

**INFORMATION AND COMMUNICATION TECHNOLOGIES FOR THE DEVELOPMENT OF
INDEPENDENT ANALYTICAL CREATIVE THINKING OF YOUNG PEOPLE IN TEACHING GEOMETRY**

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Summary. *The article discusses the development of the creative ability of students of lyceums. A version of the "problematic" problem of mathematics is proposed, which allows you to stimulate the creative potential of students.*

Key words: *ratio, solution, method, image, ability, giftedness, independence, thinking.*

INTRODUCTION

Today, due to the high mobility of the market conditions, every person during his life will often have to change not only the place of work, but also the specialty and profession, that is, the specialist must be professionally mobile. The development of production technologies has led to a significant change in the qualification requirements for employees. In addition to professional knowledge and skills, professionally significant qualities have become in demand, one of which is independence. Currently, employees must have a wide professional and qualification profile [1]. It is clear that these trends will have a significant impact on the development of education, which will be guided by the formation of a socially and professionally active person with high competence, mobility and professionalism.

It is quite clear that today, in addition to the technological training of a specialist, an essential factor in the development of education is the formation of such personality qualities as independence, the ability to make responsible decisions, a creative approach to any business, the ability to constantly learn, sociability, the ability to cooperate, social and professional responsibility, and so on. The formation of these qualities is possible with a wide introduction into practice in all stages of education of a person-oriented education, which most satisfies the humanistic goals of the formation of the future specialist. Professionally determined qualities of personality will provide education for life. The formation of a person-oriented education will also ensure the professional self-realization

of a person and support his further creative growth. So, the task set for education is not only to give a person the comprehensive knowledge necessary to become a full-fledged citizen, but also to develop in him the independence of thinking necessary to develop a creative perception of the world around him. Now the enormous importance of science for the development of culture and economy in the modern state is generally recognized. Therefore, the education and training of young scientists with such qualities that we have already mentioned is now a great independent task [2].

Scientific work refers to such a field of human activity that can be successfully developed only by those who have creative talents. It is well known that in art, literature, music only a small number of people with creative abilities can successfully work. The same applies to scientific work, here, too, only creatively gifted people can work successfully. Thus, for the effective development of scientific work, it is necessary to ensure, as well as in art, the selection of creatively gifted people. It is not difficult to see that this selection is more difficult here than in art, where it is done by life itself, and the assessment is not associated with special organizational difficulties, since the writer's bad works simply will not be read, the bad composer will not be listened to, and so on. But in the field of science, it is much more difficult to assess a person's creative achievements, although it is also produced by the public, but it is a small group consisting of scientists competent in the field. The selection of scientists according to their creative talents is one of the most difficult organizational problems of scientific work.

The success of scientific work in any field of knowledge can only be achieved by people with creative abilities, and the number of such people is small. Since this human reserve is limited, it is necessary to create conditions that ensure its most complete use. For this, one should, firstly, be able to create conditions that attract gifted people to scientific work, and secondly, organize the selection of these people in accordance with the nature of their creative talents, and thirdly, special conditions should be created to educate creatively gifted youth so that natural talents develop as fully as possible. This issue is solved in our country as follows: after graduating from high school, such creatively gifted youth are sent to academic lyceums. It is possible to influence the creative education of young people in academic lyceums only by organizing it from the outside. So far, one of the best ways is to organize Olympiads for students of academic lyceums. These are competitions in solving problems in mathematics and physics, building devices, astronomical observations and other forms of student interest in scientific and technical creativity, which cover as many participants as possible. These Olympiads are organized by a group of scientists together with employees of the relevant ministries. These Olympiads not only contribute to the identification of the most talented, creatively capable youth, but also instill in youth love and interest in creative solutions to scientific problems. We have developed such Olympiads widely, and they are held at a high level. Also, circles, seminars in various disciplines, which are organized for students of academic lyceums, have a good influence on the development of creative interests in scientific problems. These circles are

conducted by young scientists, thus, the student gets acquainted with the creative scientific process.

METHOD

It is well known that fruitful scientific work requires not only knowledge and understanding, but, most importantly, still independent analytical and creative thinking, as one of the effective means of educating, identifying and assessing these qualities, this is a solution to problems in teaching young people. Solving problems in the study of exact sciences, such as mathematics, mechanics, physics and others, is of great importance. Solving problems allows not only the students themselves to apply their knowledge to solving practical problems, but also for the teacher, tasks are one of the most effective ways to check how deeply they understand the subject. In addition, as already mentioned when teaching young people using problem solving, you can also educate and identify independent creative scientific thinking. Mathematics is a very suitable subject for initial education in the youth of creative thinking in the field of natural science. Obviously, not all tasks provide an opportunity to open up such abilities from the student. Therefore, it is necessary to separately dwell on the nature of such tasks. Experience shows that the tasks that are usually given in collections do not always have the character that brings up the independence of thinking. Usually these tasks boil down to the fact that you need to substitute the specified data into the necessary formulas, and then you will receive a certain answer. Here, the student's independence is manifested only in choosing the right formulas in which to substitute data. The qualities that we mentioned have problematic tasks.

