Opportunities to Develop Student Space Imagination in the Process of Teaching Problem Solving in Drawing Geometry

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ABSTRACT

This article shows the role and practical significance of the subject of descriptive geometry in the development of spatial imagination and thinking of students. It describes the content of issues of varying complexity that require study and creative search for solutions to positional problems in the geometry of the drawing.

Keywords: Descriptive geometry, positional problem, metric problem, straight line, projection plane, straight line traces, horizontal trace, front trace, profile trace, imagination, contemplation, creative problem, coordinate arrow, coordinate head.

In today's rapidly evolving and ever-changing world, there is a growing need for highly intellectual and creative personnel. With this mind, our country pays special attention to education. That is why President Mirziyoyev strongly insists that "without new ideas, there is no development and no innovation." In one of his speeches, President Mirziyoyev said that "it is important to further development not only academic science, but also science in higher education.[1]" In our country, large investments are being made in the construction, production and development of innovative technologies.

There is a great need for qualified professionals working in these fields. Such professionals must have a broad imagination and a high level of creativity. The main focus of educational institutions is to identify such talented young people and direct them to the field. In carrying out this responsible task, professors and teachers of technical and pedagogical universities have been working honestly. In particular, the disciplines of descriptive

[1] *Mirziyoyev Sh.M.* Tanqidiy tahlil, qat'iy tartib-intizom va shaxsiy javobgarlik – har bir rahbar faoliyatining kundalik qoidasi bo'lishi kerak. 2016 yildagi Vazirlar Mahkamasining 2016 yil yakunlari va 2017 yil istiqbollariga bag'ishlangan majlisidagi nutqi. – T.: "O'zbekiston", 2017. 46-bet.

geometry and drawing, engineering and computer graphics have their place and practical significance.

The sciences of graphic geometry and drawing have a certain advantage over other disciplines in the development of students' spatial imagination and thinking. This is because these sciences study the methods of drawing geometric shapes in three-dimensional space on a two-dimensional plane or surface. In addition, through the rules of these sciences, it is possible to restore its spatial position, shape-shape through a plane drawing of a geometric shape. Here, in order to understand, comprehend, and "digest" the "transition" from space to the plane, and vice versa, from the plane to the space, one is required to have a strong spatial imagination and thinking. Imagination and contemplation are operations related to cognitive activity in psychology.

Imagination is derived from the Arabic word meaning to think, to imagine, to imagine, to embody.

Imaginating is the reflection in the human mind of something or an event that is perceived as a philosophical and psychological term[2].

Imagination is the basic building material for imagination. In essence, the imagination is the transformation of the imagination, that is, the division of the mind into parts, the unification, the transformation, and so on. The decisive factor in a person's activity is the free imagination, that is, the purposeful free imagination of the activity[3].

The student sees and understands the geometric shape of space. He also mastered the construction of its orthogonal projection in the plane. Thus, the student "performed" the cognitive and imaginative operations of cognitive activity. Various posters and animations are used throughout the lesson, as geometric shapes such as dots, lines, and planes are abstract concepts. The result is visual perception. In life, a point, line, or plane can never be seen or touched with the naked eye. These are scientific terms, and all the details, objects, and even objects of nature in life and technology are a combination of points, lines, and planes.

Points, straight lines, and planes are simple geometric shapes, and the solution of various positional and metric problems between them is given in the textbooks. Even most of the Olympiad problems in graphic geometry are based on them. To be able to solve Olympic problems, a student must be creative. A student's creativity in graphic geometry and drawing directly depends on the level of development of his imagination and thinking.

At present, the level of development of imagination and thinking in the training of future teachers of graphic geometry and drawing is not satisfactory. Students' ability to move from space to a straight line and vice versa, from a straight line to a space, remains low. To solve this problem, pedagogical scientists, designers are conducting research. Our scientific article also describes our firms aimed at overcoming this problem. We offer our own methodological approaches to solve a number of positional problems and the process of teaching it. During our pedagogical activity, we have been experimenting them with these proposals, and it has been yielding positive results.

