

## **DEVELOPMENT OF STUDENTS' CRITICAL THINKING SKILLS IN THE PROCESS OF DRAWING**

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Nowadays, the unprecedented development of information technologies is reflected in the fact that fundamental changes are being made in all spheres of social life without exception. In particular, this rapid development leads not only to the thinking of mankind, but also to a radical change in its way of thinking, and such a new way of thinking is called "critical thinking".

In order to "develop interest in drawing among general secondary school students" in the environment of advanced information technologies, we have three ways to introduce graphic exercises into the educational process of the science of drawing today. appeared to have: 1) introducing elements of interest into the content of each of the 16 graphic works performed in the 8th and 9th grades of the "Drawing" course; 2) Subjects for graphic works related to the creative activity of students, as indicated in the "Drawing" subject program and development of a set of tasks; 3) a set of tasks for the 5th graphic work to be completed within 2 hours in the 19th and 20th lessons of the 9th grade on the topic "Solving creative graphic problems with design elements" and the content of theoretical knowledge used in their implementation development.

1. Review of the types of graphic tasks that can be prepared on the topic of "Design" of the "Drawing" course within the scope of this work.

2. Introduction of levels of complexity to tasks prepared for the subject of "Design", depending on the place they occupy in the "Drawing" course.

3. Development of the content of theoretical knowledge used in the completion of prepared tasks.

Now let's tell you exactly how we solved these tasks one by one.

First of all, let's take the image of the "Endless Staircase" (Fig. 1.1, b). Now, we bring to the readers' attention the isometric image of "The Endless Staircase". The reason that this staircase appears infinite is that elements that are far apart in space (points A and V and points C and D) are depicted very close to each other in the drawing. In order for the image to have the same optical properties in the isometric projection, the lines passing through the points A and V and S and D should form an angle of  $60^\circ$  with the horizontal line on the plan (Fig. 1.2).

Assignment. Using the representations of the blocks given in Figure 1.3, create an isometry of the "Infinite Staircase" as in Figure 1.

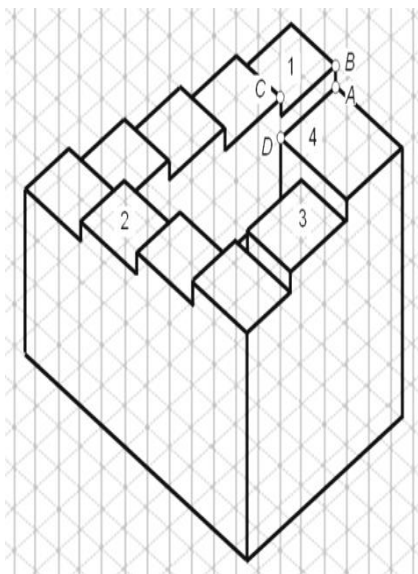


Figure 1.1. An isometric illustration of the Staircase Without Limits.

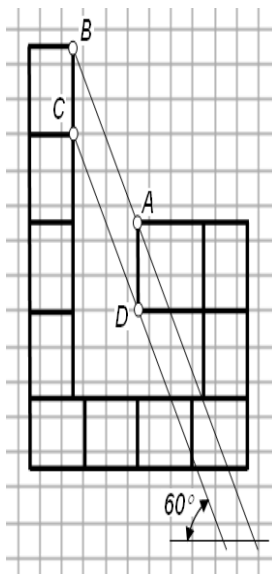


Figure 1.2. Plan of "Stairway Without End"..