In this work, we will consider the "problematic" task proposed in the work [10], which makes it possible to stimulate the creative potential of students. Here is a complete solution to the task.

PROBLEM

In the segment AB, an arbitrary point M. is taken. Squares are built on the segments MA and MB on one side of AB. The squares describe the circles crossing at point N.

1. Find the geometric position of the N point when you select M points at different locations.
2. Show that the line AN passes through the vertex of the second square.
3. Show that the ANB angle is straight.

We will propose the stages of solving this problem. First, we depict schematically the condition of the problem:

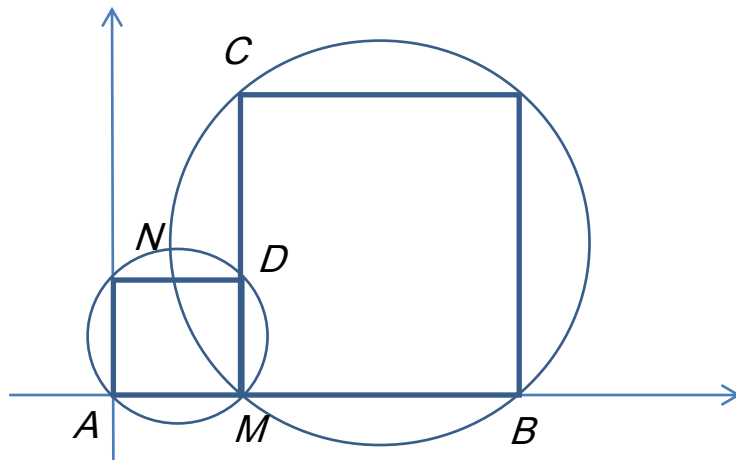


Figure 1

And let's enter some conditional names:

The main triangle-triangle given by the conditions of the problem (triangle ABC);

Moving points C and D;

Moving segments AC and BD;

A curve formed by a plurality of moving points N formed by the intersection of segments AC and BD.

To begin with, in order to have an idea of the locus of points being searched, you can try to program this process on a computer. To do this, we will use the Maple 18 software environment. Let's give you the part of the program that is recorded in Maple 18 and the final result:

$t = 0.$

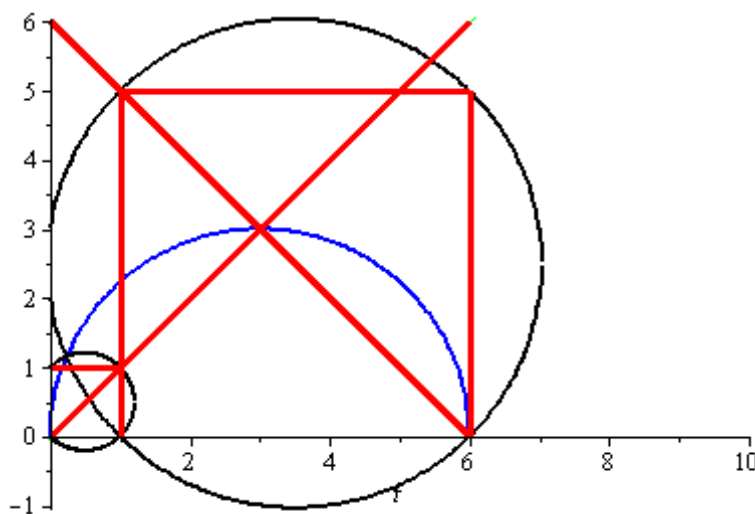


Figure 2

Figure 2 shows the solution to the problem for a segment with coordinates $A(0,0)$, $B(6,0)$ and $M(1,0)$ on the Cartesian coordinate system.

This hypothesis turns out to be true. Because it can be proved in an analytical way.

Geometric solution of the problem: We use the Cartesian coordinate system to solve the problem. To do this, move the vertex A of line AB to the origin (Figure 1). First, let's show that the triangle ANB is rectangular. Let us define the coordinates of the points: let $A(0;0)$, $B(b;0)$, $M(a;0)$, $D(a;a)$, $C(a;b-a)$.

Let's compose the equation of the line AC. Since AC passes through the origin, its equation will be $y = kx$. Since point C has coordinates $C(a; b-a)$, equation $b-a = ak$ is

considered true, hence $k = \frac{b-a}{a}$. So the straight AC drop will be $y = \frac{b-a}{a}x$ (1).

