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INNOVATIVE TECHNOLOGIES IN DESCRIPTIVE GEOMETRY AND ENGINEERING GRAPHICS

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Abstract. The scientific article presents the peculiarity of engineering activity and its need to perform monotonous work for a long time, which requires concentration of attention, and non-standard thinking of a specialist and his research skills. Both of these areas are well developed by the graphic training of students using innovative technologies.

Keywords: drawing, concentration, creative thinking, geometry and engineering graphics , innovative technologies, research skills, learning.

Currently, there is an opinion that the science of descriptive geometry has no practical value due to the development of computer technology and the apparatus of linear algebra, but the activities of specialists, both in science and in production, refute this statement: it is indispensable, as an integral part of general engineering education in engineering and construction specialties.

A modern engineering and technical worker cannot carry out his activities without communication with a computer. The development of powerful computing tools stimulates new design methods, the construction of various three-dimensional models in their programs, the study of numerous modes of operation on these models, etc. Under these conditions, the need for science itself does not disappear, but the approach to its study changes, new requirements are put forward for the methods and means of its development.

The organization of the acceptance of graphic works should be such that when signing the drawing, we must be aware that our signature confirms not only the correctness of the execution of the graphic work itself, but also that this work was performed by that student, surname and whose signature is on it, and that he understands it more or less enough for a positive attestation. If there is no certainty in this, the work is left unsigned. Having signed all individual graphic works during the semester, and with the debtors, closer to its end, but, nevertheless, not wanting to positively assess the student at the end of the semester, we have no right to say that this is due to the fact that the student he himself fulfilled them and therefore did not cope with the test or the exam. And it

is difficult for such a student to put an unsatisfactory mark on the exam with a good set of signed graphic works with admission to it. So, if there were doubts, it was not necessary to sign the drawings and allow the student to take the exam. If we suddenly begin to understand this situation, then, with all the signed works or most of them, we have no right not to certify the student positively. Legally, this does not stand up to criticism, to put it mildly, since such a set of drawings with signatures indicates that the student nevertheless coped with the training program [1] and deserves a positive assessment. This is confirmed, we repeat, by the signatures he received on the drawings submitted for verification on each topic studied. Therefore, we must admit, returning to what was said above, that the signing of the drawings is an important stage. We put our signature, and this, as has been pointed out, speaks volumes. You cannot put your signatures without making sure that the student deserves it. The signature should say a lot for him and for us. This is a kind of intermediate certification, that is, we already evaluate the student positively for the material covered. And how then, all of a sudden, we don't set a test or an exam if all the intermediate stages are successfully passed. And then, it turns out, everything is fine, and then, suddenly, no: you don't know anything at all, you're not ready, etc. Why was it necessary to sign the drawings? All stages were somehow successfully passed (we won't specify how exactly, since there is a signature), and suddenly there is such a result at the finish line. It logically shouldn't be like that. So all intermediate steps are wrong. But we put signatures, confirming that everything is fine, or rather, at least at an acceptable level. Or, it turns out that the graphic works themselves, and the final certification itself, and there is no connection between them? And why? It should not be.

It seems right not to rush to sign the drawings. The signed drawing should be a kind of knowledge control for the material covered. And we must be aware that we have already attested an intermediate student and we must really be sure that we have attested and carried out the certification properly, talked with the student, made sure that he knows the material at an acceptable level (not lower than four), asking the necessary questions, immediately receiving answers (all our questions are simple and relate to the main thing - whether a point or line of a surface belongs to teach a student to read drawings).

