Journal of Advanced Zoology

ISSN: 0253-7214

Volume ***44*** *Issue* ***S-2 Year 2023*** *Page* ***4298:4306***

DEVELOPMENT OF RESEARCH ABILITY IN STUDENTS BY SOLVING PROBLEMS RELATED TO "MECHANICS" DEPARTMENT IN SCHOOL PHYSICS COURSE

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Article History
Received: 13 Aug 2023
Revised: 12 September 2023
Accepted: 29 Oct 2023

Abstract: Methodological proposals and recommendations for the development of students' research abilities by solving problems related to the "Mechanics" section of the physics course of this school are given. Problem-solving lessons were chosen as one of the methodical bases for developing students' research skills.

Key words: *research skills, creative thinking, thinking in physics, analysis and synthesis.*

Introduction.

Today's modern education considers its main task to prepare students who have the quality of living as creative, innovative, intelligent and globally competent individuals [1].

General secondary school students need to learn not only to think in a narrow sense, but also to identify, analyze, evaluate global problems in a wide range, to be able to feel and visualize what results these changes can lead to in the future.

This article is devoted to the development of methods of developing students' research skills in the process of teaching physics at school, and it talks about the role of problem solving in the development of students' research skills.

The peculiarity of the development of research skills is that they develop during the period of activity, like other skills. Therefore, the main task of the teacher in solving this problem is to search for forms, ways and means of organizing students' research activities in the process of teaching physics, and to use them at a high level in practical activities.

The ability to research allows to deviate from the existing system of knowledge formed in practice, to see events from a new, non – standard point of view, to understand contradictions, to find ways to solve them. Research

ability cannot be completely separated from a person, they are connected with needs (in work, knowledge), interest, desire and confidence, feelings and wills, striving for a set goal, demandingness, hard work.

Relevance of the topic.

This problem is relevant in teaching gifted schoolchildren in physics. In giftedness, we identify gifted children in physics who are interested in physics and achieve significantly better results, and as a result, we compare them with their peers in physics education. Then they can study at physics and technical university institutes.

Schoolchildren who are talented in the field of physics are interested in what is related to scientific and technical progress, so the lack of information about the achievements of science and technology may not allow them to consciously choose the direction of future professional activity.

Brief analysis of scientific sources on the topic.

The terms research activity, research work, and research ability are often used in educational pedagogical literature and pedagogical scientific research works. The concept of "research activity" has a multifaceted meaning in philosophy, psychology and pedagogy. According to B. G. Mesheryakov, V. P. Zinchenko, research activity is described as one of the types of human cognitive activity [1;5]. It can be seen that the term "research activity" is interpreted differently in various psychological - pedagogical educational and scientific literature. So, there are different approaches to defining the term "research". Research: - is a type of activity that is qualitatively new and unrepeatable for a person, and is distinguished by its uniqueness. The inclusion of research elements in education increases activity, initiative, and curiosity in future specialists. It increases their interest in independent research, "inventions", "discoveries" and new ideas, develops thinking and research abilities. By involving students in research activities, firstly, they develop curiosity activity and independent research activity, and secondly, this activity formed by students serves as a basis for achieving new successes in the future, that is, they show active research and later inventive activity. Therefore, this activity is an important integral part of the educational process.

The components of research ability, creative thinking, non – standard thinking, thinking in physics, analysis and synthesis are important in the development of research skills in teaching physics. Students with research skills should have the following positive qualities. Must be curious, have a strong motivation for knowledge, be able to see the problem, be inquisitive, and have a well - developed thinking ability [2]. Students in creative thinking creates new and unusual solutions to problems or situations. Problem solving through a non – standard approach to effectively express ideas, gain knowledge, and find a solution to a problem. Students should be able to generate ideas, express their attitudes towards new ideas, and continue to generate ideas until the desired result is achieved. In non – standard thinking, students draw conclusions inconsistent with their way of thinking, in unusual ways and ways, always approach problems through creative thinking. Thinking in physics causes students to think and find solutions that are not known without thinking. There are many ways to solve any problem. Pupils pay attention to the ways in which they

have solved the given problems before them and choose the most suitable one among them.

He always finds other ways to solve any problem. In analytical thinking, students mentally or practically divide things and events into their constituent parts, synthesis and in thinking, students integrate these parts into a whole in thought or practice.

