it confirms the aim-setting of our chosen research topic. It is known that one of the reasons for the low effectiveness of PE lessons in school is the lack of students' motivation (Drachuk et. al., 2018; Furman et. al., 2018). Therefore, a number of researchers offer different pedagogical technologies for schoolchildren's physical education. There are works on increasing fitness technology use in school physical education (Zhamardiy et. al., 2020), GB-HIIT interval training (Segovia, Gutiérrez, 2020), and increasing the number of extracurricular activities (Talović et. al., 2015; Mischenko et. al., 2020).

Our use and testing the innovative pedagogical technology «flipped classroom» in conducting a school PE lesson turned out to be more effective than the traditional form of organizing school classes. This is consistent with the results of secondary educational institutions students' survey in in Spain, whose responses showed increased interest and motivation in non-traditional forms of physical education that can increase their motor activity (Zorio-Ferreres et. al., 2018).

The results of testing the physical health and functional capabilities of students whose PE classes were conducted using «flipped classroom» pedagogical technology were higher than those of girls who were engaged in the traditional program. This is consistent with the positive results of foreign language teachers' study (Wulfovich, 2017) and military school cadets' physical education (Sorokin et. al., 2016).

During our pedagogical experiment, the resting heart rate of girls in the experimental group significantly decreased by 7.8% ($p < 0.05$). This indicates an increase in the reserve capacity of their cardiovascular system as a result of the body's adaptation to physical loadings, which does not contradict the research results by other authors (Svyatova et.al., 2018). Confirmation of the fact of economizing the cardiovascular system activity is an increase in the value of the motor test for general endurance. According to the results of our study, the value of the indicator of girls aged 12 in the test «running 6 minutes» was 2 times higher in the experimental group, compared with the control one.

Hypoxic timed inspiratory capacity test allows evaluating aerobic capabilities of the human body when performing physical work. After the experiment, the time of breath retention in the timed inspiratory capacity test increased in girls of the experimental group by 36.1 %, which is 3 times more than in the control one.

Thus, the results of cardiovascular, respiratory systems positive indicators and physical fitness dynamics, as well as girls' aged 12 increased motivations to engage in physical culture indicate that conducting a school lesson using the proposed and tested «flipped classroom» pedagogical technology turned out to be more effective than conducting a lesson on the traditional form of physical education.

Conclusions

During the academic year, a pedagogical experiment was conducted to evaluate various programs effectiveness for organizing the educational process of physical education at school. To increase girls' aged 12 motivation for motor activity, functional and physical fitness, the innovative pedagogical technology «flipped classroom» was tested in the organization and conduct of a school PE lesson using recreational aerobics.

The effectiveness of using the innovative pedagogical technology «flipped classroom» in the organization and conduct of school PE lessons is confirmed by the positive results of our research.

After the experiment, the functional fitness and motor tests indicators values (speed, strength, coordination ability, endurance, speed and strength endurance, and active flexibility) in the girls of the experimental group were significantly higher than in the girls of the control one, who had PE lessons conducted according to the traditional method. The girls in the experimental group became more motivated to exercise.

This technology strengthens students' independent work skills, reduces the teacher's time to explain the educational material, and increases the motor density of the lesson.

We believe that further study of «flipped classroom» pedagogical technology use effectiveness is promising in the system of training and education of young people and conducting a modern physical education lesson at school to improve the quality of life and motivation for motor activity of the younger generation.

Conflicts of interest. The authors declare no conflict of interest.

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