The equation of the line BD will be $y = kx + l$. Since the line passes through the points

$B(b; 0)$ and $D(a; a)$, $\begin{cases} 0 = bk + l \\ a = ak + l \end{cases}$. From the system we will find the coefficients k and l :

$k = \frac{a}{a-b}$ and $l = \frac{ba}{b-a}$. So the equation of the line BD is $y = -\frac{a}{b-a}x + \frac{ba}{b-a}$ (2).

Since the product of the coefficients of equations (1) and (2) is -1, these lines will be mutually perpendicular.

Now we will prove that lines (1) and (2) intersect at a point N.

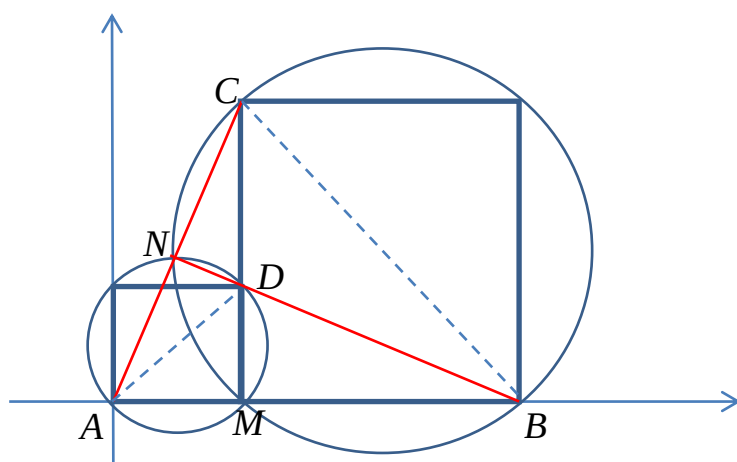


Figure 3

a) angle $\angle N = 90^\circ$ in triangle AND . From here, the diagonal of the square AD will be the diameter of the first circle, that is, the smaller circle AND will be the circumscribed circle of the right triangle. Point N belongs to a circle.

b) similarly, we can show that point N belongs to the second circle.

This means that the triangle ANB is rectangular and the line AN passes through the vertex of the second square.

Now let's define the geometric position of the N points when you select the M point in different places.

In triangle ANB , the angle N is straight and AB will be hypotenuse. Since the diameter of the circle is visible at an angle of 90° , the point N lies on the circumscribed near the right triangle ANB of the circle. Thus, the geometric location of the N points consists of a circle.

Proof by analytical method. As a result of the movement of point M in segment AB , points C and D move. Since the points move, enter the motion parameter $t \in [0;1]$. At $t=0$, the position of point M will be at coordinates $A(0;0)$, at $t=1$ at point $B(b;0)$.

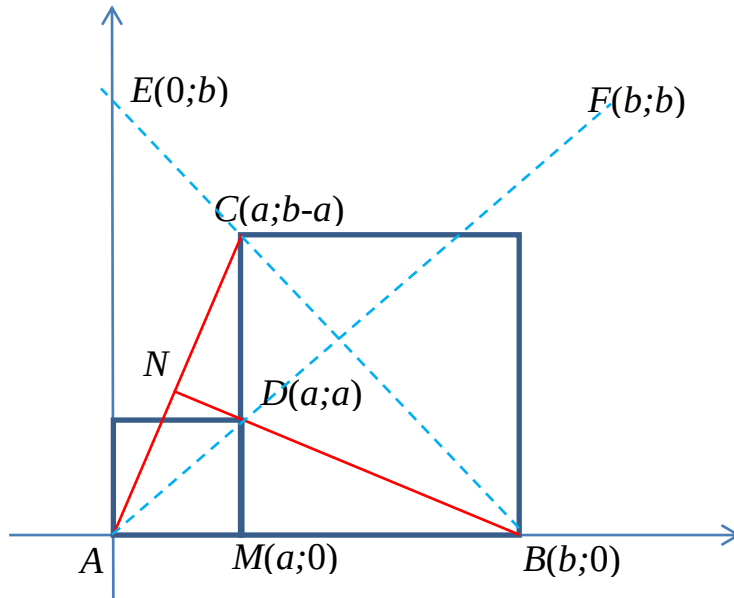


Figure 4

As a result of movement in time t , point $C(x;y)$ with path $\begin{cases} x=bt \\ y=b(1-t) \end{cases}$ moves from point $E(0;b)$ to point $B(b;0)$, and point $D(x;y)$ with path $\begin{cases} x=bt \\ y=bt \end{cases}$ from point $A(0;0)$ to point $F(b;b)$.