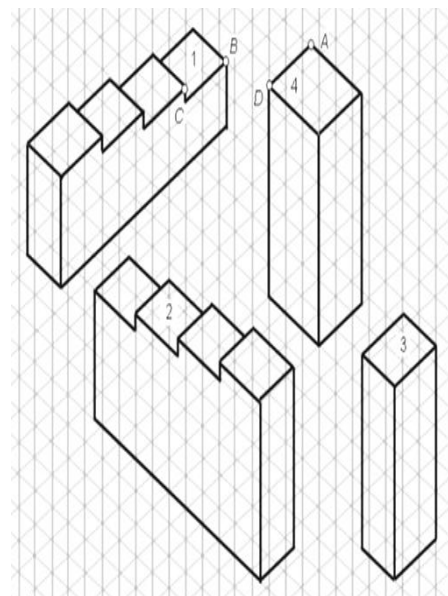


Figure 1.3. Building Blocks for The Endless Staircase.

**Note.** on the basis of the example of the assignment, it is possible to increase or decrease the number of stairs, their thickness, width and length according to the number of sides of the cell, and develop various options for it. The second type of tasks that we involved in our pedagogical test-experimental work is related to "Volume Trapezium", and the details of our work based on it are as follows.

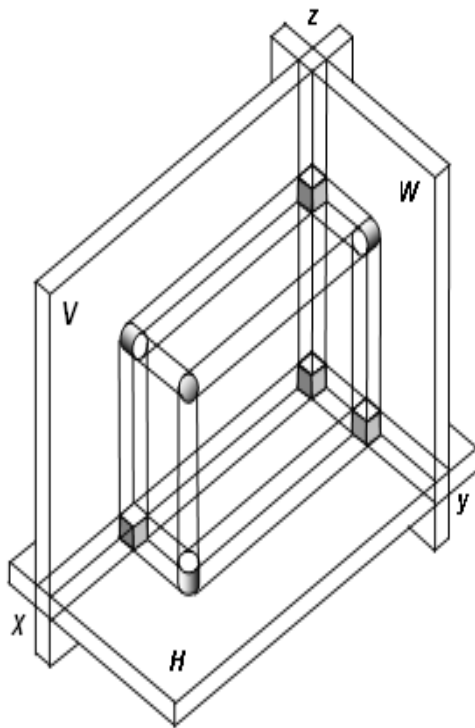
A 20-minute **lecture** in the 1st of two lessons on the topic "Solving creative graphic problems with elements of design" held in the 19th and 20th hours of the 9th grade "Drawing" curriculum:

Scientific teachings developed by the theory of **geometric modeling** lie in solving creative graphic problems. Geometric modeling is considered one of the promising directions of contemporary applied geometry, in which new geometric images that can be used in engineering, architecture, design and various other fields are created and their properties are studied

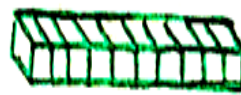
As is characteristic of all areas of creativity, non-standard ways of thinking are often used in geometric modeling when new solutions are being sought.

Let's look at an example.

In the 8th grade, you will learn the topic "General understanding of the octant and epure" in drawing, and after that, in several lessons, you will learn how to create drawings (epures) consisting of two or three projections of various geometric elements, shapes and bodies. so much on You have solved the problems. let's recall the image of dividing the geometric space into 8 octants by means of three mutually perpendicular planes: H, V and W (Fig. 1.4). here it is only necessary to note that in the picture we are seeing now, the projection planes are depicted as thick, that is, "volumetric". The "volumetric straight line" representing the x, y and z coordinate axes created by their intersection has the form of a four-sided prism. as a result, for example, each of the three projections of a "volumetric point" in the form of a sphere becomes a cylinder. "bulky points" representing the coordinates of the spherical "bulky point" here on the x, y, and z axes are parallelepipeds, and the "bulky point" at the origin of the coordinates has the shape of a cube



1.4-figure.



a)

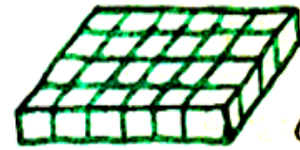


δ)



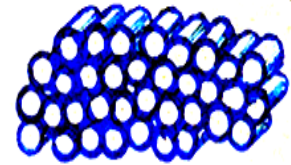
β)

1.5-figure.



a)

δ)



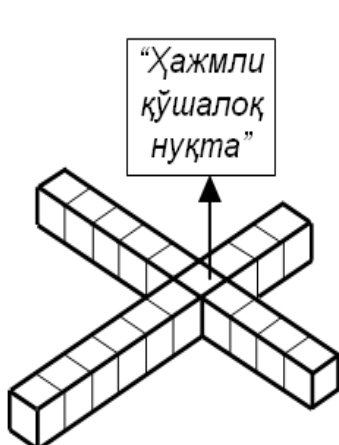
β)

1.6-figure.

