COGNITIVE INTERESTS AND THE CREATIVE ACTIVITY OF STUDENTS IN THE EDUCATION IN MATHEMATICS

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ABSTRACT

The present paper treats cognitive interests and their role in the creative activity of students. There are pointed out ways and means through which the connection between cognitive interests and the creative activity can be accomplished. We suggest a system with problems for a certain theme from the school course in Mathematics to perform this aim.

We are living in time that amazes us with its dynamic development, with constant achievements in all fields of life. In 2000, “The Lisbon Strategy” of the European Union pointed out that this dynamic development must be based on knowledge. In such a way, cognition is acknowledged as a basic factor in the development that lays a qualitative alteration of education, in order to take a leading position. Education is connected with research and creative activity as a higher degree of human activity through which all mental processes and characteristics of human personality are revealed. It is required from people to adapt quickly to the new conditions, to learn constantly on their own, to develop themselves. In this process, among the different “psychological phenomena”, a great attention is put on interests in their capacity of abettors of the activity of a person [5; 165].

There are different opinions about the nature of interest in the scientific literature. For example, B. N. Dodonov [3], [4] considers that interest is a special mental mechanism that induces the person to an activity which brings that person emotional satisfaction. G. K. Cherkasov [8] connects the interest to the active attitude of subject to the alternatives of optimal possibilities for realizing the aims.

The interest is connected to another mental phenomenon – the motive, because behind each motive always stays a definite personal need. On the base of cognitive necessity, there arises a cognitive interest which ensures conscious mastering of school material.

According to G. I. Shukina [9; 12], the cognitive interest as a complex attitude of the student to the objects and phenomena of the surrounding reality has influenced the activity to be more efficient. A. N. Leontiev [6] also thinks that the interest towards the problem, its realizing and acquiring, the desire to take part in the solving of the problem, is a necessary condition for mental activity of the students.

B. V. Gedenko's understanding [2; 5] sounds quite contemporary, "The lost of interest to education on a certain stage generates indifference and apathy, the indifference generates indolence, and the indolence – idleness and lost of ability".

We accept that the interest is a relation that accompanies the cognitive activity of the personality, in which the leading motive and the aim of the activity coincide [1; 41].

We must have in mind that the cognitive activity of the students is conditionally divided into two basic types: reproductive and creative.

The creative activity in mathematics education may be determined as individual, purposeful and motivated activity, in the process of which the learners discover new knowledge, find out new ways for solving given mathematical problems and consciously apply and adapt the acquired mathematical knowledge and skills in new situations [7].

The revealing of the creative activity of students in their education in Mathematics is explained in [7].

Here we put the accent on some of the means which stimulate the cognitive interests, which have a very important meaning for the creative activity of students.

With a view to the aim of the investigation and as a result of an analysis of themes and lessons in Mathematics, we consider that the rise and development of interest in mathematical knowledge and motives for creative activity, can be achieved through the application of different ways and means in the process of education. They are:

1. The description by the teacher which leads to the creation of a problematic situation.

2. The game with and without competitive character.

3. Revealing the practical significance of new knowledge.

4. Mathematical problems.

a) fun problems;

b) problems which require a transfer of knowledge from Algebra to Geometry and vice versa and, in general, problems by which inter-objective relations can be accomplished;

c) problems connected with the performance of a practical activity by the students;

d) "nonstandard problems" [10];

e) research problems;

f) problems that can be solved in different ways;

g) geometrical problems in the solving of which there must be made additional constructions;

h) creating mathematical problems.

The solving of problems of all these kinds is characterized by a great mental effort, with conscious application and transformation of the acquired skills and habits in newly arising circumstances.

The training in looking for solutions to such problems helps the development of habits in students for individual work, stirs ambition for quickness, resourcefulness, and initiative.

Because of the limited content of the paper, we present some problems which stir cognitive interest and stimulate the creative activity of students.

Problems that can be solved in different ways are of great importance for the stimulation of interest and display of creative activity. Such problems are for example:

<u>Problem 1:</u> Find out the value of the fraction $\frac{x+y}{x-y}$, if $x^2+y^2=6xy$ and $x>y>0$.

I way: Since $x>y>0$, then $x+y>0$ and $x-y>0$. From $x^2+y^2=6xy$, we receive $(x+y)^2=8xy$ or $x+y=2\sqrt{2xy}$ (1), $(x-y)^2=4xy$ or $x-y=2\sqrt{xy}$ (2). If we substitute (1) and (2) in $\frac{x+y}{x-y}$, we find out that the value of fraction is $\sqrt{2}$.

II way: Having in mind that $x>y>0$, we express x trough y from the equation $x^2+y^2=6xy$, i.e. $x=3y+2y\sqrt{2}$. After replacing in the fraction we receive its value.

III way: Since of $x>y>0$, then $\frac{x+y}{x-y}>0$. If we raise the fraction into second degree, we receive $\frac{x^2+y^2+2xy}{x^2+y^2-2xy}$. Replacing x^2+y^2 with $6xy$, it is easy to find the vale of $\frac{x+y}{x-y}$.

