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Psychological and Pedagogical Basis of Formation of Student Space Imagination in Teaching Graphics of Engineering

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ABSTRACT: The article reveals one of the important abilities of a creative person – his/her ability to imagine space, as well as the psychological and pedagogical features of the laws of spatial imagination and its development in students in the process of teaching graphics of engineering.

KEYWORDS: spatial imagination, psychological, pedagogical, projection drawing, geometry of the drawing, intellectual, visual, object, model, abstract.

It is well known that the main purpose of drawing is to teach how to draw and read objects. To achieve these goals, students are required to have sufficient spatial imagination.

Therefore, it is expedient to consider a number of graphic sciences, such as engineering graphics and descriptive geometry, not only as general education disciplines, but also as a field of human knowledge aimed at actively developing graphic training and spatial imagination in students.
Students' spatial imagination and logical thinking skills are further formed and developed in the department of drawing "Projection drawing" and the course "Drawing geometry". This is because students are more likely to communicate with each other, compare their knowledge, exchange ideas, and use their knowledge to solve a problem. and spatial imagination skills are formed and strengthened. There are instances of mental analysis, comparison, screening, and the optimal application of all accumulated experiences.

It is known that the visual materials used in educational practice can be divided into three groups.
- existing objects and models in space (objects, models, geometric objects, etc.), which can also include perspective images (photographs, artistic reproductions);

- conditional graphic images (drawings, sections, cuts, sketches, etc.), differing in the variety of shapes and contents;
- defined models (graphs, geographical maps, topographic plans, diagrams, chemical formulas and equations, mathematical symbols).

The visual aids in each group interact differently with the object they reflect and play a different role in revealing its spatial properties and relationships. They differ from each other in their content and create different conditions to have a correct idea about the object.

Natural models and their perspective images are its substitute models that retain exactly the same resemblance to existing objects. Based on these models, an image of a real object can be created in our minds through direct observation. They form the basis for students to form a clear picture of the objects they are studying. They are also a means of activating students 'logical thinking, as they can verbalize features that are not expressed in an image and fill in information about images.

Conditional graphic images, unlike spatial objects, can reveal properties that are not directly perceptible about the object being studied. Somewhat independent of the specific features of the object, they provide information about the construction of the object, its geometric shape, proportions, the spatial location of its individual parts.
All this allows us to raise some issues related to the use of the principle of demonstration in the teaching process. There are many models of an object that are clearly given with images that correspond to that image at different levels of abstraction. Therefore, in cultivating spatial thinking, attention should be paid to the design of models that have the

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same appearance, which differ from each other in their structure. Because in this process there is a peculiar adaptation of spatial imagination, which is formed differently in different conditions - a creative researching. Therefore, depending on the task, it should be noted in the image that not all the features and characteristics of the object, but those that are necessary for the successful implementation of the activity. In this regard, the effective and purposeful use of visual aids in drawing lessons is one of the main tools in the formation of students' spatial imagination.

Current curricula in engineering graphics and descriptive geometry focus on shaping students' skills in performing graphic tasks. The main part of the graphical tasks is given based on the problem-solving algorithm, or on the basis of ready-made task options. In the current context, the ability to see, analyze and understand images is of great importance in the intellectual development of the student. In the process of teaching, the student is a very complex physiological, psychological and pedagogical subject, and the formation of students' spatial imagination on the basis of the acquired knowledge, skills and abilities is a complex activity. Only when curiosity becomes a need and need becomes a goal do students become spiritually ready to consolidate and enhance their knowledge and mobilize the knowledge they have acquired over the years in the process.

With the help of logical thinking and perceptual literacy, a person can simultaneously improve visual analyzers, perception, imagination, development of thinking, psychological processes that take place in his mind. Because every stage of cognition begins with perception, including the formation of spatial perceptions, they understand their properties by observing and analyzing some information, for example, existing objects in existence and drawings, diagrams, models, pictures, etc. in the plane. by perceiving their abstract images, they gain an initial knowledge of them. In order to understand them, it is necessary not only to look at the given image, but also to be able to read the image or the information transmitted through it, to reconstruct in space, to understand its properties, that is, to analyze visual information.

For example, if a spatial and flat geometric figure is depicted, in some cases the depicted figure can be considered as an element, in another case - its main body and elements are separated in the drawing. Thus the separation of bodies into components takes place. In the process that takes place in our minds, the grouping of fragments divided into elements, homogeneous according to the shape or content of the element, plays an important role. In order to have a complete picture of visual information, it is also necessary to understand the connections between its elements.