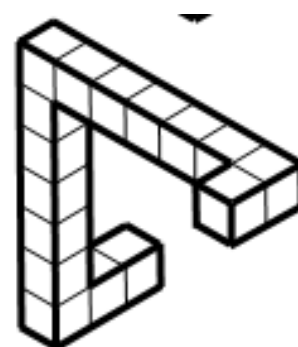
Are there any useful conclusions that can be drawn from this that can be used for creative purposes? It is possible.

"Volumetric points" in space are spheres, "volumetric points" of "volumetric planes" are cylinders, and points of "volumetric straight lines" are parallelepipeds. therefore, "volumetric straight lines" from a series of parallelepiped points (Fig. 1.5, a), "volumetric straight curves" from a series of cylinder points (Fig. 1.5, b), "volumetric spatial curves" from a series of spherical points (Fig. 1.5, c) is established.

Similarly, from the "area of thickness" of parallelepiped-points, we define a "volumetric plane" bounded by any flat "volumetric closed broken line" (Fig. 1.6, a), cylinder-points "of thickness area" with any flat "volume closed broken line" It serves to model the bounded "dimensional plane" (Fig. 1.6, b), the "thickness area" of spherical points, the "thickness surface" of any curvature (Fig. 1.6, c)



1.7-figure.



1.8-figure.

The rule. At the intersection of two "volume lines" consisting of a series of "volume points" of the same name, there are two "volume points" that are not one, but one on the other, i.e., a "double volume point" ladi (Fig. 1.7). the breaking points of the spatial "Volume broken line" formed by a series of cubic points are "double points" (Fig. 1.8).

Assignment for graphic work 5. Identify the graphic error in the given drawing. describe the solution together with its secondary projection in the V or W plane.

As a given drawing, drawing with a graphical error, we get drawing (a) in Fig. 1.2.9. for a clear and understandable process of completing the task, we consider that the object depicted in this drawing is made by lining up 21 cubes. We mark each cube with a specific number (Fig. 1.4, b)

**Instruction.** In graphic work 5, the error made in the drawing in Fig. 1.9 (a) is eliminated by removing three consecutive cubes that make up the image of the object from the composition of the image. the isometry of the resulting object is depicted along with its secondary projection in the V or W plane.

Figure 1.10 shows the table in which version the student will remove the sequence of three cubes

Variant	cubes	Variant	cubes	Variant	cubes
1	<b>1, 2, 3</b>	8	<b>8, 9, 10</b>	15	<b>15, 16, 17</b>
2	<b>2, 3, 4</b>	9	<b>9, 10, 11</b>	16	<b>16, 17, 18</b>
3	<b>3, 4, 5,</b>	10	<b>10, 11,12</b>	17	<b>17, 18,19</b>
4	<b>4, 5, 6</b>	11	<b>11, 12, 13</b>	18	<b>18, 19, 20</b>
5	<b>5, 6, 7</b>	12	<b>12, 13, 14</b>	19	<b>19, 20, 21</b>
6	<b>6, 7, 8</b>	13	<b>13, 14,15</b>	20	<b>20, 21, 1</b>
7	<b>7, 8, 9</b>	14	<b>14,15,16</b>	21	<b>21, 1, 2</b>

Figure 1.10. Options for doing 5th graphic work on 9th grade drawing.

After the tasks are distributed among the students of the class based on this table, they choose their options according to their options in a rough image (sketch) without pressing the pencil on their paper, which is specially gridded with small equilateral triangles. they start looking for solutions.