In this problem the students must compare the different ways and they have to give reasons which way is more rational.

The systematic and purposeful education of students to look for different ways for solving of the given problems, to compare and estimate them, contributes to their mathematical development. A necessity for mastering and using the learnt theory is formed in the students. A breadth and flexibility of thinking are developed.

The performance of rational solving of the problem brings up originality and unconventional creative thinking.

With the next equation we are going to illustrate one nonstandard way for its solving.

Problem 2: Find out the sum of all the solutions of the equation $x^4 - 12x^2 + 16\sqrt{2}x - 12 = 0$.

In the solving of this equation we are going to mark $\sqrt{2}$ with *a*. Then the given equation takes the type: $x^4-6a^2x^2+8a^3x-3a^4=0$.

After transformation, we obtain $(x-a)^2(x^2+2ax-3a^2)=0$. Now the student will find easily that the solutions of the equation are $\sqrt{2}$ and $-3\sqrt{2}$ and calculate their sum.

Referring to L.M. Fridman, there is not a ready rule for solving this "nonstandard problem". A great quickness and combination are required to reduce the problem to some problems (in this case two), which can be solved in a standard way [10; 52].

The creative activity of the student is expressed with the fact to find out exactly which standard problems the given one can be reduced to.

In order to solve the next problems, it is necessary to transfer knowledge from one theme in Algebra into another.

Problem 3: Solve the equation $x^9+3x-4=0$.

Solving this problem, it is very important for the student to present it in the following way: $3x=4-x^9$.

Analyzing the left side of the equation, we can see that it can be discussed as an increasing function, while the right side – as a decreasing one. Therefore, the diagrams of these functions cannot have more than one crossing point. In this way we find out that $x=1$ is a root of the equation.

Problem 4: Solve the equation $\dfrac{2x^2 - x - 2 + x\sqrt{x^2 - x - 2}}{2x^2 - x - 2 - x\sqrt{x^2 - x - 2}} = \dfrac{19}{7}$.

Solving this problem we will use the knowledge about proportions, i.e. if there is given the proportion $\dfrac{a}{b} = \dfrac{c}{d}$ $(b \neq 0, d \neq 0)$, then it is true that $\dfrac{a+b}{a-b} = \dfrac{c+d}{c-d}$ $(a \neq b, c \neq d)$ (3) and $\dfrac{a-b}{a+b} = \dfrac{c-d}{c+d}$ $(a \neq -b, c \neq -d)$ (4).

In the solving of the problem we will use (3). So we receive: $\dfrac{4x^2 - 2x - 4}{2x\sqrt{x^2 - x - 2}} = \dfrac{26}{12} \Leftrightarrow \dfrac{2x^2 - x - 2}{2x\sqrt{x^2 - x - 2}} = \dfrac{13}{12}$ (5).

Let us rewrite (5) in the following way: $\dfrac{\sqrt{(x^2 - x - 2)^2 + x^2}}{2x\sqrt{x^2 - x - 2}} = \dfrac{13}{12}$ (6).

For (6), we again apply (3) and after some transformations of the expressions in the numerator and denominator we receive $\frac{\left(\sqrt{x^2-x-2}+x\right)^2}{\left(\sqrt{x^2-x-2}-x\right)^2}=25$ (7). In order to solve (7), we must first solve the two equations: $\frac{\sqrt{x^2-x-2}+x}{\sqrt{x^2-x-2}-x}=5$ and $\frac{\sqrt{x^2-x-2}+x}{\sqrt{x^2-x-2}-x}=-5$

We again apply proportion (3) for both of the equations and receive: $\frac{\sqrt{x^2-x-2}}{x}=\frac{3}{2}$ and $\frac{\sqrt{x^2-x-2}}{x}=\frac{2}{3}$.

It is easy to find the solutions of these equations, and through examination we can find the solution of the given equation as well.

Problem 5: Solve the equations:

a) $\frac{\sqrt{x^2+7}+\sqrt{x^2-5}}{\sqrt{x^2+7}-\sqrt{x^2-5}}=3$;

b) $\frac{2x^2-3x+x\sqrt{x^2-3x}}{2x^2-3x-x\sqrt{x^2-3x}}=\frac{7}{3}$.

In order not to omit some solutions in the solving of the equation, we must have in mind that from the proportion $\frac{a}{b}=\frac{c}{d}$ $(b\neq 0, d\neq 0)$ follows the truth of $\frac{a+b}{a-b}=\frac{c+d}{c-d}$ with the additional condition that $a\neq b$ and $c\neq d$, i.e. $\frac{a}{b}\neq 1$ and $\frac{c}{d}\neq 1$.

In all these problems the students are trained to connect knowledge from one theme of the school course in Algebra to another, from one branch to another. In this way, the development of their interests is stimulated.

We must point out that the cognitive interests play a significant role in the realization of the creative activity. They are expressed in the stable purpose and the attitude of the individual to the activity. The individual is ready to perform this activity and to get acquainted with the new and the unknown. All this brings him or her positive emotions and delight from success. This is evidence of a person acting creatively.

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