And then, you should not mess around at the expense of the rhythmic, in accordance with the calendar plan, progress in learning, with the graphic works of the previous topics. In each lesson, another new topic should be studied, and all attention should be devoted to it. And what is past is past. Otherwise, confusion results, and new topics will not be assimilated by indebted students as they should. Let them accumulate their debts. And when they are tested, it will be seen. Because of it, the presentation of the material and its practical consolidation for the whole group or for some part of it, showing diligence in study, should not suffer. Maybe such a student will go to the exam with unsigned drawings. It will be conditionally admitted. But signing drawings in a hurry with a lack of study time is also not the case. Our signature should not indicate that the drawing is correct. Who needs it? And the fact that it was completed by a student whose name and signature are also there. And this was established as a result of an interview and a successful defense of the drawing, if the drawing was drawn in absentia (somewhere out there, outside the classroom). And the drawing should not be signed if the student does not really know what was given, what needed

to be built, what auxiliary constructions were needed for this and why, what method was used, and at the end of the survey - he should see surfaces, not lines , and find the missing projections of points belonging to the surface, represent their location, that is, at the beginning where presumably must find the missing projection on other images (this is already good if he sees surfaces), and know how to find it exactly, using what constructions and method. You have to go through something new and you don't have to be distracted by anything else. It is desirable (and should be striven for) that during the time of practical training, the student did something significant, if not all, but this should be enough to evaluate the student positively, and it is this assessment of his knowledge, skills and abilities (well, what else) that is important.

And what to do in a situation where the student has not received the teacher's signature under his drawings? For which there simply might not be enough time because of his lack of diligence. Well, it's his own fault for not studying. And what, a couple of weeks before the end of the semester, suddenly, he will cope with the training program? Where does the teacher have time to interview such students to ascertain the truth? It is not available not only in accordance with the curriculum of the specialty, but even physically for all debtors. And what, just to sign, going to cover the “successes” of such students in education? Of course, this shouldn't be done. And in general, in principle, it can come to such a trial: how does it not deserve a positive assessment with all the signed drawings or almost all (because of a couple of drawings, it’s also like it shouldn’t be “slowed down”). By signing like this, we give a negligent student a chance to "swing their rights."

And what is the way out? If a student is required by law to submit all the drawings in order to be admitted to the exam, then he must be admitted. It does not matter that due to his negligence, he did not succeed in protecting them properly. After all, we have not abandoned the concept of education as a service. He did not want to use this service. I just sat through classes, skipped them, did not work at home, despite all the exhortations of teachers, memos to the dean's office and warnings. Nevertheless, he brought the drawings. There is no reason not to allow it, if so. Maybe he did it on his own, because he, like, was more comfortable. He did not want to use the offered educational services - his business.

Well, at the exam, he will answer for everything. If he copes with the examination task - well, well done, he was able to master the discipline on his own. No claims. If it doesn't work - it's your own fault. Nothing to blame. This is where it will be fair to carry on the mentioned conversation with the fact that he did not draw, did not study, etc. Forcing him to study is no longer a service. This is education. And he was cut off from education.

If in order to be admitted to the exam, the student must not only present the drawings, but also protect them, then there should be so many drawings that it corresponds to the amount of study time allocated, so that there is physically enough time for the student to defend each drawing before signing. Otherwise, for what all this shaft is needed by no one knows who performed the work, which is then sent for disposal. They should equal the student's knowledge, which he acquired by doing the drawings, and not the drawings acquired. If he did not draw them himself, but we diligently check that there are no mistakes, why? Due to the large volume of drawings, we do not have time to work directly with students anyway. When does a student receive knowledge? First,

when listening. And such a student listens inattentively, if at all he attended the classes. Independent work on drawings is the last chance to comprehend discipline. What if he doesn't do that? Then we, at least, should not cover his attitude to studies by signing drawings without protection.

Why does the student not draw himself? Because we allow him to do this by signing the drawings improperly, that is, without protection. And then, you need to have such a volume of downloading drawings that the student has time to do the main part of each graphic work in the classroom. Outside the audience, only the inessential should be allowed to be done. And not vice versa. It is the unimportant that they do in the classroom, bringing almost finished drawings, and here they are completed, diverting from the new topic, or even completely ignoring the explanations on it. It is necessary, as said, to organize the opposite. The student must finish outside the classroom exactly the sheet, if it was not completed, that was started in the classroom, and it should be marked by the teacher about the degree of his readiness. If it is not possible to bring ready-made drawings, this requirement will intensify the work of the student in the classroom.

