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PEDAGOGICAL CONDITIONS AND CRITERIA FOR THE DEVELOPMENT OF GRAPHIC COMPETENCE

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Abstract. This article presents a scientific, theoretical, and methodological analysis of the pedagogical conditions, didactic principles, and assessment criteria for developing the graphic competence of future specialists. It explores the nature, content, and structural components of graphic competence, as well as the pedagogical factors influencing its formation. The article substantiates the close relationship between graphic competence and spatial visualization, logical and graphic thinking, the analysis of engineering drawings and graphical information, the modeling of technical objects, and the ability to solve engineering problems independently. Furthermore, it highlights the pedagogical significance of the professional orientation of educational content, the integration of theoretical knowledge with practical activities, the application of problem-based and task-based learning methods, the organization of independent graphic activities, and the effective use of digital educational tools. The article also substantiates opportunities for the systematic development of students' graphic competence through the differentiation of graphic assignments according to their levels of complexity, the development of individual learning pathways, the implementation of self-assessment, and the provision of feedback. The scientific and methodological approaches presented in the article aim to improve the effectiveness of graphic competence development, ensure the objective assessment of learning outcomes, and enhance the professional preparedness of future specialists.

Keywords: graphic competence, pedagogical conditions, assessment criteria, competency-based approach, graphic thinking, spatial visualization, graphic literacy, engineering graphics, descriptive geometry, cognitive component, motivational and value component, activity-based and practical component, reflective component, digital educational technologies, graphic modeling, independent graphic activity, professional competence, learning effectiveness.

Introduction. Today, improving the education system, strengthening the professional training of future specialists, and developing their independent thinking and practical skills are among the most pressing areas of pedagogical research. In particular, developing the graphic competence of students enrolled in technical and engineering programmes is of considerable importance. This is because modern specialists are expected not only to acquire sound theoretical knowledge but also to possess the ability to visualize spatial objects, read and produce engineering drawings, analyze graphic information, understand the structural and design features of technical objects, and independently solve engineering problems. In this regard, the development of graphic competence is recognized as one of the essential pedagogical factors contributing to the professional development of future specialists.

Graphic competence is a complex, integrative quality that represents an individual's ability to effectively apply knowledge, skills, and abilities related to working with drawings and graphic representations in practical activities. It encompasses a range of interrelated activities, including perceiving graphic information, analyzing its content, forming spatial representations, identifying the characteristics of geometric and technical objects, solving graphic problems, and substantiating

the results obtained. The development of this competence is closely associated with students' cognitive engagement, logical thinking, spatial imagination, interest in graphic activities, and ability to work independently. Therefore, graphic competence should be interpreted not merely as the outcome of mastering drawing techniques but as an integrated pedagogical outcome that combines an individual's intellectual, practical, and professional capabilities.

The subjects of Descriptive Geometry and Engineering Graphics play a particularly important role in developing graphic competence. Through these subjects, students study the spatial properties of geometric shapes, master projection methods, acquire skills in reading and producing drawings, representing sections and sectional views, analyzing the shapes of components, and solving technical problems through graphic methods. These knowledge and skills serve as a methodological foundation for developing students' spatial thinking, applying theoretical knowledge in practical situations, and cultivating the ability to independently solve graphic problems required in their future professional activities. However, achieving these outcomes cannot be limited to the traditional presentation of learning materials. It is necessary to ensure consistency in educational content, progressively increase the complexity of graphic assignments, integrate theory with practice, and purposefully organize students' independent graphic activities.

The effective development of graphic competence primarily depends on the establishment of appropriate pedagogical conditions. Pedagogical conditions refer to a set of factors that ensure the achievement of educational objectives by coordinating the content, methods, organizational forms, and pedagogical interactions within the learning process. From the perspective of developing graphic competence, particular importance is attached to the professional orientation of educational content, the consistent and systematic acquisition of graphic knowledge, the purposeful organization of practical classes, the use of problem-based learning situations, the establishment of interdisciplinary connections, and consideration of students' individual characteristics. Furthermore, teachers' methodological competence, the methods used to select and present graphic assignments, the encouragement of students' independent activities, and the establishment of regular feedback contribute to the consistent development of graphic competence.

The practical orientation of the educational process is of particular methodological importance in developing graphic competence. Alongside acquiring knowledge related to graphic activities, students should have opportunities to apply this knowledge while completing practical assignments of various types. For this purpose, it is advisable to systematize graphic assignments from simple to complex and organize them according to three levels of activity: reproductive, partially exploratory, and creative. Such an approach enables students initially to perform graphic operations using predetermined algorithms and subsequently to develop the ability to seek solutions independently, compare alternative methods, and substantiate the results of their activities. As a result, graphic activity extends beyond the mere production of drawings and becomes a complex cognitive process aimed at analysis, decision-making, and independent problem-solving.

