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Research Article

FORMATION OF STUDENTS' NATURAL SCIENCE LITERACY AND DEVELOPMENT OF NON-STANDARD PHYSICS TASKS BASED ON PISA

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ABSTRACT

The article discusses the methodology and results of the application of non-standard tasks (PISA) in teaching physics in secondary school.

KEYWORDS

PISA, non-standard tasks, pedagogical experiment, national program.

INTRODUCTION

Today, in the process of large-scale reforms carried out in our country, the main attention is paid to the fundamental reform of the education sector and the phased implementation of the tasks provided for by the Law "On Education". The reforms envisaged in the system of continuing education are based on the tasks of "Developing and implementing comprehensive mechanisms for the mutual integration of continuing education with science and industry." In the full implementation of the tasks set before us, the stated goals and objectives are "Strengthening the material, pedagogical and information base of educational institutions, providing the educational process with high-quality educational literature and advanced pedagogical technologies.".

In accordance with Resolution No. PF-5538 of September 5 "On additional measures to improve the public education management system", by 2030

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Uzbekistan will enter the top 30 advanced countries in the world according to the PISA (The Program for International Student Assessment) rating, the first step towards entering the country has been taken.

What is PISA and who participates in it? PISA is an international research program organized by the Organization for Economic Cooperation and Development (OECD). PISA was first held in 2000 and has been held every 3 years since then. This study evaluates the literacy of 15-year-old students in reading, mathematics and science.

The process of pilot testing of the PISA study is carried out electronically on a computer. In the process, in Uzbekistan, students aged 15 years and 3 months and 16 years and 2 months complete test tasks evaluating them in 4 areas: mathematical, natural science, reading literacy and imaginative thinking. After the experiment, students fill out a questionnaire, as well as a school questionnaire from selected school leaders and a special questionnaire from parents.

Examples of tasks designed to assess students' mathematical, natural science and reading literacy:

Tasks on the topic "The structure of matter"

Task 1. Drone racing

Drone racing is a drone race. Drones are racing to the finish line at speeds over 100 km/h. The drones are controlled by racers using special virtual reality glasses and a remote control controller. In such competitions, not only the maximum speed is required. You need to reach the finish line first, overcoming all obstacles and flying through checkpoints – special highlighted sections of the track. To do this, you need to feel the size of the drone in order to guide it between obstacles, maneuver correctly, and fit into a sharp turn. It's like a computer game that actually happens.

Fig.1.

There is a limitation in drone racing: the distance between the rotors of diametrically opposite motors should not exceed the set value.

The most popular drone classes range from 210 to 250 mm. The number of engines is usually not regulated, but almost all pilots fly quadrocopters – this is the optimal solution in terms of power, weight and aerodynamics. At the same time, the flight time of racing drones is small and averages 3-5 minutes.

Question 1: Two friends are going to participate in drone racing. The guys are determined to win and have formulated the problems that need to be solved before the competition. Which of the following questions will the students be able to answer using natural science methods? Choose all the correct answers.

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a. What color should the drone body be painted in order for the audience to like it?
c. What should be the capacity of the quadcopter's battery to fly the entire race distance?
c. Is it possible to increase the size of the propellers if the power of the electric motor is changed?
d. Can schoolchildren participate in the races of the Uzbek Drone Rating League?
e. Is it possible to use video equipment that gives an image delay of up to 20 milliseconds if the drone is supposed to accelerate to 100 km/h?
Answer: B, C, E.

Question 2: Estimate the possible length of the route for drone competitions. Give the calculations.
Answer: drones fly for 3-5 minutes. at a speed of 100 km/h. Therefore, the length of the route is approximately 5-8 km.

Question 3: Unmanned aerial vehicles are airplanes, helicopters, balloons or drones that are piloted remotely by an operator or completely automatically. For many years, the most popular use of drones has been military operations. Today, the boundaries of their activities have been expanded for drones. And the training of drone operators usually begins with drone racing. Give at least three examples of a quadrocopter to fly the entire race distance?
c. Is it possible to increase the size of the propellers if the power of the electric motor is changed?
d. Can schoolchildren participate in the races of the Uzbek League drone rating?
e. Is it possible to use video equipment that gives an image delay of up to 20 milliseconds if it is supposed to accelerate the drone to 100 km/h?
Answer: B, C, E.
Answer: Examples of the use of unmanned aerial vehicles:
1) for aerial video shooting;
2) for the delivery of online purchases in a contactless way;
3) for conducting meteorological observations;
4) to extinguish fires;
5) for traffic/cargo monitoring.