In our study, one positional question is given as an example, which shows the possibilities of developing students' spatial imagination and thinking in the process of teaching it. First of all, what issues are called positional issues? Let's answer the question. "Problems aimed at determining the third geometric shape formed by the interaction of two geometric shapes are called positional problems." For example, the intersection of two planes, the intersection of a straight line with a plane, the intersection of two surfaces, the drawing of parallel and perpendicular planes, and so on[4]. As an

[2] Ўзбек тилининг изоҳли луғати. «Ўзбекистон миллий энциклопедияси», 4 жилд, 2008-7 б.

[3] Нуркова В.В. Общая психология (Том 3, Память). –М.: «Академия». 2006-318.

[4] Valiyev A.N. Perspektiva. –T.: "Voris-nashriyot" 2012-91 bet.

example, we present a graphical problem of identifying traces of a straight line.

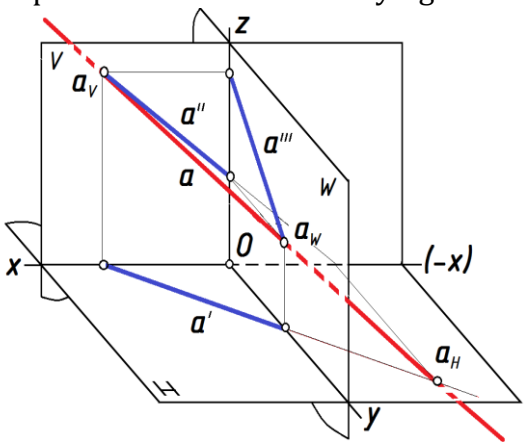


Figure 1

The points of intersection of a straight line with the planes of projection are called traces of a straight line[5]. There are three traces of a straight line in the general position in space: horizontal, frontal, and profile, respectively. There are two traces of straight lines parallel to one of the projection planes, and one trace of the projecting straight lines.

The presentation of this problem and the spatial state of the solution process are shown in Figure 1. However, students find it difficult to do this on the spot, and even some young teachers find it difficult or at least thought-provoking to find a solution if the problem is set a little differently. First of all, let's see if this positional issue fits the definition.

Here the straight line is geometric shape 1 and the projection plane is geometric shape 2. The point of intersection formed by their interaction is geometric shape 3. So the issue is definitely a positional issue. The solution of the problem should be explained to the student using a step-by-step algorithm. Because orderly work is firmly entrenched in a person's memory. Figure 2 shows the current solution of this positional problem.

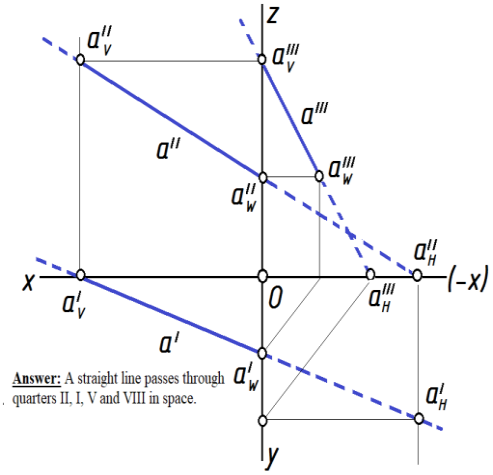


Figure 2

First, we explain how to determine the horizontal trace of a straight line.

- the point a''H intersecting the frontal projection a '' of the straight line a with the axis Ox abscissa (a''∩Ox => a''H) is determined and a vertical connecting line is drawn from it;
- the point a'H intersecting the horizontal projection a 'of the straight line a with the drawn connecting line is determined and this is the horizontal trace of the straight line;
- The profile projection of the horizontal trace aH of the straight line a is determined on the coordinate axis of the Moon by means of connecting lines a '' 'H.

[5] Murodov Sh.K. va boshq. Chizma geometriya. – T.: "Iqtisod-moliya" 2006-2008 yy.