Undoubtedly, the drawings presented by the owners of various options as the correct solution will be prepared by the teacher in advance. But they are not shown to students.

Now let's analyze the solutions presented by students on the topic of the lesson.

Based on drawing (b) of Fig. 1.9, it can be said that, despite the fact that in the task we created, the solid "Volume trapezoid" consists of 21 cube images, they are represented in the drawing as a row of 17 cube

images. that is, the image of 4 cubes in the 4 corners of the "trapezium" is considered a "double" image, and the image of one of the cubes here is superimposed on the other. They are the following: images of cubes 1 and 2, cubes 6 and 7, cubes 10 and 11, and cubes 18 and 19. thus, the drawing "Volume Trapezium" consists of a series of 17 images of 21 cubes in total. Accordingly, in the process of successively removing all three from the cubes, we face various situations. Such cases can initially be divided into two.

Case 1. Solutions consisting of 14 consecutive cube images. Such solutions include the solution of task option 3 (Figure 1.11) and the solutions of tasks of options 12, 13, 14 and 15 (Figure 1.12). "double" images of cubes at the corners of the "trapezoid" are not involved in the formation of these images.

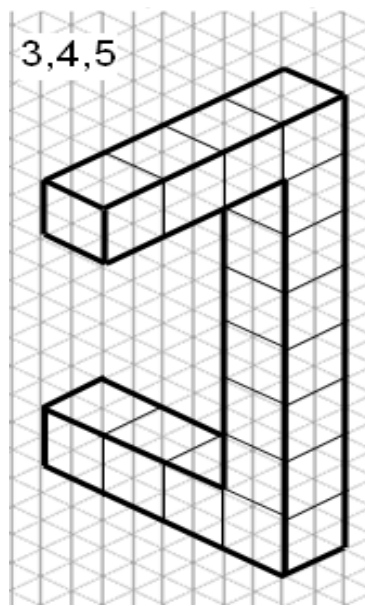


Figure 1.11.  
 The solution to the task in option 3.

