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Scientific article

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The methodology of performing positional tasks by means of graphic programs in teaching descriptive geometry

Abstract. This article examines the didactic potential of applying Rhino and AutoCAD graphic software in the teaching process of descriptive geometry and analyzes their effectiveness in solving positional problems. The study focuses on methods for determining intersection lines of surfaces, particularly the construction features of intersections between second-order surfaces and planes in general position. Special attention is given to the possibilities of visual modeling of complex spatial problems, accurate geometric constructions based on orthogonal projections, and mastering algorithmic approaches to defining intersection lines using graphic software tools. The article presents step-by-step methods for solving positional tasks in Rhino and AutoCAD environments and highlights their role in developing students' spatial thinking, graphic literacy, and independent cognitive activity. In addition, the influence of modern digital technologies on improving the quality of knowledge acquisition, forming engineering and graphic competencies, and increasing the effectiveness of the educational process is scientifically and methodologically substantiated. The research results demonstrate that graphic software serves as an effective tool for integrating theoretical knowledge with practical skills and contributes to the modernization of descriptive geometry teaching in the context of digital transformation in education.

Keywords: descriptive geometry, teaching process, surface intersection lines, Rhino, AutoCAD, geometric modeling, orthogonal projection

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Introduction

One of the important requirements for the organization of modern educa-tion is to achieve high results in a short time, without unnecessary mental and physical efforts. Bringing certain theoretical knowledge to students in a short pe-riod of time, developing their skills in certain activities, as well as monitoring students' activities, assessing the level of knowledge, skills and abilities they have acquired require high pedagogical skills from the teacher, a new approach to the educational process.

There are various ways to develop independent cognitive activity, one of them is the problem of developing Rhino and AutoCAD using graphics pro-grams. The development and application of a special method involves practical assistance to the development of this activity.

Descriptive geometry is understood as fields of knowledge that fully corre-spond to the idea of computer geometric modeling, which remain a fundamental science for any design process, the objects of which are described by the math-ematical apparatus of analytical geometry, and which are the logical basis for building programs and machine algorithms for graphical reconstruction of tasks on a computer (Tashimov, 2019).

In this article, the development of competencies of independent cognitive activity by means of graphic programs involves the organization of independent learning, which confirms S.L. Rubinstein's idea that the psyche and conscious-ness are formed in activity (Rubinstein, 2004).

In a scientific article by I. Mamurov, N. Akhmedov and F. Mamurova on the topic "Building axonometric projections using the AutoCAD computer graphics program" noted that when building axonometric projections using the AutoCAD program, greater accuracy is achieved, time is saved when drawing axonometric projections, easy reproduction of the resulting axonometric projection on the re-quired surface, in size and sequence, and the use of a preset color palette for col-oring the drawn axonometric projections. Using the desired color scheme of col-oring, it was mentioned that axonometric projections drawn using computer graphics capabilities are of great interest to students, but also have advantages such as improving their computer literacy and work skills (Madumarov & Kakharov, 2008).

In the article T.Rikhsiboev, M.Pardaeva «Chamfering sharp corners on mod-els made in 3D in the AutoCAD program» shows the sequence of chamfering sharp corners of parts in 3D based on the design (Rikhsiboev & Pardaeva, 2015).

The work carried out by the above-mentioned authors is mainly focused on geometric constructions and projection drawing. This article shows how to achieve efficiency in solving positional tasks using Rhino and AutoCAD graphics programs.

An intersection line between two surfaces is usually created by sequentially plotting the points of the intersection line. The points of the intersection line touch both surfaces and are executed using auxiliary cutting surfaces (Turdimovich, 2023). Flat, spherical, conical and cylindrical surfaces can be used as auxiliary cutting surfaces. Auxiliary cutting surfaces should be selected in such a way that when they intersect with the specified surfaces, simple and convenient lines-straight lines or circles - are formed on the section.