In the context of the current shortage of study time for the study of descriptive geometry [5, 6] and with the practically remaining volume and complexity of graphic assignments issued for individual performance, and the inability to control the degree of independence of the student's work outside the classroom, the workbook [3] is seen as the most effective tool studying the discipline only under the condition of its classroom use. It is clear that assignments in a printed workbook cannot be strictly individual [2]. But when they are used in the classroom, in the presence of a teacher, nevertheless, it is possible to ensure the individual work of each student on solving problems on each topic being studied.

Thus, we should talk about the transition to a controlled classroom independent training of students on workbooks, and effective: the student at any time will receive a qualified hint, pushing him to the right path of independent search for a solution, which excludes the simple borrowing of a ready-made solution from someone something without any, of course, benefit for themselves. Namely, the latter also takes place, although we believe that students, for the most part, prepare according to the workbook outside the classroom on their own. It is possible, but with rare exceptions it is.

And in order for the control over the independent work of students in the classroom to be effective, the workbook should provide, at least on key topics, not one, but several options for each graphic task, so that students sitting next to each other would not be tempted to thoughtlessly peep the progress of it. decisions, but had to rely more on themselves. At the same time, diligent students will have the opportunity to improve their knowledge, solving not only their own version of the topic under study, but also other options in the remaining time of classes or at home.

As experience has shown, in the absence of motivation, the use of workbooks for independent unsupervised preparation for the next practical lesson, as a means of consolidating the material of the lecture, is ineffective. Teachers, being overloaded with checking individual graphic works that have to be done during practical classes, are not able to pay due attention to workbooks, and students for the most part do not show due diligence in order to conscientiously prepare for them.

Everything is limited, as a rule, only by the presentation of individual graphic works rarely performed outside the classroom on their own and simply borrowed. Paying attention to both - workbooks and individual graphic works [4] - turned out to be unrealistic in the face of a shortage of classroom study time and low diligence of the bulk of students in the group.

The way out of the current situation, when students are allowed to perform graphic works outside the classroom, pass off works that were not independently completed as their own, and, for the same reason of low motivation for learning, their unwillingness to independently fix lecture material in workbooks, seems to be a certain compromise solution.

It is necessary to emphasize, as the main means of increasing the efficiency of assimilation of the studied material, on the implementation of graphic constructions in workbooks methodically on each topic studied in the presence of a teacher, that is, as indicated at the beginning of this material, in practical classes in the classroom when it is possible to both prompt the student and direct him to the correct path of solving the problem, and, finally, force him to work if necessary.

As for individual graphic works, which in this case have less classroom time to check and defend, their volume and complexity can and should be reduced in order to bring the entire volume of educational work performed by the teacher into line with the volume of - divisible study time for the study of the discipline.

Thus, all classroom time provided for by the curricula should be divided in a certain proportion between the time for checking and defending individual graphic works and the time for organizing classroom work in workbooks in strict accordance with the calendar plan for studying the discipline and the topic of the lecture.

At the same time, the workbook [3] should be the basis for studying the discipline and ensure consistent progress on all topics studied according to the curriculum [4] and the course of lectures [4]. Individual graphic works should become some kind of milestones in this process, passing which, the student confirms the achieved level of knowledge of the discipline, perhaps for a certain current assessment, which should become the basis of his final certification, and even the reason for certification without passing the test. or an exam, if the student agrees with it (for some, this will even be an incentive to study). Individual graphic works should be considered as such only if the graphic work it will indeed be individual, necessarily begun in the classroom and necessarily evaluated by the teacher at the end of the lesson, that is, before the student takes it out of the classroom, and the degree of its completion should be sufficient for a positive assessment of the student's diligence in studying the topic.