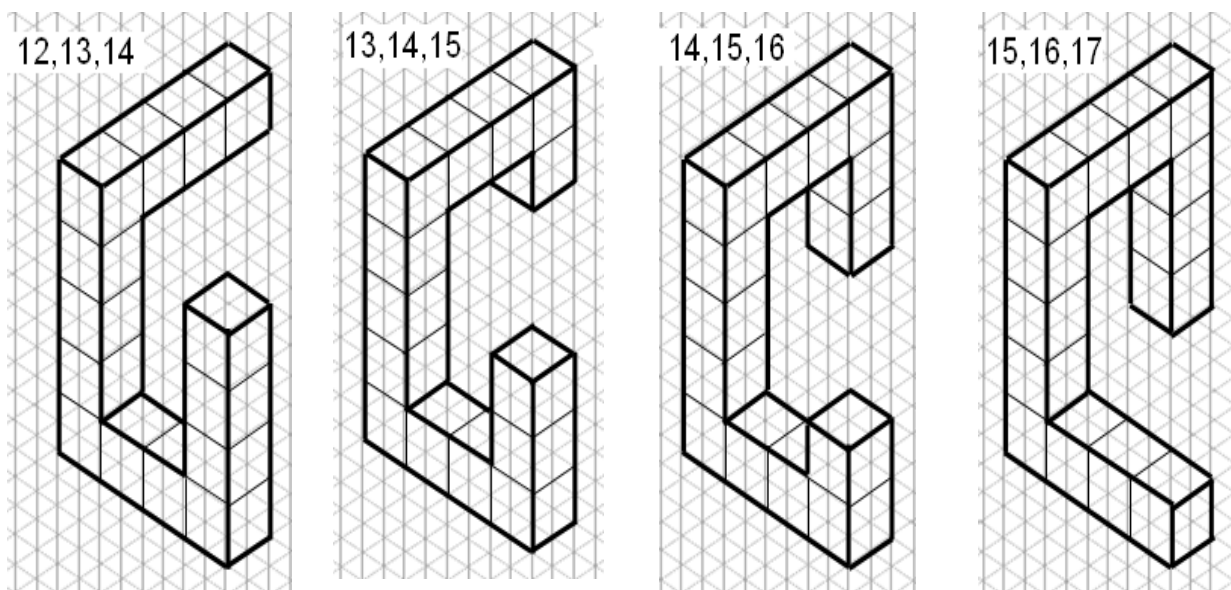


Figure 1.12. Solutions to tasks in options 12, 13, 14 and 15.

Case 2. Solutions consisting of 15 consecutive cube images. In turn, these cases can be analyzed by dividing them into 3 different cases.

Case 2.1. In the formation of solutions for this case, the three cubes that should be removed from the "trapezoid" image include its corresponding Both sides of the "double" cube image located in the corner will be involved. These include the solutions to tasks in options 1, 5, 6, and 9 (Fig. 1.13) and solutions to tasks of options 10, 17, 18, and 21 (Fig. 1.14).

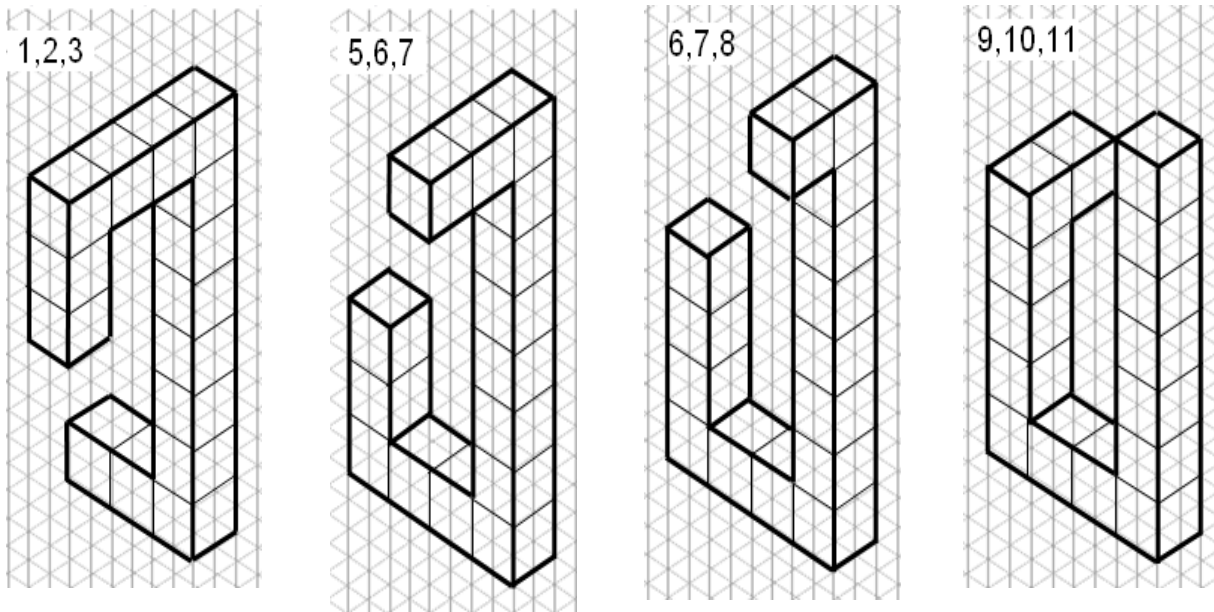


Figure 1.13. Solutions to tasks in options 1, 5, 6 and 9.