It is known that a sphere centered on the axis of a rotating surface intersects this surface into a finite number of circles. These circles are projected onto one of the projection planes as a rectilinear section, and onto the other as a circle or ellipse. This important conclusion about the line of intersection of the sphere with the surfaces of rotation allows us to construct lines of intersection of two surfaces of rotation (Adilov, 2023).

To construct a line of intersection of two surfaces in the traditional way, guided by the above-mentioned theoretical foundations, the method corresponding to the intersection of the surfaces is selected, the characteristic points related to the intersection line are determined, through the gaps of which auxiliary planes of intersection are drawn, the points related to the intersection of the surfaces are connected sequentially, the visible part of the lines is determined.

As an example, let's consider the execution of a straight circular cone and an intersection line of a cylinder located parallel to V using the Rhino graphics program (Fig. 1, 2, 3, 4).

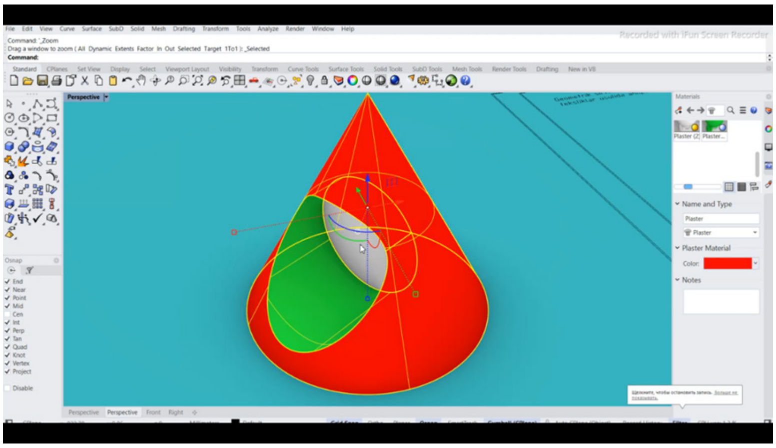

Figure 1 Iconic buildings in astana, google map

However, in the Rhino graphics software, such operations will be placed in the program's memory, where the curvature of the intersection of geometric surfaces is set, and the intersection line itself will be formed. Technologically, we will be able to perform both 2D and 3D measurements. The surfaces can be distinguished by color, seen from different angles, then they can be visualized.

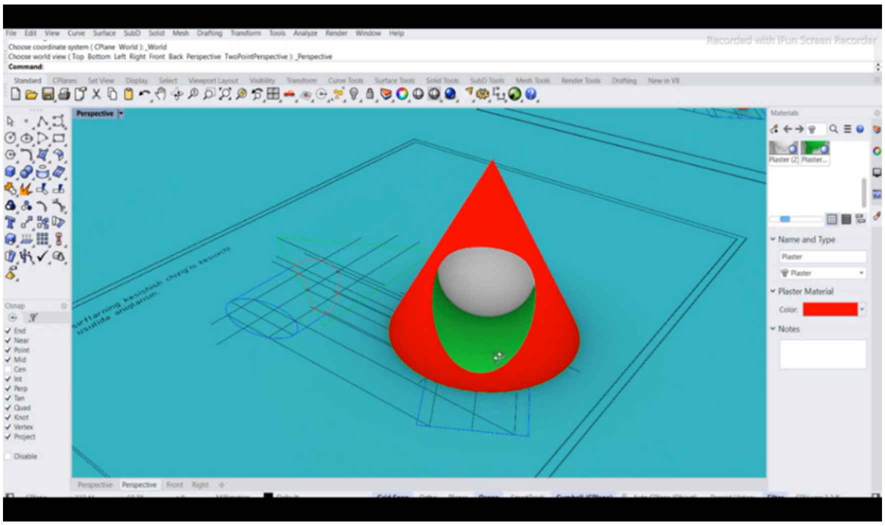

Figure 2 Construction of a cone and a cylinder intersection in Rhino

Rhino graphics software allows students to create 3D models that help them display their design ideas clearly and in detail. The program includes the ability to create complex geometric shapes. With the help of Rhino software, students have the opportunity to high-quality rendering of their models, which makes their project presentations more attractive (Erpolotovich & Kyzy, 2023).