Relying on workbooks will make it possible to give the required rhythm to the passage of the studied material, which is possible for this group, depending on the level of readiness of the bulk of students to master it. This must be taken into account, and the rhythm that can be realistically maintained in the group should be set, without overloading the students with a high intensity of “pushing” each time at the next lesson with new material. There will be no benefit. There will be forgeries, non-independent performance of graphic works, etc. It is necessary to adapt to the level of the group also by selecting an acceptable complexity of graphic works and their number.

Working in a group should be comfortable, without rush and haste. To do this, its entire volume, including both individual assignments and tasks in workbooks, must be brought into line with the allocated study time for working in the classroom. All work outside the classroom is not controlled and is not very effective. It will only overload the teacher and the student and, most likely, will give a negative result, pushing more and more students to the mentioned desire to pass off other people's drawings as their own in order to get out of the situation, save face, get admission to the exam or test . And this is becoming more and more the norm. Teachers know about it, but nothing changes. It is also impossible to keep such students in fear of being expelled from the university, and in the first year it is hardly worth treating them so radically. It is necessary to look for acceptable ways of teaching students, without building illusions and not covering up their failures, which is what the presented material is aimed at more efficient use of workbooks by organizing students' work on them in the classroom under the guidance of a teacher.

The experience of working with students from different areas of training shows that the complexity in the development and reading of drawings of parts is caused by images of threaded surfaces and setting the required dimensions of parameters and thread elements [5]. It should be noted that not only first-year students, but also graduate students face difficulties of this kind.

The formation of competencies associated with reading drawings of parts and assembly units with threaded surfaces consists of:

- from the ability to represent the elements and parameters of the thread according to its image;
– the students' knowledge of the conventions and simplifications used in the execution and design of threaded drawings, according to ESKD;
- the ability to give a verbal description of the depicted elements of the detail in a certain sequence.

At present, the concept of "pedagogical technology" is firmly entrenched in the pedagogical lexicon. The term "technology" is defined as a set of techniques used in any business, skill, art (explanatory dictionary). At the present stage of development of pedagogy, there are many definitions of the concept of "pedagogical technology", within the framework of this work, we choose the following: pedagogical technology is the construction of the teacher's activity, in which all the actions included in it are presented in a certain sequence and integrity, and the implementation involves achieving the desired result and is predictable. Today there are more than a hundred educational technologies.

Descriptive geometry is such a subject, in the study of which students get acquainted with a wide range of technical concepts. The knowledge gained during the course of studying the discipline facilitates the study of many other general technical subjects. The course is based on general scientific and general engineering disciplines.

The content of any pedagogical technology includes various means that activate and intensify the activity of students. Within the framework of the problem under study, the most interesting are such technologies in which these means are the main ones, which, first of all, has a significant impact not only on the educational process, which includes the assimilation of knowledge, the development of skills and abilities, but also on the final result. activities of students.

An analysis of the widely used and actively implemented methods of teaching descriptive geometry in the process of training technical personnel at the present stage shows that university teachers use a fairly large range of different methods and educational technologies.

The vast majority of teachers, mostly with long experience, prefer traditional teaching methods. This is a classic lecture audience or practical class, modern blackboard, chalk, posters, models. Here, the quality of students' knowledge depends, first of all, on the professionalism, talent and abilities of the teacher, the ability not only to present the studied material in an accessible way, but also the skills of high-quality, phased drawings on the board, preferably in color. Students should take notes, both theoretical material and graphic images made on the board.

Positive here is the direct contact of the teacher with the audience, the possibility of stops, additional explanations, repetition of algorithms for solving problems.

The negative aspects of such pedagogical technology include the great laboriousness of drawing on the board and, as a result, the unproductive expenditure of classroom time.