The quality of research is an important personal quality, based on which a person not only actively reacts to changes in the environment, but also develops the ability to know and understand things that were previously incomprehensible to him. Research activity in the educational system is a form of effective knowledge acquisition. In this process, intellectual and practical work culture is formed in students [3].

In the formation of research skills, it is necessary to pay attention to the following aspects, that is, the ability to see a problem, ask questions, put forward hypotheses, classify concepts, observe and conduct experiments, draw conclusions and conclude, systematize the results of a studied problem, prove one's ideas and defend it [4]. Research skills mean the effective implementation of creative activities using scientific research methods. Development of research skills is carried out on the basis of conscious integrative use of knowledge obtained from various disciplines at all stages of activity.

Depending on the type of activity, the nature of research skills, the criteria may be added or the indicators of the specified criteria may be changed. Based on the indicators of the indicated criteria and their indicators, it is possible to describe each defined level of development of research skills.

The structure and methods of performing practical work on a creative level, as well as the absence of errors in their sequence, conscious coordination and control, independent organization and implementation of the work process, self - control, analysis and evaluation of results, creative development of research work, is represented by the creation of new algorithms for performing physical experiments [6].

Levels of research skill development are interdependent. Each previous level is an introduction to the next, higher level. When moving from one level to another, there are qualitative and quantitative changes in research skills [7]. Determining the meaning of the concept of research skills requires more extensive research. Research skills are often defined as the ability to use existing knowledge and the ability to perform creative activities. Creativity is derived from the English word "create", which means "to create". Creative means a person's creative ability aimed at creating new things and solving problems. If we proceed from this point of view, when defining the concept of "research skills", attention is paid to their practical activities [9]. The definition of the concept of research skills is related to the content and meaning of the concept of research activity. In the pedagogical literature, research activity is approached from two different points of view. First, research activity is an activity related to the student's independent education, research work. It is also interpreted as an activity of working with didactic teaching tools. Second, research activities are considered as educational activities. Be creative in choosing issues that develop research skills in the "mechanics" department of

physics related to these components we give an analysis of examples of thinking, analysis and synthesis components in physics [8].

The purpose of the article.

The purpose of the research is to base, develop and introduce a methodical system for developing the research abilities of gifted schoolchildren in the teaching of physics. Identifying the problem of developing the research skills of gifted students in teaching physics in pedagogical theory and practice, determining the type of research work in physics that is most convenient for developing the research skills of gifted students, creating a methodological system for developing the research skills of gifted schoolchildren in teaching physics, this is a gifted school in physics identifying students, involving them in research activities.

Scientific novelty of the article.

It is a modern method of professional research in the field of physics, and the implementation of advanced level research in physics using modern methods for students of middle and senior school age, using components that develop research skills.

The concept of the methodical system of development of research ability of gifted students in teaching physics is developed on the basis of the following rules. In developing the research ability of gifted schoolchildren in physics, the importance of performing independent research work at a deep level and the importance of effective educational forms, determining the tendency of schoolchildren to conduct experimental research work at a deep level.

Issue 1 . The T-150 crawler tractor is moving at a maximum speed of $\vartheta = 18$ km / h. Find the projection of the velocity vectors of the upper and lower parts of the track onto the X and X_1 axes. The X axis is connected to the ground, and the X_1 axis is connected to the tractor. Both axes are oriented according to the movement of the tractor (Fig. 1) [1 0].

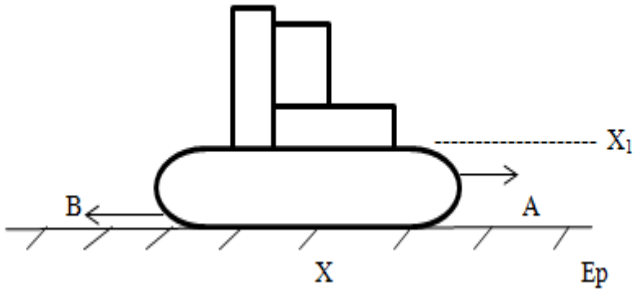

Figure 1

Solving . The student uses creative thinking skills to solve this problem. In this case, at the initial time, the tractor caterpillar is divided into the upper A and lower V parts, and the projection of the speed vector is determined as follows. $\vec{\vartheta} = 18км/соат = 5м/с$ Points A and V move with speed in opposite directions relative to each other . $5м/с$ Therefore, at point A $\overrightarrow{\vartheta_A} = \overrightarrow{\vartheta_A} + \overrightarrow{\vartheta_B} = (5+5)м/с = 10м/с$. At point V, the movement relative to the tractor

is $\overrightarrow{\vartheta_B} = 5м/с$. At point V, it is at rest relative to the Earth $\vartheta_B = 0$. At point A, it is directed opposite to the Earth and $\vartheta_A = -5м/с$ is [13].