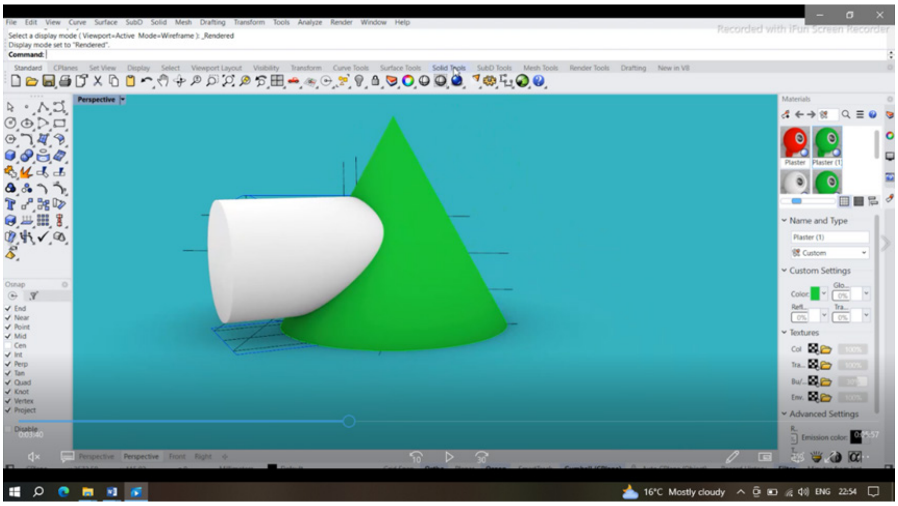

Figure 3 Construction of a cone and a cylinder intersection in Rhino

Rhino provides students with new features such as parametric design, analysis, or various other functions. Students have the opportunity to add materials and textures to bring the models to life even more, which will enhance the quality of the drawings.

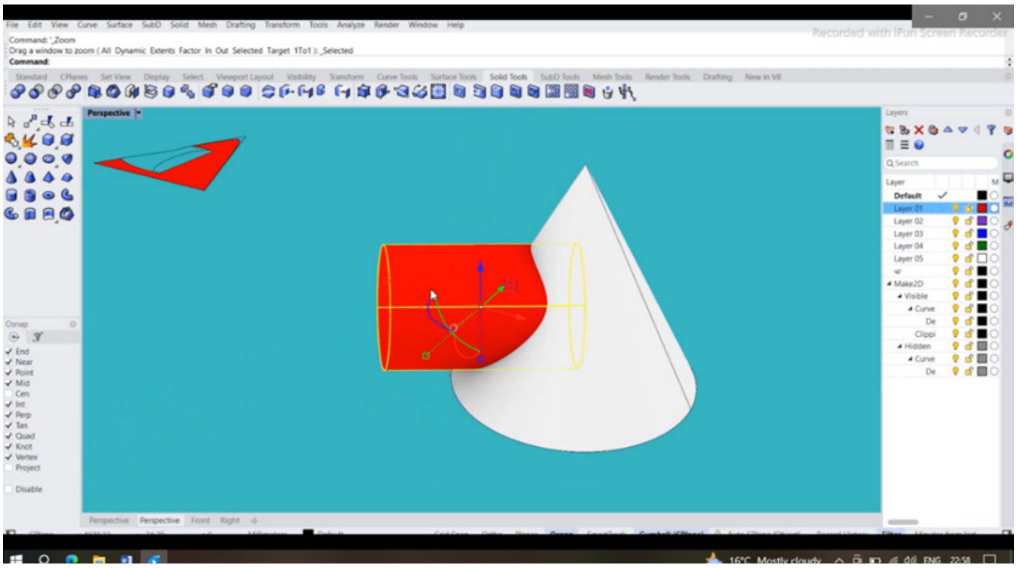

Figure 4 Construction of a cone and a cylinder intersection in Rhino

Modern graphics systems from AutoCAD and other applications are widely used in aviation, shipbuilding, pipeline, construction and other industries. The generally accepted abbreviation CAD corresponds to the concept of CAD (automated design system) for design engineers. This term usually refers to programs that execute drawings and even more complex design systems using a computer.