Now let's explain how to determine the frontal trace of a straight line a.

- the point a'V intersects the horizontal projection a 'of the straight line a' with the axis Ox abscissa (a'∩Ox => a'V) and draws a vertical connecting line from it;
- the point a`B intersecting the frontal projection a '' of the straight line a with the drawn connecting line is determined and is the frontal trace of the straight line;
- The profile projection of the frontal trace aV of a straight line a is determined on the Oz coordinate axis by means of connecting lines a '' 'V.

In the last step, we explain how to determine the profile trace of a straight line a.

- the point a'W intersects the horizontal projection a 'of the straight line a with the ordinate of the Moon (a'∩Oy => a'W) and it is moved to the second position of the Moon's axis at an arc or at an angle of 45o, from which a vertical connecting line is drawn;
- Determine the point a '' 'W, which intersects the projection of the profile a' '' of the straight line a with the drawn connecting line, and this is the profile trace of the straight line;
- The frontal projection of the profile trace aW of the straight line a is determined on the Oz coordinate axis by means of connecting lines a''W.

This algorithm can be used to detect traces of a straight line in any situation.

As can be seen from the graph, the frontal, profile, and horizontal traces of a straight line in space as it passes through quarters II, I, V, and VIII are identified. Also, if the drawing is observed, the horizontal projection a 'of the straight line a has the horizontal projection of the frontal track a'V, the horizontal projection of the profile track a'W - the profile projection and the horizontal projection of the horizontal track a'H - horizontal. This rule applies accordingly to each projection of a straight line.

In addition, Figure 3 clearly shows that it is possible to trace the profile of a straight line even if the profile projection a '' 'is not given or drawn.

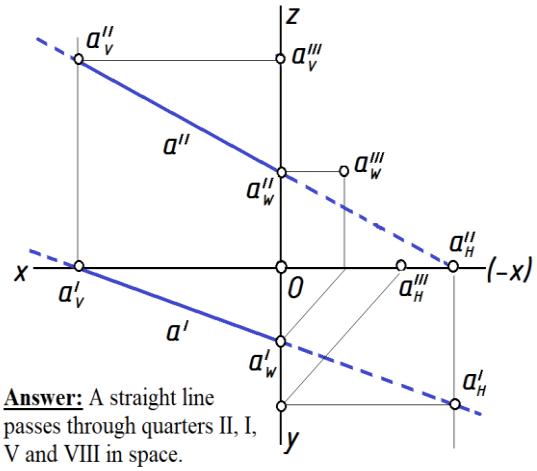


Figure 3

After explaining the above algorithm to the student, the following questions are asked to encourage him to think logically.

1. How many traces of a straight line are there in the general situation?
2. How many traces of a straight line are parallel to the plane of projections, and why?
3. The projector is a nectar trail of a straight line, and why?
4. What is the geometric shape of the profile traces of straight lines drawn at an angle of 60 ° to the plane of the projection of the profile W through a point in space, and why?
5. In what situation do the horizontal and frontal traces of a straight line overlap, and why?
6. Explain the traces of a straight line in the bisector.
7. How many characteristic and non-characteristic traces of a straight line projecting a profile, and why?
8. AB is the nectar trace of a straight line given by its coordinates - A (AX = 0, AY = 0, AZ = 60), B (BX = 80, BY = 70, BZ = 60)?

Many such questions can be asked to compel the student to think logically and develop his or her spatial imagination.

In the next stage, the student is given practical graphic problems. In this case, the problem is not the right position, but the opposite position. That is, if previously it was necessary

to determine the traces of a straight line, now it is necessary to restore the projections of the straight line with traces. Such an inverse position forces not only the student, but sometimes some inexperienced teacher to think.

