

## METHODS OF TEACHING COMPLEX SECTIONS OF DESCRIPTIVE GEOMETRY TO STUDENTS OF ARCHITECTURAL SPECIALTIES

### МЕТОДИКИ ВИКЛАДАННЯ СКЛАДНИХ РОЗДІЛІВ НАРИСНОЇ ГЕОМЕТРІЇ СТУДЕНТАМ АРХІТЕКТУРНИХ СПЕЦІАЛЬНОСТЕЙ

*The work is devoted to improving the methods of teaching the discipline «Descriptive Geometry» to students studying in the specialty «Architecture and Town Planning».*

*High-quality training of specialists is an important task of higher education institutions. Descriptive geometry, which is closely related to the disciplines that are studied in the future directly in the specialty, is basic, so special attention should be paid to its high-quality mastery. Problems that lead to a decrease in the success and quality of training in the discipline have been identified, which prompted teachers to search for and develop new effective methods of teaching it.*

*In the second semester of the 2024–2025 academic year, the Odesa State Academy of Civil Engineering and Architecture (OSACEA) applied a methodology for teaching descriptive geometry, according to which, along with the presentation of the main material of the classes, students were sent pre-made video recordings of explanations of the implementation of examples of individual tasks and solving problems. Viewing the filmed material the required number of times and the ability to enlarge the images as a result allowed students to independently understand the problems that arose and solve the problems. Analysis of the learning results and a survey among students indicated the advantages of such a methodology. The work also focuses on the proposed methodology for teaching one of the complex topics in descriptive geometry. The teachers used specially developed step-by-step images of an example of solving the problem, each of which is accompanied by a detailed description of the constructions. This approach allowed students to review the material for the amount of time they needed and independently deal with the problems that arose when solving the problems. The teacher, in turn, did not waste time on repeated constructions on the board or in a graphic editor. This teaching methodology allowed them to work effectively with the group, increasing the success rate and level of training of students. In order to assess the effectiveness of implementing the improved methodology into the educational process, an analysis of the learning outcomes was conducted. It was determined that in the groups of the 2024–2025 academic year, where the new methodology was used, the speed of execution and the quality of work are higher than in the groups of previous years of study. The proposed methodology for teaching descriptive geometry is effective and can be implemented in the educational process.*

**Key words:** *descriptive geometry, teaching methods, specialty «Architecture and Town Planning», training format, quality of education.*

*Робота присвячена вдосконаленню методів викладання дисципліни «Нарисна геометрія» студентам, які навчаються за спеціальністю «Архітектура та містобудування».*

*Якісна підготовка спеціалістів є важливою задачею закладів вищої освіти. Нарисна геометрія, яка тісно пов'язана з дисциплінами, що вивчаються в подальшому безпосередньо за спеціальністю, є базовою, тому потрібно приділяти особливу увагу її якісному засвоєнню. Були виявлені проблеми, які призводять до зниження успішності та якості навчання з дисципліни, що спонукало викладачів до пошуку та розробки нових ефективних методів її викладання.*

*В Одеській державній академії будівництва та архітектури (ОДАБА) у другому семестрі 2024–2025 навчального було застосовано методику викладання нарисної геометрії згідно якій разом з викладенням основного матеріалу занять студентам надсилались заздалегідь зроблені відеозаписи пояснень виконання прикладів індивідуальних завдань і розв'язання задач. Переглядання відеозапису матеріалу у необхідній кількості разів та можливість збільшення зображення побудов в результаті дало змогу студентам самостійно розібратись у виниклих проблемах та розв'язати задачі. Аналіз результатів навчання та опитування серед студентів вказали на переваги такої методики. В роботі також акцентовано увагу на запропоновану методику викладання однієї зі складних тем з нарисної геометрії. Викладачами застосовано спеціально розроблені покрокові зображення прикладу розв'язання завдання, кожне з яких супроводжується детальним описом виконання побудов. Такий підхід дав змогу студентам роздивитись матеріал необхідну для них кількість часу, і самостійно розібратись з виниклими проблемами при розв'язанні задач. Викладач, в свою чергу, не витрачав час для повторних побудов на дошці чи в графічному редакторі. Така методика викладання дозволила ефективно працювати з групою, підвищуючи успішність та рівень підготовки студентів. З метою оцінки ефективності впровадження у навчальний процес удосконаленої методики проведений аналіз результатів навчання. Визначено, що в групах 2024–2025 навчального року, де застосовувалась нова методика, швидкість виконання і якість робіт вища, ніж в групах попередніх років навчання. Запропонована методика викладання нарисної геометрії є ефективною, її можна впроваджувати у навчальний процес.*