Methodology

The methodology of this research is based on enhancing students' cognitive activity and competencies by integrating modern computer technologies into the teaching of engineering graphics. The following set of methods and approaches was employed during the study:

Theoretical Analysis and Systematization

The research began with a comprehensive review of scientific literature in the fields of descriptive geometry and computer modeling. The study was grounded in S.L. Rubinstein's activity theory, which posits that the psyche and consciousness are formed through activity, as well as the conceptual findings of researchers like

I. Mamurov and N. Akhmedov regarding the advantages of computer graphics. Descriptive geometry was analyzed as the fundamental science underpinning modern design and machine algorithms.

Comparative and Technical Analysis

A comparative analysis was conducted between traditional drafting methods and the use of Computer-Aided Design (CAD) systems:

Traditional Method: Sequential plotting of intersection lines using auxiliary cutting planes and reference points. Innovative Method: Utilizing the algorithmic capabilities of Rhino and AutoCAD to generate high-precision models in both 2D and 3D formats.

Modeling and Experimental Tasks

The practical phase of the research involved developing algorithms for solving positional problems within Rhino and AutoCAD environments. Specific scenarios included:

Rhino Environment: Constructing intersection lines between a cone and a cylinder, utilizing color differentiation for surfaces, visualization, and testing parametric design features.

AutoCAD Environment: Intersecting a cone with a plane to construct second-order curves (e.g., ellipses). This process monitored the student's ability to synthesize theoretical knowledge with software commands.

Didactic Approach

The teaching methodology focused on the transition of the student from subordinating their actions to the logic of a new tool to mastering that tool as an extension of their own cognitive activity. This approach facilitates the organization of independent learning and the formation of modern engineering thinking.

Technical Tools

The following software packages were utilized as the primary research instruments:

Rhino 3D: Used for modeling complex geometric shapes and high-quality rendering.

AutoCAD: Used for automating drawings, constructing orthogonal and axonometric projections, and executing graphical algorithms.

Results and Discussion

Now let’s turn our attention to the problem of using the AutoCAD program in the process of teaching graphic disciplines, which is one of the automatic drawing programs that is currently widespread. It has now become the standard in personal computer systems in the field of CAD. Automatic drawing software is the cherished dream of designers and engineers, which not only frees them from such painstaking work as drawing, but also provides ample opportunities for creative thinking, innovation in the process, and processes such as instant application of what they have created to paper in their imagination.

But at the same time, this powerful drawing software is connected with the educational process, especially with the execution of drawings in engineering graphics (descriptive geometry, geometric, projection, machine, construction, topographic drawing, etc.), naturally penetrating into his sciences and firmly established in it. This phenomenon can certainly be called natural, since any achievement of humanity cannot ignore it if it is directly related to the educational process. When we are given the correct instructions for completing any drawing. So, we are told that it is a straight line, circle, rectangle, prism or cylinder, etc. It can instantly draw shapes not only in orthogonal projections, but also in axonometric projections, that is, display them visually, or execute them in parallel. In addition, it can also perform positional tasks such as the intersection line of surfaces. There is no need to sit back if the commands are given in the correct sequence, as in computer games. He can make the necessary geometric constructions and drawings of any type. Moreover, he performs drawings at a high level.

This is the main advantage and disadvantage of automatic drawing programs from an educational point of view, since they do not explain the process of completing the required work, after completing the command, the correct result is achieved. But using it as a drawing tool, you can also make drawings using traditional methods. When this is done, its effectiveness will decrease significantly, and it will become an expensive tool for sketching. However, in some cases, this method is also used if the situation requires it. But the contribution of such transactions is short-lived and is used much less frequently. It is necessary that we now perceive this phenomenon as a real being, as progress, and effectively use its advantages and turn its disadvantages into achievements.

