Optimization of operational control in physical education using digital technologies based on heart rate indicators

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Abstract

Objective of the study is to substantiate the capabilities of digital tools in improving the operational control of physical activity during physical education classes.

Methods and structure of the study. The study involved girls and boys aged 15-16, who were students of the 10th grade, school GBOU No. 1505 "Preobrazhenskaya". The experiment took place within 5 months within the framework of the Athletics and Skiing blocks. The students were divided into control and experimental groups, in which the contents of the warm-up and the main part of the lesson differed. With the help of a fitness bracelet, the pulse of students was recorded, and using the formulas for the pulse value of exercises, the level of optimal load for each student was calculated.

Results and conclusions. The content of the exercises in the experimental group were more optimal and effective than in the control group. Fitness gadgets are an effective tool for teachers to optimize operational control in physical education lessons.

Keywords: *operational control, fitness gadget, heart rate.*

Introduction. Pulse plays an important role in physical exercises, as it allows to determine the level of load in a timely manner, analyze the recovery time of the body of the person engaged [9]. In this regard, it is extremely important to keep a pulse chart during a physical education lesson. A pulse chart, which is determined by pulse diagnostics, is a method of operational control in physical education lessons in comprehensive schools [4]. Today, a fitness gadget is a relevant tool for measuring pulse.

Objective of the study is to substantiate the capabilities of digital tools in improving the operational control of physical activity during physical education classes.

Methods and structure of the study. The educational experiment was conducted at the State Budgetary Educational Institution of Moscow, School No. 1505 Preobrazhenskaya, as part of physical education lessons. The study involved 60 10th-grade students, divided into control (CG) and experimental (EG) groups using the randomization method while maintaining sample homogeneity by key parameters: age (15-16 years), level of physical fitness (based on the results of preliminary testing), gender composition (15 girls and 15 boys in each group). Both groups studied according to the standard program of V.I. Lyakh, corresponding to the current Federal State Educational Standard.

During the lesson, the following indicators were recorded using the Huawei band 6 fitness bracelet:

- Heart rate (HR) – at 5-second intervals.
- Duration of the exercise (active work time, pauses).
- Distance traveled (taking into account GPS data).
- Intensity of physical activity (calculated using the metabolic equivalent – MET).

Classes in the CG were conducted according to a standard plan without using data from fitness bracelets. In the EG, the teacher adjusted the load based on the analysis of data from the devices, which consisted of the following:

- individualization of tasks (selection of exercises taking into account the students' heart rate zones).

• optimization of the duration of lesson stages (warm-up, main part, recovery) based on the average values of the group's heart rate.

The pulse cost of the exercise (PCE) was calculated using the formula:

$$\frac{\text{PSU} = \text{Average heart rate} \times \text{Execution time (min)}}{1000}$$

For example:

A student ran for 10 minutes with an average heart rate of 140 bpm → PSU = 1.4. The standard for tenth-graders: 1.2–1.6 PSU per lesson. Corrective measures were taken: students with PSU<1.2 were given additional homework (e.g., a 15-minute warm-up monitored via a bracelet). Students with PSU>1.6 had their intensity reduced in the next lesson. Students received visualized reports (HR graphs, distance traveled, intensity zones achieved) to understand their results. The teacher also analyzed the rate of heart rate decrease after exercise (according to the pulse chart). If the heart rate dropped to the norm (>3 minutes), the proportion of aerobic exercise was reduced in the next lesson. Rapid recovery (<2 minutes) served as a signal to increase intensity.

The PSU results were used to assess energy expenditure and plan subsequent lessons. An example of a pulse chart for one of the students is shown in the figure.

In the main part of the lesson, the EG and CG performed the Cooper test - running, after which they studied according to the curriculum - track and field.

As part of the operational control, testing of the participants in the pedagogical experiment was conducted. The Student t-test (or t-test) was chosen as the method for testing the hypothesis. The results of

Pulsegram of student 1

the initial testing of the participants in the pedagogical experiment showed that the differences in all parameters between the groups are insignificant, which indicates the same level of physical development, therefore, confirms the homogeneity of the sample. All students completed the track and field block for one and a half months. The control group studied mainly short-distance running: 30, 100, 200, and 500 meters.

Results and conclusions. The results of the experiment showed that the CG program had little effect on the work of the heart muscle.

At the same time, the EG revealed that the average pulse of the participants decreased significantly, the average indicator of the distance covered did not in-

Table 1. Test results (Cooper Run Test) of the control group at the beginning and end of the experiment

Indicator	Results at the beginning of PE	Results at the end of the PE	Student's t-test	Reliability of differences, p
Pulse, bpm	137 ± 7	136 ± 8	1,9	> 0,05
Distance, m (Cooper test, running)	2508 ± 286	2541 ± 667	2,6	> 0,05
Pulse value	666 ± 41	646 ± 33	0,4	> 0,05

Table 2. Results of the experimental group at the beginning and end of the experiment

Indicator	Results at the beginning of PE	Results at the end of the PE	Student's t-test	Reliability of differences, p
Pulse, bpm	135 ± 9	130 ± 8	8,4	> 0,05
Distance, m (Cooper test, running)	2481 ± 252	2548 ± 325	1,9	> 0,05
Pulse value	660 ± 27	618 ± 50	2,8	> 0,05

crease significantly (Table 2). Both of these indicators significantly affected the pulse cost parameter of the exercise, therefore, it can be concluded that the program of the experimental group had a positive effect on the level of endurance, as well as mild hypertrophy of the cardiac ventricles, since the stroke volume became higher.

Conclusion. The use of a digital device designed to assess pulse rates during physical activity helps to increase the efficiency of operational monitoring of the physical condition of those involved, and to correct the volume of the load and its intensity.

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