Another important aspect of this process is the scientific determination of criteria for identifying and assessing the level of development of graphic competence. Evaluating educational outcomes solely on the basis of the accuracy of the final drawing or students' theoretical knowledge does not provide a comprehensive assessment of their graphic competence. This is because graphic competence manifests itself through the interrelationship of knowledge, practical activity, motivation, and the ability to analyze one's own performance. Therefore, it is important to consider the motivational-value, cognitive, activity-based and practical, and reflective components when determining the level of its development. The motivational-value component reflects students' interest in graphic activities and their awareness of the professional significance of such activities;

the cognitive component represents their level of knowledge of graphic principles and methods; the activity-based and practical component indicates their ability to complete graphic assignments; and the reflective component demonstrates their ability to analyze the results of their own activities, identify errors, and take measures to eliminate them.

Developing criteria and indicators corresponding to these components helps ensure consistency and objectivity in the assessment of graphic competence. In this process, attention should be paid to students' level of mastery of graphic knowledge, accuracy in reading and producing drawings, ability to solve graphic problems based on spatial visualization, capacity for independent decision-making, appropriateness of the methods used to complete assignments, and ability to evaluate their own performance. Clearly defined assessment criteria enable teachers to analyze educational outcomes, identify existing shortcomings, and improve methodological approaches aimed at developing graphic competence.

From this perspective, identifying the pedagogical conditions for developing graphic competence, scientifically substantiating its structural components, developing assessment criteria and indicators for determining its level of formation, and improving the mechanisms for their implementation in the educational process constitute a relevant scientific and methodological problem. A systematic investigation of this problem will provide the necessary theoretical and practical foundations for improving the content of graphic education, increasing the effectiveness of practical classes, developing students' independent graphic activities, and strengthening the professional training of future specialists.

The content, sequence, and organizational methods of practical classes are of considerable methodological importance in developing graphic competence. The process of completing graphic assignments should encompass all stages, beginning with students' acquisition of theoretical knowledge and progressing towards their independent application in practical activities. On this basis, it is proposed that practical classes in the subject of Descriptive Geometry and Engineering Graphics, aimed at developing graphic competence, should be organized in four stages.

Stage 1 — Motivational and Cognitive Preparation

At this stage, particular attention is paid to stimulating students' interest in the topic being studied, helping them understand the professional significance of graphic activities, and activating the necessary theoretical knowledge. The teacher explains the objectives of the topic, its fundamental concepts, geometric principles, and the essence of the graphic assignment to be completed. For example, when studying the topic of projection, the relationships between representations of a geometric object on different projection planes are explained. Students are guided towards understanding the relationship between the spatial shape of an object and its representation in a drawing.

The main objective of this stage is to ensure students' readiness to acquire graphic knowledge, develop a positive attitude towards the subject, and establish the cognitive foundation necessary for subsequent practical activities.

Stage 2 — Graphic and Analytical Activity

At this stage, students analyze the shape, structure, principal elements, and relationships between the components of a given geometric or technical object. The main areas of activity include understanding the conditions of a graphic problem, identifying the necessary geometric constructions, selecting an appropriate representation method, and determining the sequence of operations required to complete the task.

Before developing a graphic solution, students are taught to analyze the content of the problem, identify the available information, and determine the relationships between its constituent elements.

For this purpose, it is advisable to employ question-and-answer techniques, problem-based situations, comparison, and analytical methods. Alongside developing the cognitive component of graphic competence, this stage helps students develop independent thinking, logical reasoning, and the ability to determine appropriate strategies for solving graphic problems.

Stage 3 — Practical and Graphic Activity

At this stage, students directly complete graphic assignments on the basis of the theoretical knowledge they have acquired. They develop skills in correctly using drawing instruments, accurately constructing geometric elements, coordinating projections, applying line types appropriately, indicating dimensions, and preparing drawings in accordance with the relevant technical requirements.

When completing practical assignments, particular attention is paid to students' working processes, the sequence of construction operations, accuracy, and degree of independence. Where necessary, the teacher provides methodological guidance while creating opportunities for students to develop graphic solutions independently.

Differentiating assignments according to their levels of complexity is one of the essential conditions of this stage. Initially, students complete simple geometric constructions. Subsequently, they are required to connect several geometric elements, create complex representations, and independently produce drawings of technical objects. This stage contributes to the development of the activity-based and practical component of graphic competence.

Stage 4 — Independent and Reflective Activity and Assessment

At the final stage, students complete independent graphic assignments based on the knowledge and skills they have acquired. They analyze the problem conditions, select an appropriate graphic solution method, independently produce drawings, and verify the accuracy of their work.