This achievement of mankind in the field of image, i.e. the use of automatic drawing programs not only as a means of making images, but also as a means of cognition, can be considered as the historical development of the human mental process. This case requires a new approach to it in the process of executing graphical algorithms using automatic drawing programs.

Consider, for example, an example of constructing a line of intersection of a circular cone with a plane in the general case (Fig. 5). Suppose that the line of intersection of a plane and a cone is generally a second-order curve, such as an ellipse.

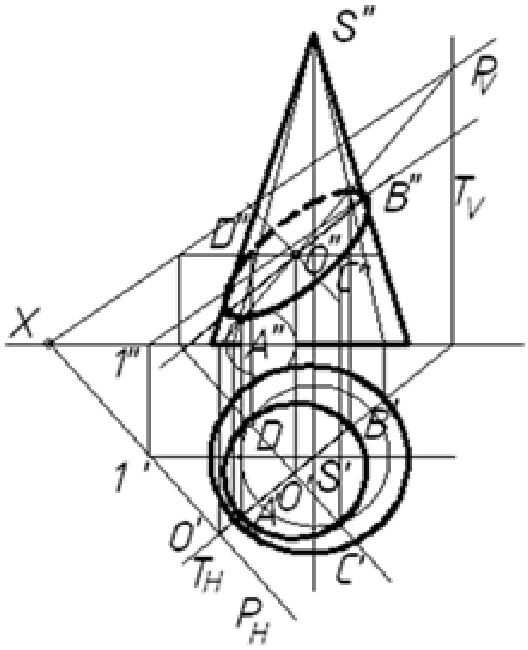

Figure 5 Example of constructing a line of intersection of a circular cone with a plane in the general case

When we define this in the traditional way, that is, using auxiliary secant planes, the reference points, the upper and lower points are determined first. These points are the target points for us, which give us «control» so that we do not deviate from the area of the producing line, because sometimes the shape of the ellipse may not be the same as itself when graphical errors are made. Then the points between them are determined. The more the number of points related to the intersection line is determined, the higher the degree of accuracy of the curve shape when connecting the formed points. When performing this task, attention is usually paid to the general shape of a curve, such as an ellipse. Now there is no need to create a series of points associated with the ellipse that is created when performing this task using AutoCAD. But here it becomes very important that we know in advance which curve is formed when the surface is cut by a plane. That is why this case requires theoretical knowledge and preparation from the student, since he already knows what kind of curve the intersection line will be, for example, if an ellipse is formed, it will be necessary to determine the directions and magnitudes of the major and minor axes of the created ellipse, based on the capabilities of the program.

Another reason for this is that the drawing program requires that the ellipse have mutually perpendicular directions and the magnitude of its major and minor axes, since the program can draw an ellipse only through its major and minor axes. In this case, all surfaces of the second order: cone, cylinder, sphere, ellipsoid, paraboloid, etc. belong to (Fig. 6).

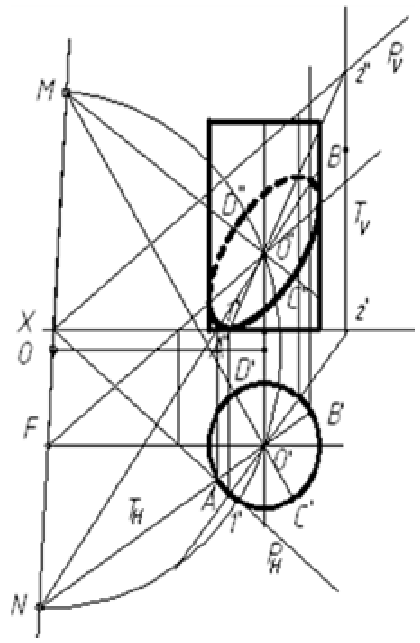

Figure 6 Example of constructing a line of intersection of a circularcylinder with a plane in the general case

The basic scheme of mastering any new tool is that first the student subordinates his action to the logic of the new tool, and then acquires new capabilities by subordinating it to the logic of his activity. At the second stage, this tool becomes a tool capable of solving various educational and other tasks in the student's activity. The transformation of a thing into a student's tool begins to shape the student's thinking, thinking and his own learned behavior in a new way in accordance with the circumstances (Tashimov et al., 2019).