Since the line AC passes through the origin, we find its equation $y=kx$: $b(1-t)=kbt \Rightarrow k=\frac{1-t}{t}$. This forms equation $y=\frac{1-t}{t}x$ (1).

Find the equation of the line BD $y=kx+l$: $\begin{cases} bt=kbt+l \\ 0=bk+l \end{cases} \Rightarrow k=\frac{t}{t-1}$ and

$l=-\frac{bt}{t-1}$. This forms equation $y=\frac{t}{t-1}x-\frac{bt}{t-1}$ (2).

Equating equations (1) and (2), we find the coordinates of their suppression point:

$$N(x; y): \frac{t-1}{t}x = \frac{t}{t-1}x - \frac{bt}{t-1} \Rightarrow \begin{cases} x = \frac{bt^2}{2t^2 - 2t + 1}, \\ y = \frac{bt(1-t)}{2t^2 - 2t + 1} \end{cases} \quad (3).$$

The formed parametric equation (3) characterizes the trajectory of the point $N(x; y)$

. From this equation, we derive parameter t :

$$\frac{x}{y} = \frac{\frac{bt^2}{2t^2 - 2t + 1}}{\frac{bt(1-t)}{2t^2 - 2t + 1}} = \frac{t}{1-t} \Rightarrow (4).$$

$$y = \frac{bt(1-t)}{2t^2 - 2t + 1} = \frac{b \frac{x}{x+y} \left(1 - \frac{x}{x+y}\right)}{2 \left(\frac{x}{x+y}\right)^2 - 2 \frac{x}{x+y} + 1} = \frac{bxy}{2x^2 - 2x(x+y) + (x+y)^2} = \frac{bxy}{x^2 + y^2}$$

$\Rightarrow$

$$x^2 + y^2 = bx \Rightarrow x^2 + y^2 - bx = 0 \Rightarrow x^2 - 2x \frac{b}{2} + \frac{b^2}{4} + y^2 = \frac{b^2}{4} \Rightarrow$$

$$\left(x - \frac{b}{2}\right)^2 + y^2 = \left(\frac{b}{2}\right)^2.$$

The equation formed is a circle equation with centrom $\left(\frac{b}{2}; 0\right)$ and radius $\frac{b}{2}$. Thus,

the geometric location of the point $N(x; y)$ on the plane consists of a circle.

RESULTS AND DISCUSSION

The resulting three equations are circles with radius but with different centers.

Thus, we proved this hypothesis. Now you can use it in the future to solve the main problem set at the beginning.

A characteristic feature of such tasks is that they do not have a certain complete answer, that is, problematic, since the student can, as far as his inclinations and abilities are concerned, go into the study of the question posed. The student's responses provide an opportunity to assess the propensity and nature of their scientific thinking. An independent solution to such problems gives the student a training in scientific thinking and develops a love for scientific problems in it. In addition, most of them do not specify numerical values of physical constants and parameters, and they are allowed to be chosen by the decisive one.

CONCLUSION

In the psychological study "Mathematical Creativity," Henri Poincaré describes in detail the situation in which he managed to make one of the discoveries. This was preceded by a long preparatory work, a large share, in which, according to the scientist, the process of the unconscious was. The stage of insight must be followed by the second stage - careful conscious work to put in order the evidence and its verification. A. Poincaré came to the conclusion that the most important place in mathematical abilities is occupied by the ability to logically build a chain of operations that will lead to the solution of the problem [4]. Here we are talking about mathematical creativity available to few. But, as J. Hadamard wrote, "between the work of a student solving a problem in algebra or geometry, and creative work, the difference is only in level, in quality, since both works are of a similar nature" [3].

In his brochure "On the profession of mathematics," addressed to youth, Andrei Nikolaevich Kolmogorov identified three groups of specific mathematical giftedness - algorithmic, geometric and logical [5]. He believed that the ability for figurative geometric thinking can and should be trained on problems of the following type: What polygon will result if you cut the cube with a plane passing through its center perpendicular to the main diagonal?

When solving scientific problems, a scientist always has to clearly represent in his imagination the magnitude and relative significance of those physical parameters that serve to describe the phenomenon under study. This is necessary in order to be able to choose those that are decisive in the experimental study of this phenomenon. Therefore, it is necessary to teach the young students that the symbols in the formulas that determine physical quantities always represent specific quantitative values for them. For physics, unlike mathematics, both parameters and variables in the mathematical equation must be specific quantities [1-2]. It should be noted that, at the same time, when complex problems are solved, students should use not only literature, but also consultation. The ability to use, consultation, the scientist also needs to learn, as well as the ability to use literature. In scientific work, advice and conversations with comrades and leaders are necessary for the success of work, and this must be taught from the very beginning of training.

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