Task 2. The spread of odors. On a long winter evening, two friends Muhammad and Islam decided to conduct an experiment. Muhammad measured the air temperature in the room, took an air freshener and sprayed it from the far corner of the room. Islom, being in the opposite corner, turned on the stopwatch at the same time. When Islom smelled the air freshener, he turned off the stopwatch. After that, the friends aired the room well. Muhammad measured the temperature again – it turned out to be lower than the temperature of the air in the room during the first experiment. By repeating all the same actions as in the previous case, the friends got a different time.

Question 1: Choose the correct statement.
A. Friends studied the dependence of the speed of propagation of the smell of an air freshener on the aggregate state of a substance
B. Friends studied the dependence of the speed of propagation of an odor on the temperature of the air in the room.
C. The distance to which the smell of an air freshener spread during two experiments changed.
d. With a decrease in the temperature of the air in the room, the speed of odor propagation increases.
Answer: B

Question 2: After ventilating the room again and measuring the temperature, the guys changed the air freshener to mom's perfume. The air temperature for the third experiment was the same as in the second experiment. After doing the same, the friends got a new time for the smell to spread. In order to determine which smell spreads faster, Muhammad suggested comparing the results of the first and third experiments, and Islam – the second and third experiments. Which of the guys is right? Explain your answer.

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Answer: Island. In order to determine the dependence of one quantity (the rate of odor propagation) on another (the kind of odorous liquid), it is necessary that the other parameters of the experiment be the same (temperature, distance). The distance in all three experiments was the same, and the temperature was the same in the second and third experiments, so the Island is right.

Tasks on the topic "Interaction of bodies"

Task 1. Buses

The bus is traveling on a straight road. The driver named Peter put a glass of water on the dashboard. Suddenly, Peter abruptly presses on the brakes.

Question 1: What is most likely to happen to a glass of water?

a. The water in the glass will remain in a horizontal position.

c. The water will pour out from side 1.

c. The water will pour out from side 2.

d. The water will spill, but it is impossible to determine whether it will pour out from side 1 or 2.

Answer: From

Question 2: Peter's bus, like most buses, uses gasoline as fuel. Such buses pollute the environment. Trolleybuses are used in some years: they are powered by an electric motor. The electrical voltage required for the engine is supplied via power lines (like electric trains).

Electricity is generated at power plants using fossil fuels. Proponents of using trolleybuses in cities say that this type of transport does not pollute the environment. Are the trolleybus supporters right in their judgments? Explain your answer.

Answer: No, because power plants also pollute the environment.Yes, but this applies only to the city, the stations themselves, nevertheless, pollute the environment.

We know that the pedagogical experiment is a key method of scientific research in education aimed at testing hypotheses, studying and evaluating various techniques and innovations. The purpose is to analyze the results of the pedagogical experiment, identify the main trends and provide recommendations for improving the educational process.

First of all, in the experimental year, during the practice, a search experiment was conducted, during which methodological techniques for using new technologies were worked out, a methodology for setting up an experiment was developed, the depth in the volume of the pre-experimental and post-experimental sections were determined, and a number of other small private methodological issues were resolved.

They used everyday tools, a textbook and a classical method. The proposed technologies were used in the experimental class. The presentation of the material was conducted in accordance with the teaching methodology developed by us.