Here are some of the graphical issues:

a) determine the traces of a straight line passing through the given points A and B (Figure 3, a);

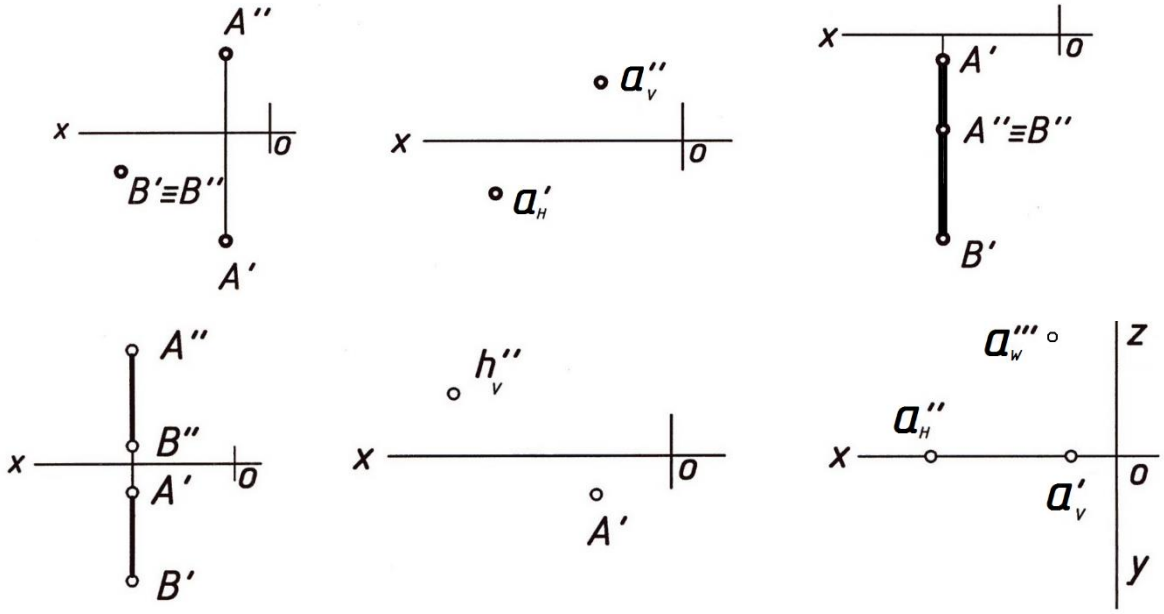
b) determine the projections of a straight line with traces a (Figure 3, b);

c) Identify the traces of the straight line AB (Figure 3, c);

d) Determine the traces of the straight line AB without using the projection of the profile (Figure 3, d);

e) determine the projections of the horizontal straight line h (h ', h ") using the frontal trace and the horizontal projection of the point A lying on it (Figure 3, e);

f) determine the three projections of a straight line a (a ', a ", a' ") given traces (or projections of the trace and the other two traces) (Fig. 3, d);



Such issues require a strong spatial imagination and thinking. Let us now turn our attention to the meaning of the term thinking in cognitive psychology. Tafakkur is an Arabic word meaning to think, to think, to think. First, the process of active perception of objective reality in the imagination, understanding and discussion, the ability to think, to think. Second, it means thinking, reasoning, discussing, thinking[6].

This means that the student analyzes the relationship of a straight line in space with its own traces and planes of projections, thinks about it, imagines the process of geometric construction, that is, reality, and discusses the idea. This is a cognitive activity and the student is mentally stressed. There is a conflict of opinion. The student comes to a final conclusion through short or long thinking, reasoning, comparison, analysis, practical examination, and decision-making. An excellent light upon light if the solution is correct. If there is a mistake, the teacher asks the student questions that lead him / her to the correct answer, reminding him / her of the algorithm and diagram shown in Figure 2. The main achievement here is that the student is encouraged to think, to think, to imagine the abstract, to embody geometric constructions in his imagination, and it is done.

In conclusion, solving many positional and metric problems in graphic geometry and teaching it correctly will help to develop students' spatial imagination and thinking. Then we will have a young generation that has

[6] Ўзбек тилининг изоҳли луғати. «Ўзбекистон миллий энциклопедияси», 4 жилд, 2008-13 б.

its own independent thinking, creative approach to problems and, of course, the ability to find solutions.

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