Conclusion

As a conclusion, it can be said that when solving positional tasks using a graphical program, students' competencies regarding independent cognitive activity develop. Clearly, the educational programs independently developed by each university must undergo a thorough analysis of technical discipline types. This is essential to ensure a balanced integration of fundamental, natural science and mathematics, general technical, and specialized components in the training of Bachelors of Engineering and Technology.

References

Erpolotovich, T.N., & Kyzy, T.Z.B. (2023). Spatial development of students'imagination in engineering graphics by solving problems related to design. *Current Research Journal of Pedagogics*, 4(03), 30-33.

Madumarov, K.K. and Kakharov, A.A. (2008). Factors for increasing spatial thinking. In: *Problems of Integration of Science and Production: Materials of the Conference*. Namangan, 29–30 May, P. 399–400.

Rikhsiboev, T. and Pardaeva, M. (2015). Chamfering sharp corners on models made in 3D in the AutoCAD program. In: *Scientific and Theoretical Foundations of Training Teaching Staff in the Field of Descriptive Geometry and Engineering Graphics in the System of Continuous Education: Materials of the Republican Scientific-Practical Conference*. Tashkent, 15 April, P. 130–132.

Rubinstein, S.L. (2004). *Osnovy obshchey psikhologii [Foundations of General Psychology]*. Sankt-Peterburg: Piter.

Tashimov, N. (2019) Algorithmization of the descriptive geometry course as a didactic basis for teaching modern IT-technology tools. *Mugallim ham uzliksiz bilimlendiriu [Teacher and Continuous Education]*, (5), P. 29–31.

Tashimov, N.E., Zoitov, S. and Oblakulova, L. (2019). Methods of development and application in the educational process of computer technology in teaching graphic disciplines. *European Journal of Research and Reflection in Educational Sciences*, 7(12).

Turdimovich, A.S. (2023). Ways to develop students' design ability. *Current Research Journal of Pedagogics*, 4(4), P. 6–10.

Adilov, P. (2023). Use of the auxiliary projection method in improving the quality of engineering graphics education. *Journal of Academic Research and Trends in Educational Sciences*, 2(2), P. 160–165.

Ташімов Нұрлан Эрполатұлы

Низам атындағы Өзбекстан Ұлттық педагогикалық университеті, Ташкент, Өзбекстан

Сызба геометриясын оқыту кезінде графикалық бағдарламалар арқылы позициялық тапсырмаларды орындау әдістемесі

Аңдатпа. Бұл мақалада сызба геометрия пәнін оқыту үдерісінде Rhino және AutoCAD графикалық бағдарламаларын қолданудың дидактикалық мүмкіндіктері мен олардың позициялық есептерді шешудегі тиімділігі қарастырылады. Зерттеу барысында беттердің қиылысу сызықтарын анықтау әдістері, әсіресе екінші ретті беттердің жалпы жағдайдағы жазықтықтармен қиылысуын салу ерекшеліктері талданады. Графикалық бағдарламаларды пайдалану арқылы күрделі кеңістіктік есептерді көрнекі түрде модельдеу, ортогональ проекциялар негізінде дәл геометриялық құрылымдар жасау және қиылысу сызықтарын анықтаудың алгоритмдік тәсілдерін меңгеру мәселелері қарастырылады. Мақалада Rhino және AutoCAD ортасында орындалатын позициялық есептердің кезеңдік шешу жолдары ұсынылып, олардың студенттердің кеңістіктік ойлауын, графикалық сауаттылығын және өзіндік танымдық белсенділігін дамытудағы рөлі айқындалады. Сонымен қатар, заманауи цифрлық технологияларды қолданудың жаңа білімді сапалы меңгеруге, инженерлік-графикалық құзыреттерді қалыптастыруға және оқу үдерісінің тиімділігін арттыруға ықпалы ғылыми-әдістемелік тұрғыдан негізделеді. Зерттеу нәтижелері графикалық бағдарламалардың сызба геометрияны оқытуда теория мен практиканы ұштастыратын маңызды құрал екендігін көрсетеді.