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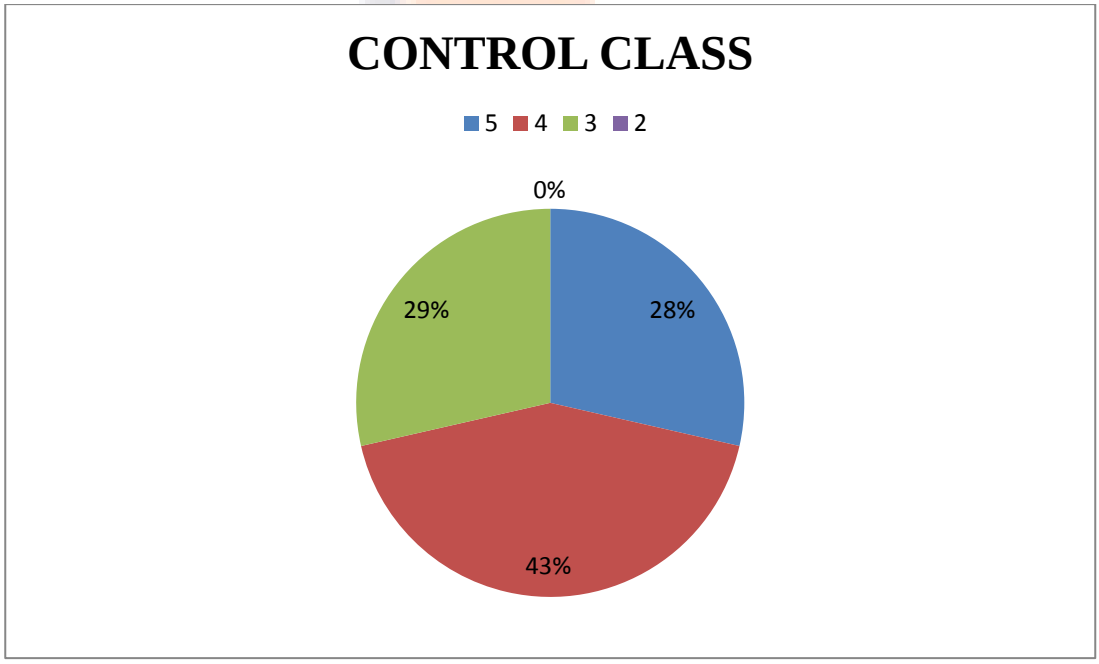
The experiment tested the effectiveness of lessons using tests and non-standard physics tasks based on PISA.

Table 2

Generalized table of student test results

7 "A" and 7 "B" classes

Control class 7 "A" class						Experimental class 7 "B" class					
Number of students	Evaluations Class				Knowledge quality analysis	Number of students	Evaluations Class				Knowledge quality analysis
	5	4	3	2			5	4	3	2	
30		2	0		71 %	35	2	6			80 %



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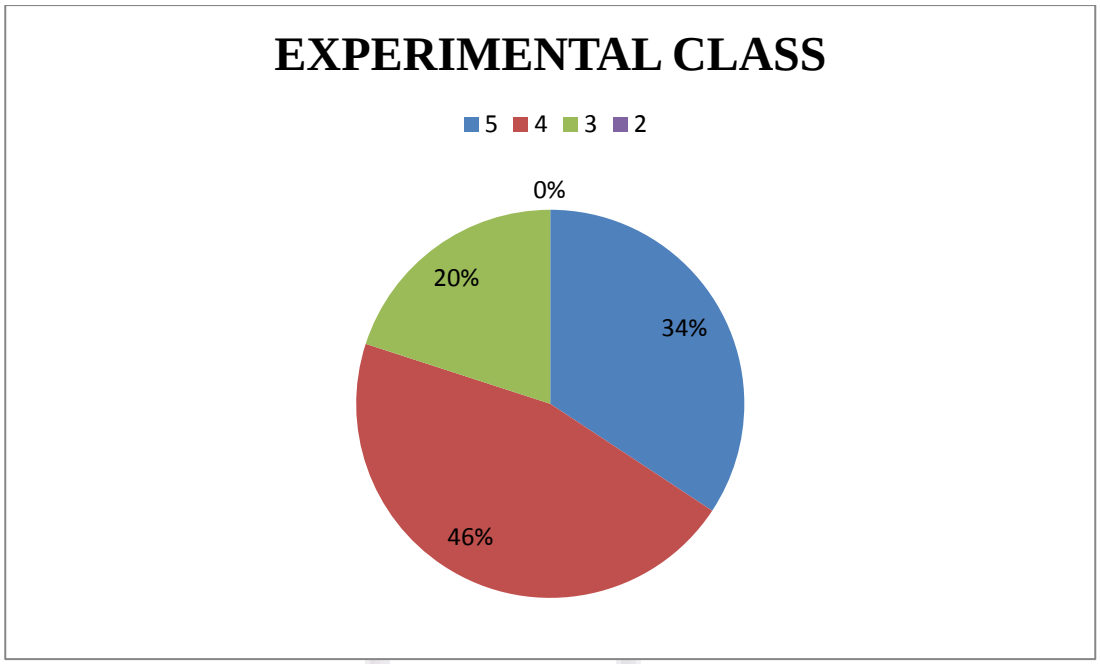

The diagram shows that in the experimental class the results differ from the control class by 9%. The results of the experiments showed an increase in the level of knowledge among students, which allowed us to conclude that it is the new technique that has a beneficial effect on the level of knowledge of students. This indicates that the effectiveness of lessons using tests and non-standard tasks in physics and astronomy based on PISA in a secondary school is more effective than the traditional method of teaching physics.

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