During the analysis of completed assignments, particular attention is paid to identifying graphic errors, understanding the causes of their occurrence, making the necessary corrections, and evaluating the results of their own activities. Students are required not only to present the completed drawing but also to explain the method applied and justify the selected graphic solution.

This stage contributes to the development of the reflective component of graphic competence, creates conditions for students to adopt a critical approach to their own activities, and enables them to complete subsequent assignments more effectively.

The main feature of the proposed model is that graphic activity develops systematically, beginning with motivational and cognitive preparation and progressing through analytical and practical activities towards independent problem-solving and reflective assessment.

Assessment Criteria and Indicators of Graphic Competence

To determine the effectiveness of the process of developing graphic competence, it is necessary to establish clear criteria and indicators that make it possible to assess its level of formation. Assessment should not be based solely on the final quality of a drawing but should also encompass students' theoretical knowledge, ability to conduct graphic analysis, practical skills, independence, and reflective activities.

Assessment Criteria and Indicators of Graphic Competence

Based on the structural components of graphic competence, the following four main criteria are proposed for its assessment.

Assessment criteria	**Main indicators**

1. Motivational-Value Criterion	Interest in graphic activities; awareness of the professional significance of drawing and graphic knowledge; willingness to complete assignments; responsibility and perseverance.
2. Cognitive Criterion	Knowledge of geometric concepts and principles; understanding of projection methods; ability to read drawings; spatial visualization of objects; ability to analyze graphic problems.
3. Activity-Based and Practical Criterion	Ability to complete graphic assignments independently; accuracy of geometric constructions; proper use of drawing instruments; preparation of drawings in accordance with established requirements; practical application of graphic solutions.
4. Reflective and Assessment Criterion	Checking one's own work; identifying and correcting errors; justifying graphic solutions; analyzing results; evaluating and improving one's own performance.

These criteria are interrelated and serve to provide a comprehensive assessment of various aspects of graphic competence. For example, a student may have theoretical knowledge of projection principles but may encounter difficulties when applying them in practical assignments. Similarly, producing a drawing that meets the required standards does not necessarily indicate that the student fully understands the graphic solution, can justify it, or is capable of independently identifying errors. Therefore, all the criteria should be applied in an integrated and coordinated manner.

Levels of Graphic Competence Development

Based on the assessment criteria, students' graphic competence can be characterized at three levels:

- Basic Level. The student has partially mastered the fundamental graphic concepts but requires the teacher's assistance and model-based instructions when completing more complex assignments. The ability to independently identify and correct graphic errors remains limited.

- Intermediate Level. The student understands the fundamental geometric and graphic principles and is capable of completing typical graphic assignments. However, in new or more complex situations, the student may experience certain difficulties in selecting an appropriate solution method, justifying the graphic results, and independently identifying and correcting errors.

- Advanced Level. The student independently analyzes graphic problems, selects an appropriate solution method, produces accurate drawings in accordance with established requirements, justifies the results, and independently identifies and corrects errors in their own work.

These levels make it possible to determine the extent to which students' graphic competence has been developed and to identify appropriate forms of individualized methodological support within the educational process. For the practical assessment of these levels, it is advisable to use clearly defined indicators for each criterion and a predetermined assessment scale.

Conclusion. Based on the analysis of the pedagogical conditions and assessment criteria for developing graphic competence, the following conclusions have been drawn.

First, graphic competence is an integrative professional quality that combines the theoretical knowledge, spatial visualization, graphic thinking, practical skills, and reflective abilities of future

specialists. Its development requires not only the acquisition of graphic knowledge but also the application of this knowledge to practical tasks and the independent development of graphic solutions.

Second, the effective development of graphic competence requires professionally oriented educational content, the integration of theory and practice, the gradual increase in the complexity of assignments, encouragement of independent activities, an individualized approach, and the provision of reflective assessment.

Third, a methodological model aimed at the systematic development of graphic competence has been proposed, based on organizing practical classes through four successive stages: motivational and cognitive preparation, graphic and analytical activity, practical and graphic activity, and independent and reflective activity. Within this model, the student is regarded not as a performer who merely reproduces a ready-made solution but as an active participant who analyzes graphic problems, selects appropriate solution methods, produces drawings, and evaluates the results of their own work.

Fourth, the use of motivational-value, cognitive, activity-based and practical, and reflective assessment criteria has been identified as an appropriate approach to evaluating graphic competence. These criteria make it possible to comprehensively assess students' graphic knowledge, practical skills, ability to work independently, and capacity to analyze the results of their own activities.

In general, the development of graphic competence should be based on the harmonious integration of educational content, pedagogical conditions, practical activities, and assessment criteria. The proposed theoretical and methodological approaches can serve as a methodological foundation for the purposeful development of graphic competence in the teaching of Descriptive Geometry and Engineering Graphics, strengthening students' independent and creative activities, and improving the professional training of future specialists.

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