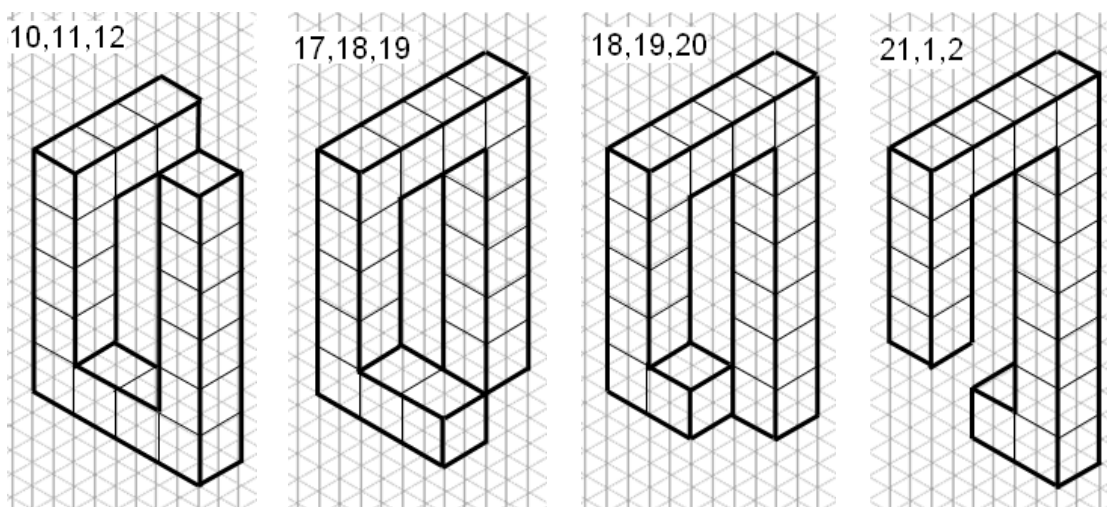


Figure 1.14. Solutions to tasks in options 10, 17, 18 and 21

Case 2.2. In forming the appropriate solutions for this case, only one of the "double" cube images located in its corresponding corner will be involved in the triplet of cubes removed from the "trapezoidal" image. these include the solutions of tasks in the 2nd, 4th, 11th and 16th options (Fig. 1.15).

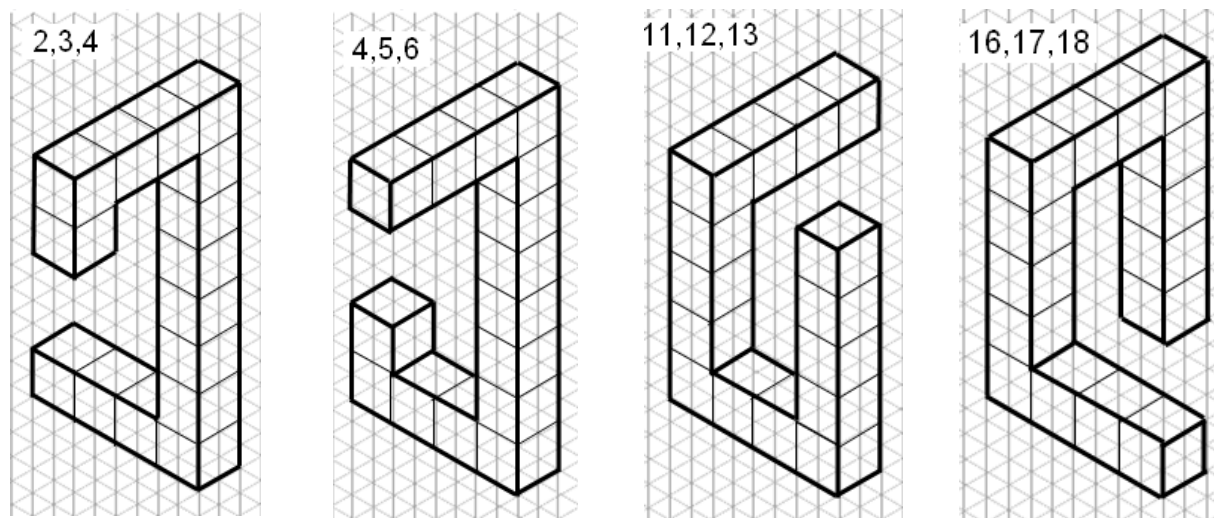


Figure 1.15. Solutions of tasks in options 2, 4, 11 and 16.