The main innovative elements of traditional teaching methods at present are various options for using handouts, both in practical and lecture classes. In recent years, following the rapid development of computer technology, various methods of teaching descriptive geometry with the use of technical teaching aids are actively used. Multimedia technologies are increasingly used in lectures on descriptive geometry and engineering graphics. The video image makes it possible not to waste time and effort on purely technical issues, allows you to show three-dimensional models, stage-by-stage execution of drawings, and free the teacher to communicate with the audience.

The possibility of placing video materials on the Internet portals of educational institutions allows the video course to be available for viewing by students of correspondence and distance learning. When studying computer graphics, various means of three-dimensional solid-state modeling are used, which, at the modern level, allow polytechnical and vocational training of students for the conditions of modern production. The implementation of these tools and teaching methods is aimed at forming the basics of computer engineering graphics, skills in the development of drawing and graphic documentation using CAD.

The presented methods and technologies for teaching engineering and graphic disciplines, although they have gone through many years of testing, must constantly be improved in the direction of reducing the shortcomings and increasing their advantages, including the formation of interest in the subject being studied. However, no matter how perfect innovative technologies are used in teaching and studying graphic disciplines, without improving the methods of perception of the studied material by students, it is almost impossible to achieve success.

The level of students' motivation, the activation of their cognitive interest in learning activities, all this becomes possible when resolving emerging contradictions, as well as when creating problem situations in the learning process. Overcoming difficulties and solving problems, often intertwined with life situations, students experience a constant need to acquire new knowledge, skills and abilities.

Thanks to such an organization of classes in descriptive geometry, in which the student, under the guidance of a teacher, independently solves problematic problems and masters professional skills,

it is possible to increase students' interest in the discipline being studied. In this situation, the research principle of learning is implemented, where the student learns to analyze the presented situation, justify his own opinion on it, look for ways to solve the task and, as a result, feel pleasure from the work done, which, in turn, arouses his interest in subsequent tasks.

As a rule, problem-based learning technology is used at the stage of reporting a topic or after studying it as part of students' independent work. The main task of the teacher within the framework of this technology is to create a problem situation that should surprise students and create a favorable environment for discussing options for solving a particular educational problem. Thus, instead of receiving a ready-made assignment, students, after posing problems, begin to search for solutions, thus discovering possible solutions on their own. This is followed by pronunciation of the algorithm of the problem, which is mandatory, and, accordingly, its application in practice when performing independent work.

Within the framework of problem-based learning, the technology of learning differentiation is a penetrating technology, since in any learning system there is a differentiated approach to one degree or another. The purpose of this technology is to teach everyone at the level of his capabilities and abilities, as well as adapt learning to the characteristics of different groups of students and, thus, develop the student's interest in the subject of descriptive geometry, which seems possible within the framework of problem-based learning and, specifically, when applying the projective method. .

There is differentiation not only in terms of the level of preparation of the student, but also in terms of interests, which allows everyone to show their abilities. For all topics, it is possible to prepare differentiated task cards that allow students to independently choose for themselves the level of the task that is feasible for high-quality work. We can confidently say that a job well done in accordance with GOSTs of a simpler level is no less important than complex work.

Great prospects within the framework of problem-based learning are revealed by project activities, which are aimed at developing the personal qualities of students and at the active formation of personality by acquiring professional skills through active methods of action and developing interest in studying a particular discipline.

A project is a set of actions specially organized by teachers and independently performed by students, where they can be independent in making decisions and responsible for their choice and the result of their work, for creating a creative product. The project method is a pedagogical technology focused not on the integration of factual knowledge, but on their application and acquisition of new ones (through self-education).

This method has been actively used in the pedagogical work of practitioners for a long time in teaching projection drawing. Thus, it becomes obvious that obtaining professional knowledge at the proper level becomes possible only when the student is given the opportunity for free creative development. The positive factors of the project activity include:

Project activity allows the teacher to carry out an individual approach to each student, distribute responsibilities in groups according to abilities and interests.