During the perception of the given pictorial information, the student compares and clarifies the individual parts of it with simple objects and concepts known to him. Defining a standard situation - in the process of setting the task (use the sign of parallelism to build a cube), as well as by highlighting familiar concepts in new conditions (triangle sides - intersections, ends - points), explain the specific appearance of the general concept (triangle - equilateral triangle or an equilateral triangle).

When working with explicit visual learning material, spatial thinking activities are focused on creating a holistic spatial imagination. The spatial cross-sections created do not have to be a rigid image. In the learning process, working with spatial images involves not only the reconstruction of the object, but also the performance of actions on them, fragmentation, rounding of individual elements, interaction with other objects as part of the object, and these constitute spatial thinking. All this serves to form a generalized spatial image that is close to concepts. Spatial properties and relationships are inseparable from a particular object and subject - these are especially evident in geometric objects (three-dimensional surfaces, models, drawings, diagrams, etc.) that have a specific abstract appearance of real objects. Therefore, geometric objects (their various combinations) serve as the main tool in the formation of spatial imagination and operations on them.

In modern psychology, the concept of **spatial imagination** is associated with the concept of an image formed as a result of the perception of an object or event. Spatial perception is a holistic subjective image in which the spatial object or phenomenon is transformed and perceived in our minds, and in the process of this activity the pictorial information is reflected in the memory. Therefore, we can look at the process of forming and developing the spatial imagination as a process of creating images in our minds and acting on them.
Spatial imagination is a unit of knowledge and their images obtained as a result of analysis, perception of information about it on the basis of a real object or model through the sensory organs.

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ready-made task options. If such a methodological approach is possible in the teaching of drawing in secondary schools, the same cannot be said about the teaching process in high school.

In the current context, the ability to see, analyze and understand images is of great importance in the intellectual development of the student. In the process of teaching, the student is a very complex physiological, psychological and pedagogical subject, and the formation of students' spatial imagination on the basis of the acquired knowledge, skills and abilities is a complex activity. Only when curiosity becomes a need and need becomes a goal do students become spiritually ready to consolidate and enhance their knowledge and mobilize the knowledge they have acquired over the years in the process.

With the help of logical thinking and perceptual literacy, a person can simultaneously improve visual analyzers, perception, imagination, development of thinking, psychological processes that take place in his mind. Because every stage of cognition begins with perception, including in the formation of spatial perceptions, they understand their properties by observing and analyzing some information, such as existing objects in existence and planes, diagrams, models, raems, etc. by perceiving their abstract images, they gain an initial knowledge of them. In order to understand them, it is necessary not only to look at the given image, but also to be able to read the image or the information transmitted through it, to reconstruct in space, to understand its properties, that is, to analyze visual information.

The analysis of visual information begins with the formation of a general idea of the information presented in the images (object, model, raem, drawing, scheme, etc.) and the separation of its elements.

For example, if a spatial and flat geometric figure is depicted, in some cases the depicted figure can be considered as an element, in another case - its main body and elements are separated in the drawing. Thus the separation of bodies into components takes place. In the process that takes place in our minds, the grouping of fragments divided into elements, homogeneous according to the shape or content of the element, plays an important role. In order to have a complete picture of visual information, it is also necessary to understand the connections between its elements.

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Thus, in the process of mastering new material, the student sees familiar objects as a drawing, scheme, graph, or model element, separates and clarifies them, that is, applies a familiar standard situation to the given information. Preliminary data from the given information are the basis for distinguishing the symbols of a geometric object and forming its primary image.

The student then identifies and details the initial descriptive information, comparing it with some generalized images (model, standard). As a result of mental and visual analysis and comparison, new additional information is obtained, while they are checked with knowledge about the object, the differences between the standard and it are assessed. Thus, in the student's memory, the initial formation and the final consolidation take place - an abstract image of the existing object in existence, that is, a spatial imagination.

When working with explicit visual learning material, spatial thinking activities are focused on creating a holistic spatial imagination. The spatial cross-sections created do not have to be a rigid image. In the learning process, working with spatial images involves not only the reconstruction of the object, but also the performance of actions on them, fragmentation, rounding of individual elements, interaction with other objects as part of the object, and these constitute spatial thinking. All this serves to form a generalized spatial image that is close to concepts.

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