Case 2.3. When creating solutions for this case, only one of the "double" cube images, which is located in its corresponding corner, participates in the composition of the three cubes removed from the "trapezoidal" image. but here the solutions of two options remain exactly the same: These include the solutions of tasks in options 7 and 8 and tasks of options 19 and 21 (Fig. 1.16).

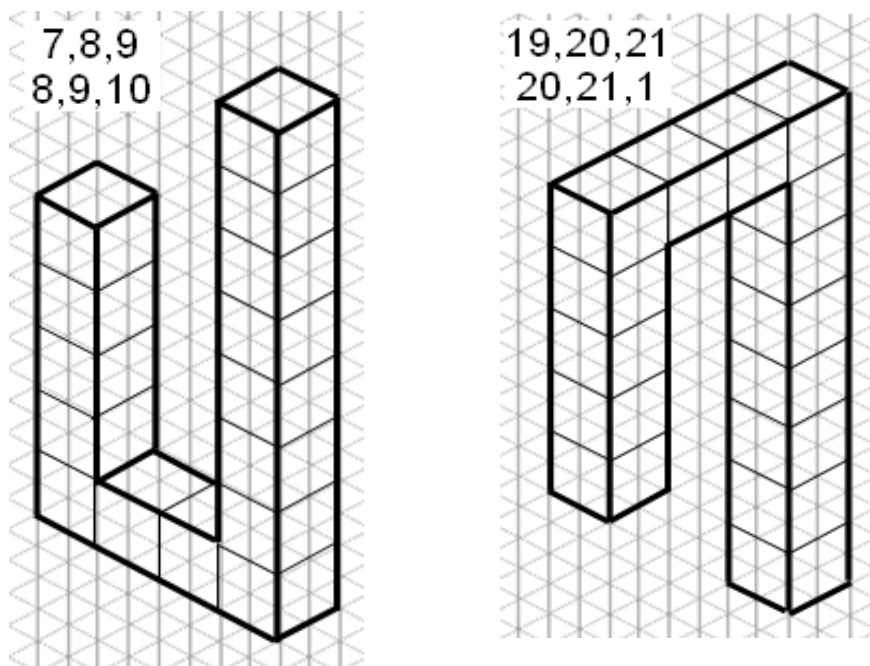


Figure 1.16. Solutions to tasks in options 7, 8, 19 and 20.

An example of the state after the completion of the task is shown in Figure 1.17.

According to the working program on drawing of the 9th grade on the topic "Solving creative graphic problems with elements of design" in the 19th and 20th lessons for 2 hours and the details of which are mentioned above, the activities are very important for us. That's the point it happened that during the 2 weeks of these two classes, drawing activities among the students of the class became more active. every day after class 4-5 students come to us and share their difficulties in creating a solution according to their option, and even after finding a solution, they still have doubts and come back the next day, asking what they ask they became the ones to tell the future.

