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PROBLEMS OF DETERMINING THE LEVEL OF SPATIAL IMAGINATION OF STUDENTS IN THE PROCESS OF TEACHING THE COURSE OF ENGINEERING GRAPHICS

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Annotation
This article discusses aspects of improving the effectiveness of training in higher education, strengthening future teachers' sustainable interest in science, educating mature specialists from them by achieving a broad and deep understanding of the foundations of science.

Keywords: mastery, spatial imagination, spatial image..

According to the "National Personnel Training Program," a key priority remains the need to build on existing knowledge to acquire new insights and foster creative thinking skills.
For the learning process to be both productive and effective, students must reach a certain level of cognitive activity. This activity should serve as both a goal and a means in education, particularly in developing students' spatial imagination, which is a fundamental component of cognitive activity.
Imagination, like perception, is a holistic reflection of objects and phenomena as they exist, along with their properties and characteristics. It captures the qualities of things that directly impact the sense organs, such as vision. However, unlike perception, imagination reconstructs images of things that have previously

influenced the human senses, making it a secondary representation of those objects or phenomena.

Defining Spatial Imagination

Spatial imagination is the ability to mentally reconstruct an object's shape, dimensions, parts, and position in space. In other words, it is the mental image of an object formed in memory. Psychologists categorize spatial imagination into two types:

1. **Memory Images:** These involve recalling an object without further mental processing.
2. **Imaginary Images:** These involve mentally processing stored images and enriching them with new hypotheses.

Imaginary images are further divided into two subtypes:

- **Imaginary Images:** New images created through mental processing of given materials, such as drawings, descriptions, and vivid imagery.
- **Creative Imagination Images:** These involve more complex mental transformations and reconstructions.

In drawing lessons, imagination plays a crucial role in mentally visualizing objects from their drawings, constructing images based on descriptions, and generating third projections from two given projections. To effectively teach subjects such as drawing and geometry, educators must first assess the development level of students' spatial imagination. This can be achieved through tests requiring students to engage in spatial reasoning.

Assessing Spatial Imagination

First-year students often exhibit varying levels of spatial imagination due to objective and subjective factors, which can negatively impact their ability to assimilate new material. To address this issue, educators must first assess students' spatial imagination levels and tailor lessons accordingly. Spatial imagination is a crucial factor in mastering graphic sciences effectively.

Test questions help determine students' spatial imagination levels. These tests, based on high school geometry and drawing materials, include problems involving both planar (two-dimensional) and spatial (three-dimensional) reasoning. Students must solve these problems mentally without relying on paper and pencil. While some problems require two-dimensional spatial imagination, others demand the ability to visualize objects and their relationships in three dimensions. The ability to solve such problems mentally indicates a well-developed spatial imagination, while reliance on drawings or models suggests a need for further development.

Experimental Training Stages

The experimental training process consists of two stages:

1. Determining the Level of Spatial Imagination

2. Correction and Development

Based on test results, students' spatial imagination levels are categorized as follows:

- **High Level:** The student correctly answers test questions mentally within the specified time.
- **Intermediate Level:** The student correctly completes the problems but requires pen and paper.
- **Low Level:** The student struggles to solve problems even with the aid of paper, pencil, and geometric models.

Test Questions

Planar Geometry (Planometry)

1. Can a triangle be constructed with given side lengths?
2. Is it possible to form a triangle if the sum of two sides equals the third side?
3. Can a triangle exist if the sum of two sides is shorter than the third side?
4. Can a triangle exist if the sum of two sides is longer than the third side?
5. Given a circle with a 16 cm diameter, will a straight line at a distance of 6 cm, 8 cm, or 10 cm intersect it?
6. Two circles have radii of 2 cm and 3 cm. If the distance between their centers is 4 cm, do they intersect? What if the distance is 10 cm?
7. What angles do clock hands form at 2:00? What about at 10 and 20 minutes past the hour?

8. Given a straight line 8 cm from the center of a circle with a radius of 4 cm, find the shortest and longest distances to a point on the circle.
9. Given a point inside and outside a circle, which is longer: the distance from the point to the tangent or the distance to the nearest intersection?
10. Given a square, what shape is formed by connecting the midpoints of adjacent sides?
11. A rectangular flower garden has a 28-meter perimeter. If the longest side is three times the width, what are its dimensions?

Stereometry and Projection Drawing

1. How many vertices, edges, and faces does a cube have?
2. How many edges meet at each vertex of a cube?
3. How many diagonals are on a cube's surface?
4. How many diagonals can be drawn between opposite cube vertices?
5. How many parallel lines can be drawn from a point outside a plane?
6. What surface is formed when a square rotates around one side?
7. What shape results from rotating a right triangle around its leg or hypotenuse?
8. What surface forms when a right triangle rotates around an axis parallel to one leg?
9. What surface forms when a hexagon rotates around one of its sides?
10. What shape is formed when a cube is cut parallel to an edge?
11. What shape is formed when a cube's edges extending from one end are cut by a plane?
12. What shape appears in the cross-section when a cube is cut diagonally?
13. What shape results when a cylinder is cut parallel or perpendicular to its axis?
14. What shape does a sphere form when cut by a plane?
15. Under what conditions does a ring produce a circular cross-section when cut?
16. What is the position of a line segment relative to projection planes if: a) its projection is a point? b) its length equals its projection? c) its projection is shorter than its length?

18. How do two intersecting lines relate in space if: a) their projections meet at a single point? b) their projections form a single cross-section? c) their projections intersect at two points? d) there is one intersection and a separate point?
19. How is a right triangle positioned relative to projection planes in different views?

Conclusion

By assessing students' spatial imagination levels and structuring lessons accordingly, their understanding of geometry, projection drawing, and technical drawing will improve significantly. This approach should also be applied in engineering graphics courses. The next stage of research will focus on developing teaching methods and tools to enhance spatial imagination in engineering education.

Organizing engineering graphics lessons requires a creative approach from educators. Higher education institutions must take on the responsibility of fostering active, inquisitive, and creative individuals. Developing cognitive activity through spatial imagination is crucial not only for effective learning but also for overall intellectual development. This, in turn, fosters a deeper respect and enthusiasm for students’ future professions.

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