Issue 2 . Determine the radius of the circular orbit of a stable satellite that appears to be stationary relative to the Earth's surface (Figure 2) [11].

Solving . By non – standard reasoning, the student writes the formulas for calculating the circular orbit of a satellite as follows:

a) First of all, it is possible to specify the quantity that is not sufficiently disclosed to the condition of the issue. According to the issue, to an observer on the Earth's surface, the satellite appears to be stationary, that is, "hanging". For this to happen, the period of rotation of the satellite must be exactly equal to the period of the Earth around its axis. In addition, the direction of rotation of the satellite must be the same as that of the Earth. That's why we wrote T=1 day in the list of given sizes.

b) Two opposite forces act on the satellite moving along a circular orbit with radius r. One is the gravitational force of the satellite, its value is expressed as follows based on the formula of the law of universal gravitation.

$$F = G\frac{M \cdot m}{r^2} \quad (1)$$

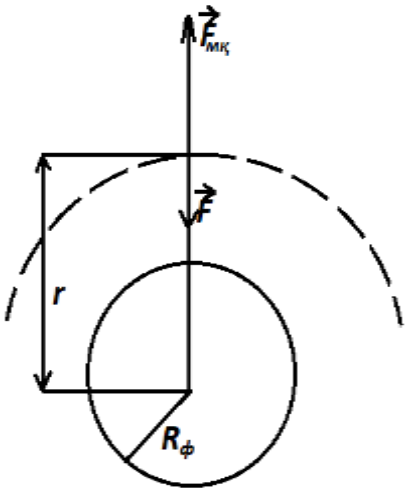

Figure 2.

m _ – satellite mass, M – Earth mass, G – gravitational constant. The second force is the centrifugal force, its value can be determined as follows.

$$F_{м.к} = ma_{м.к} = m\frac{\upsilon^2}{r} = \frac{m\left(\frac{2\pi}{T}r\right)^2}{r} = \frac{4\pi^2 mr}{T^2} \quad (2)$$

a $_{m.q}$ is centrifugal acceleration, its amount is $a_н = \frac{\vartheta^2}{r}$ equal to normal acceleration; y is the linear velocity of the satellite in its circular motion, its value is $\left(\upsilon = \frac{2\pi r}{T}\right)$ determined as the ratio of the length of the circular orbit to the period of the satellite's rotation. . c) When the values of the forces F and F $_{m.q}$ in opposite directions are equal, the satellite moves along a circular orbit. Therefore $G = \frac{Mm}{r^2} = \frac{4\pi^2 mr}{T^2}$ can write the equation and find r from it.

$$r = \sqrt[3]{\frac{CMT^2}{4\pi^2}} \quad (3)$$

r can be calculated by finding the values of G and M in this equation from the table. But expression (3) can be simplified. For this, it is taken into account that the acceleration of free fall at points immediately close to the Earth's surface $g_0 = G\frac{M}{R_{ep}^2}$ is expressed as a relation.

Because $r = \sqrt[3]{\frac{CMR_{ep}^2T^2}{4\pi^2R_{ep}^2}} = \sqrt[3]{\frac{g_0R_{ep}^2T^2}{4\pi^2}} = \sqrt{\frac{9{,}8\frac{м}{c^2}\left(6{,}37\cdot10^6\right)^2(86400c)}{4(3.14)^2}} = 4{,}2\cdot10^7\,м$

will be equal to Therefore, problems of this form are considered creative thinking problems [12].

Issue 3 . A ball of mass 100 kg is l attached to a string of length = 40 cm and is moving in a circle lying on a horizontal plane. Find the kinetic energy of the candle if the thread makes a = 60^0 constant angle E_k with the vertical during the movement [12].