**Ключові слова:** *нарисна геометрія, методи викладання, спеціальність «Архітектура та містобудування», формат навчання, якість освіти.*

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**Introduction.** One of the most important among the many subjects studied by students in the specialty «Architecture and Town Planning» is the discipline "Descriptive Geometry", which is taught in the first year of the Odesa State Academy of Civil Engineering

and Architecture (OSACEA) for two semesters. The purpose of the discipline is to teach students geometric modeling of objects and processes, the ability to rationally solve engineering geometric problems. When studying descriptive geometry, students acquire

such competencies as the ability to correctly execute and read drawings of spatial objects and buildings, and acquire abilities and special skills of graphic literacy. This discipline contributes to the development of spatial perception of the future specialist and teaches to perceive the environment figuratively.

**Statement of the problem in general terms and its connection with important scientific or practical tasks.** High-quality training of specialists in the specialty of «Architecture and Town Planning» is an important task of a higher education institution that prepares students in the relevant field. Descriptive geometry is one of the most complex disciplines that future architects need to master well. After all, in the future, based on the acquired knowledge in this subject, students proceed to study disciplines directly in their specialty. According to the results of the analysis of the quality of education over the past few years (when switching to full or partial distance learning), a decrease in the quality of works on descriptive geometry and the speed of their completion by students has been noted. This fact requires the search for new effective solutions for teaching descriptive geometry and their further implementation in the educational process. Therefore, in order to improve the quality of training for students of the specialty «Architecture and Town Planning», the teachers of the Department of «Descriptive Geometry and Engineering Graphics» of the OSACEA were faced with the task: with a limited number of hours allocated for classroom lessons and in any format of learning (online, offline or mixed), to develop new effective methods of teaching the discipline «Descriptive Geometry».

**Analysis of recent research and publications.** The high quality of students' training depends on their interest in studying the discipline. Therefore, the teachers of the Department of «Descriptive Geometry and Engineering Graphics» are constantly searching, developing and improving new methods of teaching descriptive geometry for online, offline and mixed learning formats [1, p. 143]. Over the years of teaching, it has been noticed that the use of models when explaining the topics of descriptive geometry classes helps students better understand the material. Therefore, the employees of the department created models for various sections of the discipline, which are used in the educational process. When teaching online, teachers take photos of models from different angles in advance, and then use the footage for explanations. This teaching method allows students to develop spatial thinking, which helps push them to find the right solution to a problem [2, pp. 17, 25]. In recent years, when explaining and simultaneously solving problems on the board (using chalk and drawing tools) in an offline learning format, the teacher takes a photo of each step of the construction. The collected set of photo materials is subsequently used in explanations in the online learning format and, if

necessary, is sent to students. This allows students to independently look at the photo and figure out the problem, which contributes to understanding the material and helps in solving problems. The considered methods are very convenient, as they save time on explanations, the prepared materials are useful in mastering complex topics of descriptive geometry, but to obtain higher learning results, it is necessary to search for and develop an improved methodology for teaching the discipline.

**Highlighting previously unresolved parts of the overall problem.** Let us consider several main factors that lead to a decrease in the quality of teaching the subject «Descriptive Geometry», which is difficult for students to study. The reduction in the number of classroom hours allocated to the discipline has led to the fact that teachers, in a limited time, must provide the necessary material in a concise form. For this reason, they do not have enough time in the classroom to re-explain the material to students who need it, as they are forced to give preference to teaching information on the topic of the lesson. Another teaching problem is that under martial law, air raid sirens sometimes sound during classes, and the learning process stops during this period. This leads to the teacher having to provide material briefly and incompletely in the classroom hours remaining for the corresponding lesson. Another problem of teaching descriptive geometry is the lack of graphic skills among students entering technical education institutions. This is due to the fact that the subject «Drawing», which is closely related to descriptive geometry, is excluded from the list of school subjects. This fact means that teachers, while teaching material on descriptive geometry, are forced, if necessary, to additionally provide information on the subject «Drawing». The above-mentioned problems encourage teachers to search for and develop new effective methods of teaching the subject «Descriptive Geometry».