Creating situations in which a student who does not show much success in learning has the opportunity to communicate closely with more capable students.

Search for possible points of contact between fantasy and reality.

The method of project-based learning has advantages over classical methods due to the fact that at different stages of the educational process, students act mostly independently, and the teacher acts as a specialist consultant. Also, an important advantage of the project method in vocational education is the direct connection of training tasks with real production and everyday situations [6]. For example, with the topic “Letter curves”, you can try to summarize the study of the topic, show the application of the drawing and curves in human life, and introduce you to many professions that use the use of drawings.

Clusters can become a leading technique, as in the call stage, reflexes, and the strategy of the lesson in general. Clusters are a graphic technique for organizing material. The scheme may look something like this: in the center - the main concept, and around - semantic units. There may be many more of them. This technique can be applied at the call stage, when we systematize information before getting to know the main source - the text in the form of questions or headings of semantic blocks [2]. For example, the use of critical thinking technology, the compilation of a cluster in the lesson "Letter curves", and clusters are also used in the classes of systematization of knowledge on the topic "Sections and cuts", on the topics "Projection of a point and a straight line", "Mutual position of straight lines in space".

Conclusion

The conditions for the formation of the designated competencies are the knowledge and skills of students acquired in the process of studying theoretical material on the image and designation of the thread, its parameters and elements.

Students need to know:

- the main parameters of the thread: profile, pitch, direction of turns, etc.;
- rules for the symbolic image and designation of internal and external threads in;
- rules for the image on the drawings of a threaded connection;
- rules for the symbol of threaded connections. The student must be able to represent:
- parts with external and internal thread;
- grooves for the exit of the thread-cutting tool;
- threaded connections of parts.

For the formation of competencies associated with reading drawings, special exercises can be recommended [6], and the learning process itself can be divided into four stages.

At the first stage of the formation of competencies related to reading drawings of parts with threaded surfaces, it is necessary to widely use real products (parts). Exercises with real parts can include tasks such as: analysis of the geometry of a threaded part (shape of surfaces, thread elements); features of the manufacture of external and internal threads; comparison of the profile of threaded surfaces, features of the formation of cuts and sections, and others.

At the second stage of learning to read drawings, one should study the conditional image of the thread using the example of a "bolt-nut" in accordance with the standard. The following exercises are suggested:

1. Define the image of the thread in the view.
2. Determine the image of the thread in the section.
3. Find the correct dimensioning on the images (in view and in section) of the thread.
4. Based on real carving details, find the main view.

At the third stage of the formation of competencies related to reading drawings of parts with threaded surfaces, it is recommended to compare real parts with their images. Exercises can be as follows:

1. Finding the main image of a real threaded part.
2. Connecting half of the view and half of the section of the part.
3. Determination of a correctly executed section, incision.
4. Finding the image of thread elements.

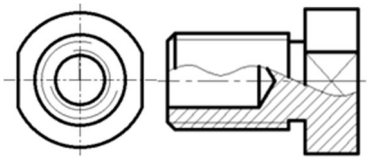

Fig. 1. Example of the exercise "Thread Image"

The fourth stage of formation. One of the methods for teaching students to read drawings is modeling in a graphics editor, for example, doing exercises using KOMPAS 3D, Inventor:

1. Finding the view on the left of the part according to the given main views.
2. Finding the main image of the part according to the given view (Fig. 1).
3. Finding the image of the part according to the given cut and section.
4. Modeling according to given images.

Results.

The draft concept of early profiling and popularization of engineering education, which allows launching a mechanism for positive systemic changes in engineering education in Uzbekistan, including increasing interest in engineering and technical professions, providing early professional orientation for students, will improve the quality of engineering education. education. Particular attention should be paid to the problems of fostering responsibility and environmental awareness of future engineers, which requires the creation of methodological developments for technology teachers and teachers of general engineering departments of technical universities.

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