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METHODOLOGICAL RECOMMENDATIONS FOR IMPROVING THE DIDACTIC SUPPORT OF TEACHING DESIGN TOPICS IN SCHOOL DRAFTING CLASSES

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Abstract

The design of parts and products is taught in school drafting classes. Mastering the subject of drafting well helps students develop graphic technical literacy and spatial imagination. This article highlights the methods used in teaching design-related topics in drafting, as well as educational and methodological materials aimed at enhancing students' creativity and improving their spatial imagination. Additionally, it analyzes scientific and methodological approaches aimed at improving the didactic support for teaching design topics in drafting.

Keywords

design, didactics, imagination, creativity, interactive methods, theoretical research method, empirical research method, survey, oral interview method, thinking, creativity, spatial imagination.

Introduction. The education system of every country is closely linked to its socio-political, economic, and cultural life. This is because a nation's economic development and cultural progress improve only when its education system reaches a high level. In particular, this can be seen in the “Development Strategy of New Uzbekistan for 2022–2026,”[16] initiated by our country's leader.

The President of our country, Sh. M. Mirziyoyev, has expressed his trust in the youth by stating in his speech: “Indeed, only you, our dear youth, who have mastered modern knowledge and professions, who think independently, and who always live with a sense of responsibility for the fate of the nation, can step forward with confidence and solve the tasks that life itself is placing before us today.”[17]

[16] https://lex.uz/uz/docs/-5841063
[17] Speech of the President of the Republic of Uzbekistan, Sh. Mirziyoyev, at the IV Congress of the "Kamolot" Youth Social Movement.

In particular, great attention is being paid to design and engineering fields to ensure spiritual development and elevate the sector to a new level. New programs are being implemented to support young designers and engineers. Specifically, in his 2022 Address, our President stated: "We will expand support for talented youth. Together with prestigious international organizations, we will establish specialized Engineering Schools in the fields of chemical industry, electrical engineering, transport, and energy. This system has never existed in our country before. In short, we will create a system for training engineers of the new era."[18] Engineering schools are being opened in various regions of our country, providing us with unique opportunities.

During the process of teaching the subject of drafting to school students, they begin to develop design skills. Students involved in the design process must acquire the ability to create and interpret drawings. Based on given conditions for a specific object, a student must think creatively, visualize, and apply the principles of drafting to put their ideas on paper.

We know that design includes modifying certain aspects of an object to make it more convenient without altering its fundamental structure. First and foremost, for such a skill to emerge, a student must develop critical thinking. In addition to thinking, spatial imagination must also be cultivated.

The word *imagination* derived from Arabic and means thinking, imagining, visualizing, and mentally picturing something.[19]

Spatial imagination is a person's ability to perceive and visualize the surrounding environment in three dimensions. This means being able to mentally picture all objects around us. In any situation, the ability to imagine a particular object upon hearing its name and to mentally perceive it is a sign of well-developed spatial imagination. The most effective way to develop spatial imagination is through the perception of real objects and their verbal description.

In particular, in the field of drafting, for students to further develop design skills, teachers must possess both professional expertise and pedagogical mastery at a high level. Additionally, a drafting teacher must have a well-developed ability for creative thinking. To achieve this, a teacher must understand didactics, grasp its content, and be able to apply it in practice. Didactics, in simple terms, refers to how a teacher should effectively convey knowledge to students, what methods and tools should be used, and how to organize the teaching process efficiently. In other words, didactics teaches what is necessary to ensure effective learning.

[18] https://kun.uz/kr/72820569
[19] Explanatory Dictionary of the Uzbek Language. Uzbekistan National Encyclopedia – 2008.

Didactics (Theory of Education: from the Greek "didaktikos" – teaching, and "didasko" – learning) is a field of study that explores the theoretical aspects of education. It examines the essence of the educational process, its principles, laws, the roles of teachers and students, educational goals, forms, methods, tools, outcomes, and ways to improve the teaching process.[20]

Design topics in the drafting subject are considered complex. However, according to the state standard, the 9th-grade drafting textbook allocates only 3 hours to design-related topics. This is insufficient to fully develop students' literacy in design. Despite this, many innovative teachers are successfully implementing various initiatives in design education. They achieve this by organizing extracurricular clubs and assigning additional tasks to talented students and club members.

When teaching design topics in drafting lessons, educators should effectively utilize various didactic principles to ensure productive and engaging lessons.

Literature review. The purpose of each subject taught in education is to train qualified personnel and help the younger generation find their place in life. In this regard, the role of books is invaluable.

In the field of technical drawing, studying educational literature aimed at improving the didactic support of design topics is crucial. The curriculum for technical drawing includes numerous interesting tasks across almost all topics.

In particular, the textbook Drafting 9,[21] co-authored by I. Rahmonov, D. Yuldasheva, and M. Abdurakhmonova for 9 th grade students, provides a thorough explanation of graphic problems. The school textbook includes materials on basic design problems and extensively covers various types of objects and engineering documentation. However, since it is a school textbook, design-related topics in technical drawing are presented in a simpler and more concise manner based on the school curriculum. Despite this, technical drawing teachers can supplement the school textbook with other books and methodological guides on design.