**Purpose of the article.** The aim of the work is to improve the quality of teaching the graphic discipline «Descriptive Geometry» to students of the specialty «Architecture and Town Planning». The aim is achieved by searching, researching and implementing new effective teaching methods into the educational process.

**Presentation of the main research material.** In the 2024–2025 academic year, teachers of the Department of «Descriptive Geometry and Engineering Graphics» of the Odesa State Academy of Civil Engineering and Architecture developed and refined new methods of teaching complex sections of the discipline «Descriptive Geometry» for students of the specialty «Architecture and Town Planning» in order to make the material easy and accessible to understand. It was decided to make video recordings of explanations of individual tasks and problem solving during the classes. In the offline form of training,

explanations and constructions were recorded on the board, and in the online form, they were recorded on the screen. The recorded material, which was sent to students as needed, became very useful to them, because in the future it can be used when examining the explanations in detail for the required amount of time for a particular student. A survey among students confirmed that the recorded material helped them a lot when performing individual tasks, since in case of any misunderstandings they were able to watch the video recordings the required number of times, as well as enlarge the image of the constructions on the board.

In the above work, we also want to focus on the new methodology for teaching the complex topic of descriptive geometry «Construction of perspective and reflection of a group of bodies with a lowered plan and scale of heights with two vanishing points», proposed in the 2024–2025 academic year. The teachers of the department have previously developed step-by-step images of the task on the example of a group of bodies. According to the new methodology, it is proposed to add step-by-step images of an example of solving the task and additional video recordings with explanations of the implementation to the teaching material. Step-by-step images begin with the construction of the condition and layout of the task, then the lowered plan, the scale of heights, the construction of the perspective of objects using the lowered plan and the scale of heights, the determination of the objects' shades, the construction of shadows from

objects on the subject plane and shadows from some objects on others, the construction of reflection in a horizontally located mirror, and finally the design of the final image, Fig. 1. Each of the images is accompanied by a detailed description of the construction at the corresponding stage. The developed example covers the entire possible variety of object forms that are available in the options provided to students for completing the task. The proposed material can be used in all forms of learning – online, offline and mixed, since at any moment students have the opportunity to open it on their smartphones and, looking at the example, find and understand it when a problem arises in solving the task.

The method of teaching material using step-by-step images is convenient for students who were absent from class, or who were distracted during the explanations, and listened to part of the material provided, or among those who do not perceive the explanation of the material the first time. In turn, the teacher offers such students to open the proposed example at a particular step and explains the material they missed or did not understand, without performing repeated constructions on the board or in a graphic editor. This teaching method significantly saves classroom hours, which allows them to work effectively with the group, increasing the success rate and level of training of students.

To assess the effectiveness of the implementation of the new methodology in the educational process,