Түйін сөздер: сызба геометрия, оқыту үдерісі, беттердің қиылысу сызығы, Rhino, AutoCAD, графикалық модельдеу, ортогональ проекция

Ташимов Нурлан Эрполатович

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Методика выполнения позиционных задач средствами графических программ при обучении начертательной геометрии

Аннотация. В данной статье рассматриваются дидактические возможности применения графических программ Rhino и AutoCAD в процессе преподавания начертательной геометрии, а также их эффективность при решении позиционных задач. В исследовании анализируются методы построения линий пересечения поверхностей, в частности особенности пересечения поверхностей второго порядка плоскостями общего положения. Особое внимание уделяется возможностям визуального моделирования сложных пространственных задач, выполнению точных геометрических построений на основе ортогональных проекций и освоению алгоритмов определения линий пересечения средствами графических программ. В статье представлены этапы решения позиционных задач в среде Rhino и AutoCAD, раскрывается их роль в развитии пространственного мышления студентов, графической грамотности и самостоятельной познавательной активности. Кроме того, научно-методически обосновывается влияние современных цифровых технологий на повышение качества усвоения новых знаний, формирование инженерно-графических компетенций и совершенствование образовательного процесса. Результаты исследования показывают, что использование графических программ способствует интеграции теоретической подготовки и практических навыков, а также выступает эффективным инструментом модернизации преподавания начертательной геометрии в условиях цифровизации образования.

Ключевые слова: начертательная геометрия, обучение, линии пересечения поверхностей, Rhino, AutoCAD, графическое моделирование, ортогональная проекция

Список использованной литературы

Erpolotovich, T.N., & Kyzy, T.Z.B. (2023). Spatial development of students'imagination in engineering graphics by solving problems related to design. *Current Research Journal of Pedagogics*, 4(03), 30-33.

Мадумаров К.Х., Кахаров А.А. (2008). Факторы повышения пространственного мышления. В: *Проблемы интеграции науки и производства: Материалы конф.* Наманган, 29–30 мая, С. 399–400.

Рихсибоев Т., Пардаева М. (2015). Снятие фаски острых углов в 3D-моделях, выполненных в программе AutoCAD. В: *Научно-теоретические основы подготовки педагогических кадров в области начертательной геометрии и инженерной графики в системе непрерывного образования: Материалы Респ. научно-практ. конф*. Ташкент, 15 апреля, С. 130–132.

Рубинштейн С. Л. (2004). *Основы общей психологии*. Санкт-Петербург: Питер.

Ташимов Н. (2019). Алгоритмизация курса начертательной геометрии как дидактическая основа обучения современным средствам IT-технологий. *Мугалим ҳам узликсиз билимлендириу*. (5), С. 29–31.

Tashimov, N.E., Zoitov, S. and Oblakulova, L. (2019). Methods of development and application in the educational process of computer technology in teaching graphic disciplines. *European Journal of Research and Reflection in Educational Sciences*, 7(12).

Turdimovich, A.S. (2023). Ways to develop students' design ability. *Current Research Journal of Pedagogics*, 4(4), pp. 6–10.

Adilov, P. (2023). Use of the auxiliary projection method in improving the quality of engineering graphics education. *Journal of Academic Research and Trends in Educational Sciences*, 2(2), pp. 160–165.

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