For example, the study guide Drafting (Fundamentals of Design in Technical Drawing)[22], co-authored by Professor I. Rahmonov and Associate Professor A. Valiyev, provides detailed explanations on drafting and reading drawings, as well as principles for designing parts and assemblies. However, this guide does not cover design problems related to geometric and projection drawing, focusing more on mechanical engineering components.

[20] https://reja.tdpu.uz/shaxsiyreja/openlessonfiles/1167_5-Mavzu%20Ped%20Nazariya1.pdf
[21] Rahmonov I., Yuldasheva D., Abdurahmonova M. Chizmachilik. -T.: "O'ZBEKISTON", 2019.
[22] Rahmonov I., Valiyev A. Drafting. -T.: "Voris-nashriyot", 2011.

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Additionally, the methodological guide Fundamentals of Design in Technical Drawing[23], authored by Associate Professor A.N. Valiyev and others, includes exercises aimed at developing spatial imagination, as well as topics on design fundamentals, initial design problems of objects, and engineering construction tasks. However, it lacks materials on teaching methodologies for design topics.

The methodological guide Drafting (Design)[24] by N. Gulomova provides information on modifying the shape of parts and structural issues. However, it does not address the classification of design topics or the pedagogical and psychological aspects of enhancing spatial imagination.

The textbook Methodology of Teaching Engineering Graphics,[25] authored by E. Ro'ziyev and A. Ashirboyev, focuses on teaching technical drawing with the latest updates in drawing standards and the application of modern educational technologies. However, it does not provide extensive methodological recommendations for improving didactic support in teaching design topics.

These analyses indicate that there is a need to improve both the content of design topics and the methodology for teaching them in today's educational landscape.

Research Methodology. Teaching technical drawing involves enhancing students' spatial imagination, fostering creativity, developing skills in drafting and reading drawings, and improving theoretical recommendations in these areas. The use of methodological materials, handouts, slides, animations, and interactive teaching methods ensures the quality and effectiveness of Drafting lessons.

To improve the effectiveness of teaching design topics in technical drawing, the following methodological approaches should be applied:

1. Theoretical Research Methods: Teachers should analyze existing scientific literature on design, study advanced theories in technical drawing, and implement innovative approaches in the educational process. Additionally, students should be encouraged to conduct independent research, engage in creative thinking, and develop new types of components.

For example, students can be given various tasks to analyze the structure of commonly used technical components from geometric and structural perspectives. (Figure 1)

[23] Valiyev A., Karimova S., Jumanova M., Mardov S., To'rayev X., Jiyenbayeva S Fundamentals of Construction in Drafting – T.: 2013.
[24] Gulomova N. Drafting. (design) - Toshkent 2015.
[25] Ro'ziyev E., Ashirboyev A.Teaching methodology of engineering graphics – T.: 2010.

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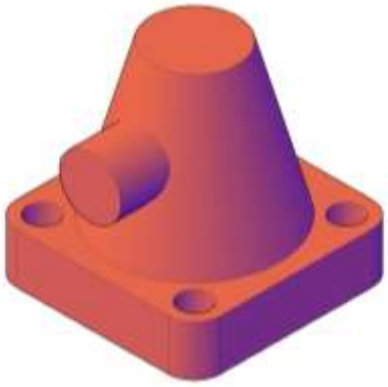

Figure 1

The detail shown in Figure 1 consists of a prismatic base positioned on a horizontal plane, a right circular cone, and a cylindrical surface. (Figure 2)

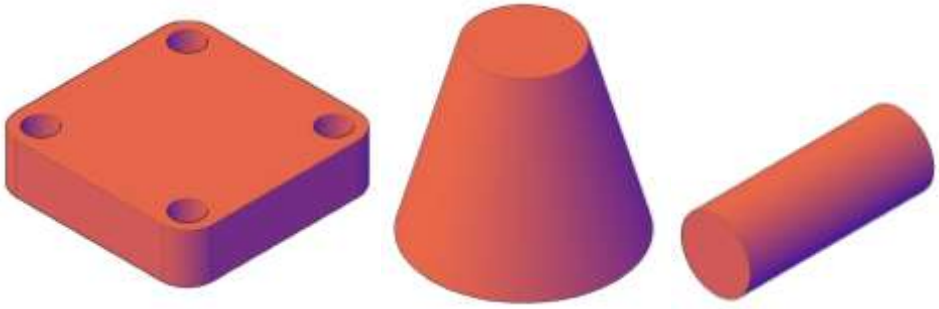

Figure 2

By changing the position of these given simple surfaces, we can create various complex details. (Figure 3)

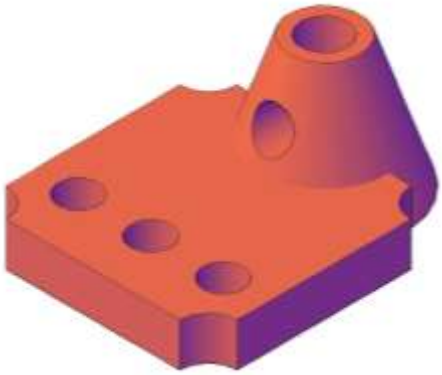

Figure 3

The teacher should develop students' design skills through drawing exercises similar to those shown in this variant.

