ISSN NO: 2770-2367
Date of Publication: 10-05-2023

Basic didactic principles and mathematical competencies in teaching mathematics

Сиддиков З.Х.
Senior Lecturer, Doctor of Philological Sciences (PhD) of the Department "Methods of Primary Education" at the Federal State University

Annotation. The article outlines the main didactic principles and mathematical competencies in teaching mathematics. In the process of teaching mathematics, the student will begin to overcome various difficulties, the richer his mental activity, the more often an atmosphere of creative upsurge is created in the lesson, the more effective teaching and education. The reader will find many specific examples of the implementation of this thesis in teaching mathematics.

Key words: basic didactic principles, mental activity, development, confidence, observation,

Success in teaching mathematics largely depends on the development of students' sustainable interest in the subject. First of all, it should be remembered that interest in mathematics is developed when the student understands what the teacher is talking about, when the tasks proposed to him are interesting in content or method of solution, when the student is given the opportunity to think for himself, draw a conclusion, generalization, etc. When, in the process of learning, a broad perspective of the usefulness of studying a particular issue opens up before the student, there is confidence in their cognitive abilities.

Therefore, it is advisable in teaching mathematics to follow the basic didactic principles of teaching:

- from simple to complex;
- from specific observations, examples and experiments to conclusions and generalizations;
- from practical results to formulations of rules and theorems.

The student must be constantly attached to the joy of mental labor in such a way, where possible, to let him experience the joy of creativity, discovery, victory. Let at first this “creativity” of his be the discovery of a long-discovered one, and victories appear in the form of a successful solution of simple problems, nevertheless, the student will experience the same feelings as a real scientist working on a serious problem. And the more often the teacher of mathematics gives the student the opportunity to experience this joy, the deeper and more stable the student's interest in the subject will be.

And the more often in the process of teaching mathematics the student begins to overcome various difficulties, the richer his mental activity, the more often an atmosphere of creative upsurge is created in the lesson, the more effective teaching and education. The reader will find many specific examples of the implementation of this thesis in teaching mathematics.

In the practice of teaching mathematics, the formation of the interest of schoolchildren by solving problems has so far been carried out mainly through entertaining (fascinating, unusual, unexpected, etc.), specially incorporated in the plot of a particular mathematical problem or in the method of solving it.

Of course, solving such problems is not useful. The famous French physicist Louis de Broglie wrote that modern science is "... the daughter of surprise and curiosity, which are always its hidden driving forces that ensure its continuous development."

The amusement inherent in the very plot of the problem is advantageous in that the student awakens interest in the problem, the desire to solve it immediately after he gets acquainted with its condition. However, there are also negative aspects in this method of excitation among schoolchildren of interest in the task:

firstly, this kind of amusement is usually purely external (the mathematical essence of such a problem is often trivial);

 ISSN NO: 2770-2367
Date of Publication: 10-05-2023

secondly, tasks with an entertaining plot are not (and legitimately) characteristic of the daily learning activities of a schoolchild.

It is impossible (and indeed expedient) to make the tasks of the textbook outwardly entertaining. Therefore, the entertainment inherent in the method of solving a particular problem is more productive for the formation of students' interest in solving problems.

Here is a typical example of such a task.

"Draw an arbitrary set of shapes (squares, triangles, circles) in the picture. Cross out a pair of figures, replacing the crossed out pair with one figure according to the following rules:

(△, ○) = △; (△, □) = ○; (□, ○) = □; (○, ○) = ○;
(□, □) = △; (△, △) = □.

As a result, one figure will remain in the set. Explain why the shape of this remaining figure does not depend on the order in which pairs are chosen for the next strikethrough. Find a way to quickly find the shape of the last figure."

Starting to experimentally cross out figures and replace them with another figure in accordance with the condition of the problem, the student notices that the operation he performs resembles well-known algebraic operations (arithmetic operations): the third component is found from these two components - the result of the operation. Strikethrough Shapes has many properties that are similar to those of number multiplication:

(□, △) = (△, □) = ○; (△, ○) = △; (□, ○) = □

The shape of the remaining figure does not depend on the order of crossing out due to the existing commutative and associative laws of this unusual operation. Students can also easily find quick ways to establish the shape of the remaining figure, for example:

a) all circles are crossed out (without replacement);

b) all triplets of squares or triangles are crossed out.

The aesthetic education of schoolchildren is also an organic part of their upbringing of national independence.

Aesthetic education should be understood as the formation of a system of knowledge and skills related to all arts, all forms of manifestation of beauty in the reality around us and acquired both in the learning process and in extracurricular activities.

The very nature of mathematics presents rich opportunities for instilling in students a sense of beauty in the broadest sense of the word. Such properties of mathematical objects as symmetry, properties of regular polygons, ratio of figure sizes, etc. able to awaken in students an innate aesthetic sense; and it is the business of the mathematics teacher, where possible, to bring this to the attention of the students.