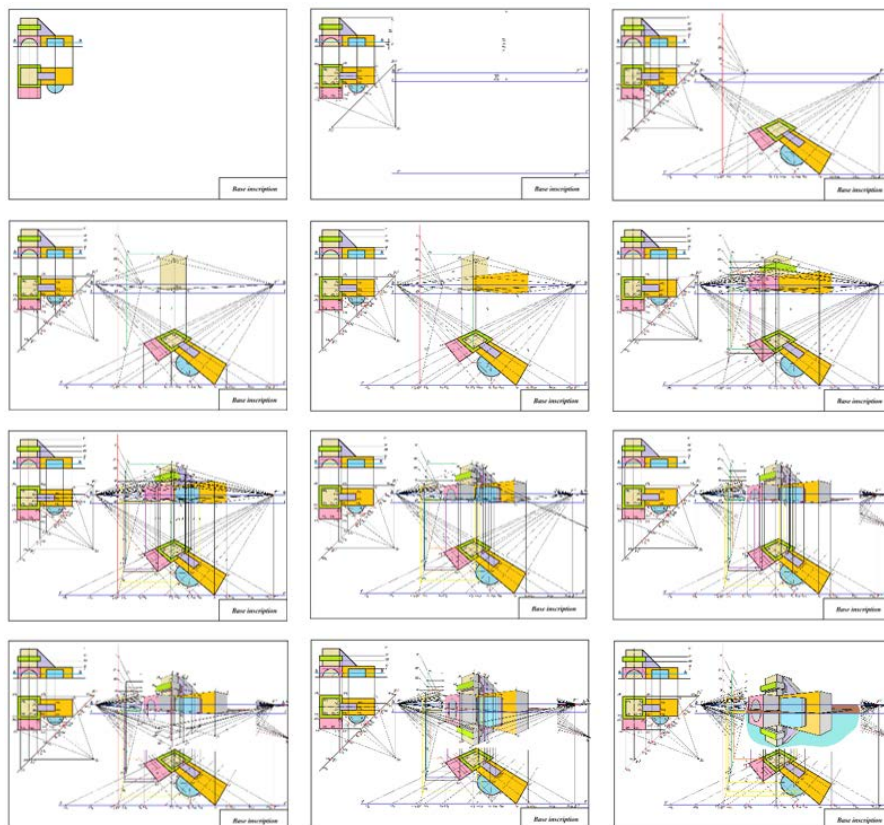


Fig. 1. Some of the developed step-by-step images



Table 1

## Learning outcomes for performing a calculation-graphic work

Year of study	Group number	Number of students in the group	Percentage of students who submitted assignments on time	Percentage of students who submitted assignments on time and received high grades
1	2	3	4	5
2024–2025	A-180	28	82	79
	A-181	23	79	96
2023–2024	A-172	24	38	78
	A-173	25	64	88
2022–2023	A-161	25	32	75
	A-163	23	39	89

an analysis of learning outcomes was conducted. The data obtained from performing calculation-graphic works among two groups (A-180 and A-181) of the 2024–2025 academic year, where the new methodology was used, were considered. To compare learning outcomes, data were selected from two groups (A-172 and A-173) for the 2023–2024 academic year and two groups (A-161 and A-163) for the 2022–2023 academic year. The parameters that characterize success and quality were selected, respectively, as the number of students in the group who completed the work on time (i.e., within the deadline set by the teacher), and the number of students in the group who received high grades («excellent» and «good») for the task that was completed on time. The obtained data are summarized in Table 1.

When comparing the results, it can be seen that in the groups of the 2024–2025 academic year, the percentage of students who passed the task on time is much higher than in previous years of study (on average, by about 37%). As for the percentage of students who passed the task with high grades among those who completed the task on time, it can be seen that the average indicator for the last academic year is slightly higher (on average, by about 5%). According to the results of the analysis of the conducted studies, it can be concluded that in the groups of the 2024–2025 academic year, which were provided with explanations using additional video materials and step-by-step images of an example of the task, the speed of completion and quality of work are higher than in those groups where these additional materials were not used, that is, the proposed methodology is effective, it can be used in the future in the educational process.

Fig. 2 presents several graphic works completed by students in the 2024–2025 academic year using a new teaching methodology in the educational process.

**Conclusions.** The paper presents an improved methodology for teaching complex topics in the

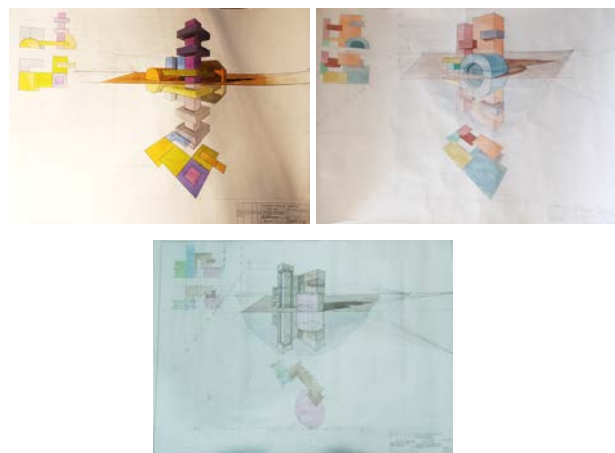


Fig. 2. Examples of work completed by students in the 2024–2025 academic year

graphic discipline «Descriptive Geometry» to students of the specialty "Architecture and Town Planning". which can be used in any format of training. Studies of the results of training using the proposed methodology were conducted. Analysis of the research results indicated an increase in the speed and quality of work performed by students, which indicates the effectiveness of the developed teaching methodology. It is proposed to apply the presented methodology when teaching complex topics in graphic disciplines in higher education institutions.

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