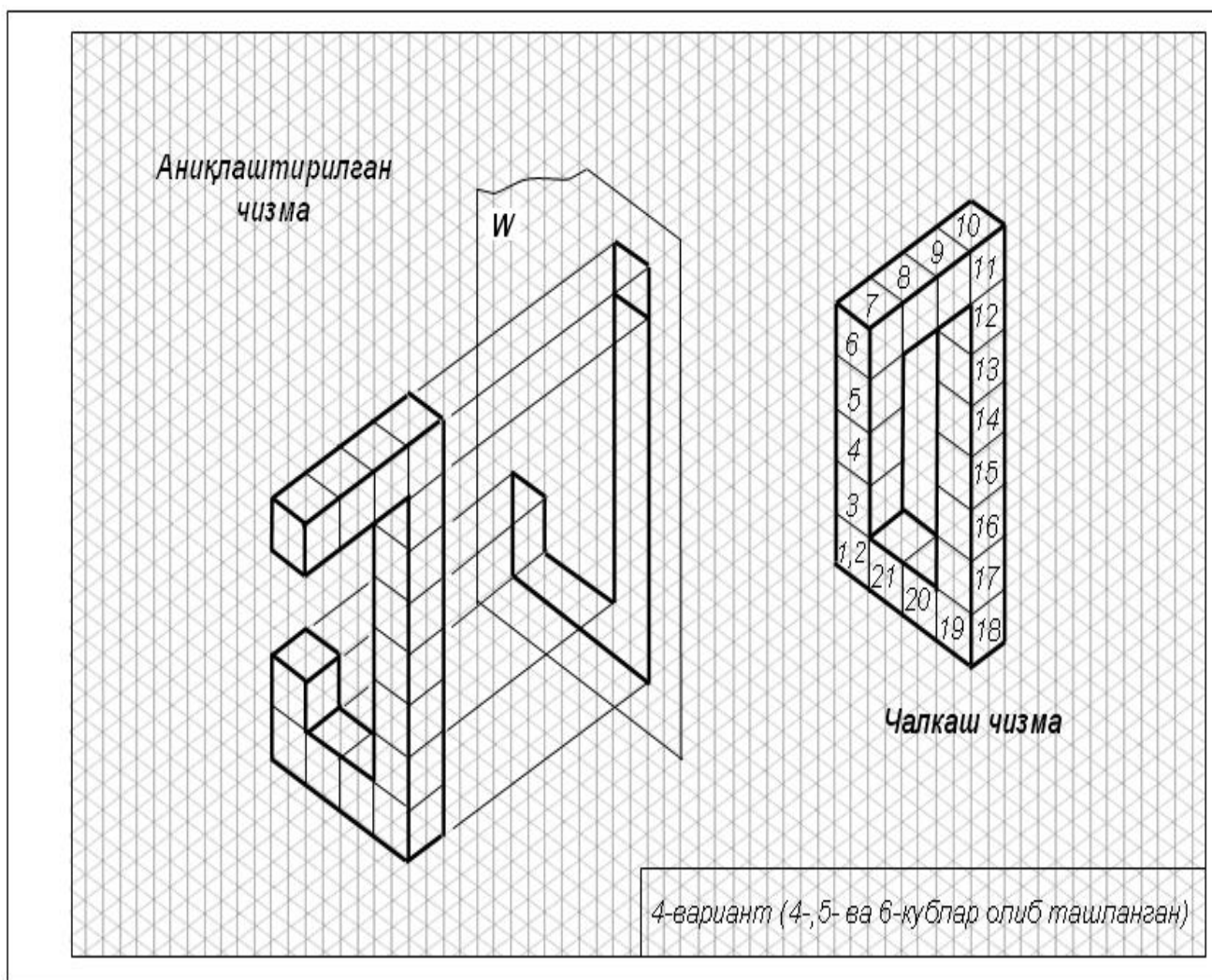


Figure 1.17. Sample of the 5th graphic work on drawing of the 9th grade.

Several times I witnessed three or four students passionately arguing over the assignment diagram in front of the class board during the break. even generally, the slow learners turned to the advanced students for solving their problems, and they wholeheartedly satisfied such requests. some students began to study exactly what changes could be made by increasing or decreasing the total number of cubes forming the "Penrose Triangle" or the "Volume Trapezium" or the number of individual cubes removed from them.

Another important point is that the 9th grade students were sharing their interesting graphic puzzles with the students of the grade below them, and they were also actively participating in solving these types of problems. among the discarded papers collected by the school cleaners, there were only a lot of drafts that were thrown away because they tried to solve interesting graphic tasks, but did not come up with a solution



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