Solving . To solve this problem, the student uses the thinking component in physics, which forms the ability to think physically. As the ball moves in a circle, a $F_{мм}$ tension force acts on it. We have the equality R= l sin a . Therefore, centripetal force

$$F_{мм} = \frac{m\upsilon^2}{R} = \frac{m\upsilon^2}{l\sin\alpha}\,(4)$$

It is found by the formula. We make a formula for the tensile strength of the thread from the drawing. $F_м = \frac{mg}{\cos\alpha}$ Aspiration to the center is for strength

$$F_{мм} = \frac{mg}{\cos\alpha}\sin a = mg\cdot tg\alpha \qquad (5)$$

we form the equation. The forces acting on the sphere are compensated from the condition of the problem. So, from equations (4) and (5) $\vartheta = gltg\alpha\sin\alpha$ we form the equation. Putting its value in the kinetic energy formula

$$E_к = \frac{m\vartheta^2}{2} = \frac{mgtg\alpha\sin\alpha}{2} = \frac{100\cdot10\cdot\sqrt{3}\frac{\sqrt{3}}{2}}{2} = \frac{3000}{4} = 750ж$$

will be equal to

Issue 4 . The projectile broke into three pieces at the highest point of the trajectory. The movements of all three parts occur in exactly one plane. The first block of mass 9 kg is directed vertically upwards with a speed of 60 m/s. The speed of the second piece is 40 m/s, and its mass is 18 kg, directed parallel to the horizon. Determine the direction of the third part [13] .

Solving . The student enters the content of the problem by being able to synthesize it while solving the problem. After a thorough analysis of the problem (synthesis achieves the following results due to the combination of the elements obtained as a result of this analysis), he determines the direction of the third fragment of the projectile.

a) The explosion occurs at the highest point of the trajectory. In other words, the velocity of the projectile before the explosion was zero, and the momentum was also zero. The fragmentation of the projectile occurred as a result of the action of internal force.

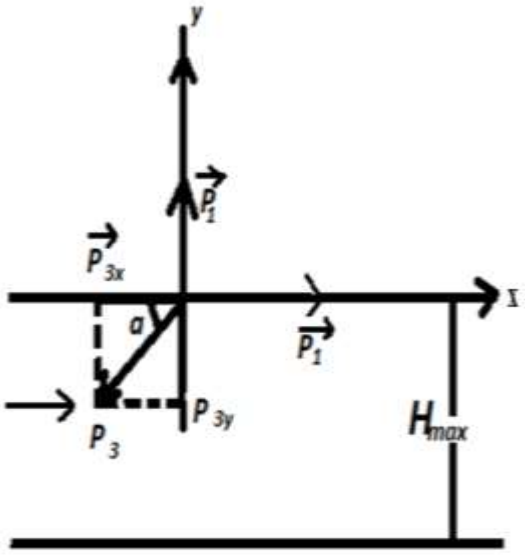

Figure 3

Therefore, after the explosion, the momentum vector of the system remains unchanged and equal to zero, that is, $0 = P_1 + P_2 + P_3$ or $0 = m_1\vartheta_1 + m_2\vartheta_2 + m_3\vartheta_3$

b) Let's pass the axis OX in the direction of movement of the second section, and OU perpendicular to it, that is, along the direction of movement of the first section. Then the projection of the above equation representing the law of conservation of momentum onto the coordinate axes OX and OU z

$$0 = m_2\vartheta_2 - m_3\vartheta_3 \cos\alpha$$
$$0 = m_1\vartheta_1 - m_3\vartheta_3 \cos\alpha$$

If we shift the terms with (-) in this equation to the left, and then divide the second of the resulting expressions by the first, $tg\alpha = \frac{m_1\vartheta_1}{m_2\vartheta_2}$ we will form the relationship. From this we can write the following expression that defines a :

$$\alpha = arctg = \frac{m_1 \vartheta_1}{m_2 \vartheta_2}$$

c) We calculate $\alpha = arctg \frac{m_1 \vartheta_1}{m_2 \vartheta_2} = arctg \frac{9 \cdot 60}{18 \cdot 40} = 37^0$

The third piece of the projectile is oriented with the first piece at an angle of $(90+37)^0 = 127^0$ [12].

In general, it is necessary to choose issues of this type in the development of students' research abilities. Creative thinking, non – standard thinking, thinking in physics, which develops research skills when choosing a problem, the ability to analyze and synthesize was used and the analysis of issues relevant to this component was considered.

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