The German psychologist G. Fechner, studying the aesthetic tastes of people, conducted an interesting experiment.

Ten isoperimetric rectangles were cut from the same material with the following adjacent sides:

1) 1:1=1; 2) 6:5=1,2 ; 3) 5:4=1,25 ; 4) 4:3=1,(3) ; 5) 29:20=1,45 ;
6) 3:2=1,5 ; 7) 34:21=1,62 ; 8) 23:13=1,77 ; 9) 2:1=2 ; 10) 5:2=2,5

Each of the participants in the experiment was asked to indicate the rectangle that seemed to him the most beautiful. As a result of the experiment, most of its participants chose a rectangle with an aspect ratio of 34:21 or close to it. But it is for such rectangles that the length of the larger side is approximately equal to the geometric mean between the half-perimeter of the rectangle and the length of the side. So, for example, for a rectangle with an aspect ratio of 34:21 we have:

$$\frac{p}{n} = \frac{55}{34} \approx 1{,}618 \ ; \quad \frac{a}{h} = \frac{34}{21} \approx 1{,}619 \, .$$

The experience of G. Fechner was a confirmation of the property, noticed in antiquity: a rectangle with sides approximately equal to parts of a segment divided in extreme and average ratio is the most pleasant for visual perception.

ISSN NO: 2770-2367
Date of Publication: 10-05-2023

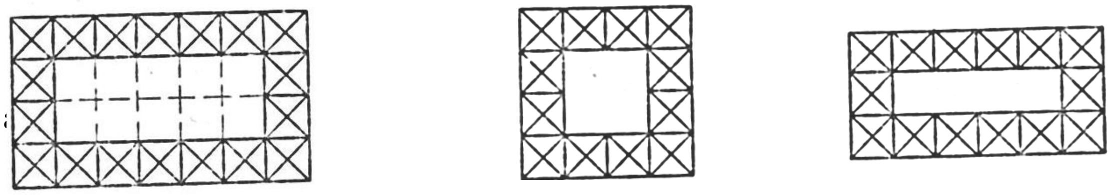
No less important in the aesthetic sense are the so-called elegant solutions to any problem, as well as the possibility for the student to express his own creativity in the process of studying mathematics, in particular, in the process of solving problems.

Problem solving becomes available to almost every student if the teacher encourages the student's efforts in search of an original or rational solution to the problem, and if the teacher constantly evaluates the solutions found by students from an aesthetic standpoint. So, for example, students cannot but deliver aesthetic pleasure by an elegant solution to the following problem:

"Find a rectangle whose sides are integers and whose area is numerically equal to the perimeter."

Solution: The desired rectangle consists of unit squares (cells). On the sides of the rectangle, we select a “border” with a width of one cell (Fig. 1, a).

It is easy to see that it is impossible to establish a one-to-one correspondence between the cells of the border and the linear units of the contour, since there are always 4 (element) units more in the contour.



а) б) в)

drawing.1

Given the condition of the problem, we can conclude that the remaining "core" of the rectangle should contain 4 cells, which can be represented as a rectangle in only two ways:

And . Bordering this “core” with a border, we obtain two possible solutions to the problem (Fig. 1, b, c).

Let's consider another example.

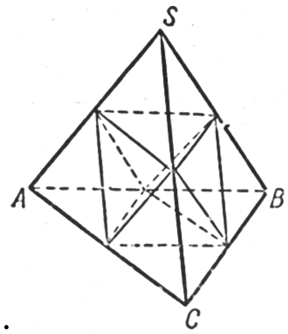
Task. The four trihedral angles of the regular tetrahedron SABC are truncated by sections passing through the midpoints of three edges. Determine the ratio of the volume of the obtained body to the volume of the SABC tetrahedron.

An elegant solution. Let's denote the volume of this regular tetrahedron as SABC - (Fig. 2), the volume of each removed tetrahedron - . Then each removed tetrahedron has linear dimensions twice as small as the original one, which means .

By the condition of the problem, four such tetrahedra are removed, which means, $V_1 = \frac{1}{8}V$.

By the condition of the problem, four such tetrahedra are removed, which means, $4V_1 = \frac{1}{2}V$.

Therefore, the volume of the remaining body (octahedron) is also equal to $\frac{1}{2}V$.



drawing.2

Literature

1. Л.Д.Бройль. По тропам науки. М. 1962г.
2. В.Л.Минковский. Об элементах эстетического воспитания на уроках математики. Математика в школе. 1963г. №4.
3. В.А.Оганесян. и др. Методика преподавания математики в школе. Общая методика. М. Просвещения. 1980г.

ISSN NO: 2770-2367
Date of Publication: 10-05-2023

4. А.Ж.Усаров и др. Методика преподавания математики. Общая методика. Учебное пособие. Т. SAHHOF. 2021г.