2. *Empirical Research Methods*: This method involves pedagogical observation, where the teacher monitors the students activity and level of understanding during the lesson. By conducting surveys and interviews with students, the teacher identifies the challenges and effective methods encountered in learning design topics in drafting. Different types of surveys can be used:

For example, questionnaires help gather students' opinions, while oral interviews assist in analyzing students practical work, their attitude toward design,

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and identifying difficulties. The questionnaire method helps identify students' interest in design topics. For instance, before the lesson begins, the teacher prepares a set of questionnaire questions for each student based on distributed material. The questions could include:

1. What do you understand by the term "design"?
2. Have you ever designed any object in your life? What was it?
3. What do you think is the role of design in our life?

Once the questions are prepared, the teacher distributes the materials to the students, and within a short time, they write down their opinions and thoughts on the questions. Based on the feedback, the teacher organizes the lesson on design topics accordingly. The oral interview method is recommended for reinforcing the lesson at the end of the class. That is, the teacher explains the topic, and during the process of drawing designs, students might face various difficulties. In such cases, the teacher can use the oral interview method effectively. The teacher provides detailed explanations based on the questions raised by most students, working together with them. Additionally, the teacher can ask interesting design-related questions during the lesson:

1. Why is the bottom part of an iron kettle larger, while the bucket or teapot for brewing tea is smaller?
2. Why is the mouth of a glass bottle for water smaller, while the one for milk is larger?
3. Why do kitchen utensils and teapot bottoms have a circular design instead of being flat?

Through experimental trials, the teacher implements methodological recommendations to improve the didactic support for teaching design topics in school drafting.

Analysis and results. When discussing the subject of drawing, it is important to note that, during the teaching of drawing, students' design skills gradually develop.

Design refers to "the process of creating and drawing plans for new models of objects (tools and devices, buildings and structures, various machines and apparatuses, clothing and furniture)."[26]

It is essential to make effective use of design topics when teaching school-age children. Design involves changing a specific object either in form or content and creating convenience for that object. In the design process, students must have the skills to create and read drawings. To imagine, think creatively, and transfer these ideas to paper, students must know the rules and principles of the drawing subject.

[26] Explanatory Dictionary of the Uzbek Language. Uzbekistan National Encyclopedia – 2008.

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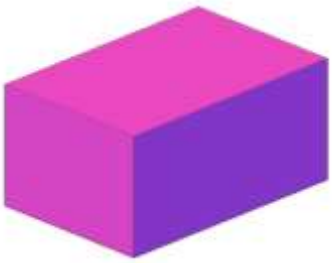
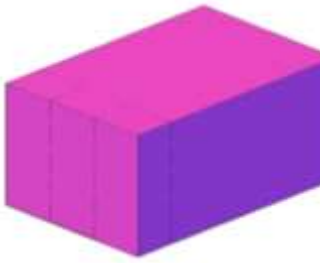
To develop design abilities, special attention should be given to ensuring the effectiveness of education through pedagogical and psychological qualities. For this, the teacher should also increase their ability to engage students with new ideas. For example, the teacher should first demonstrate how to design a simple detail step by step on the board (Table 1). After students have acquired some skills in design, they should be given various drawing tasks similar to their own version. Through this, design skills will gradually develop.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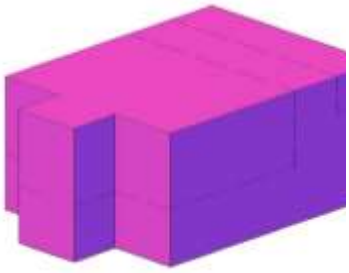	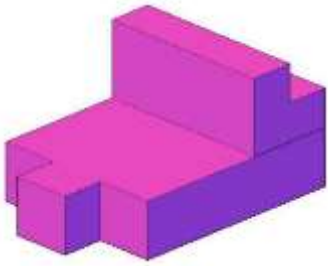	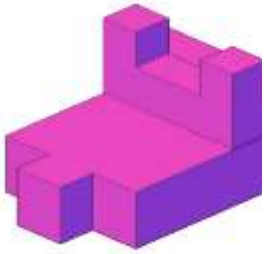
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Table 1

As mentioned above, in order for students to develop design skills, the teacher needs to engage students in this subject through various options. The 9th grade textbook provides drawings of various details on the topic of design. However, because the design topic is explained very briefly in the school textbook, advanced teachers can organize clubs and create various options to develop students' interest in design. An example of this can be seen in the third drawing. In this drawing, the student, by using the layout line, should spatially imagine the given detail and either cut or carve out parts of it.

Presentation of Graphic task ***Solution of the Graphic task***

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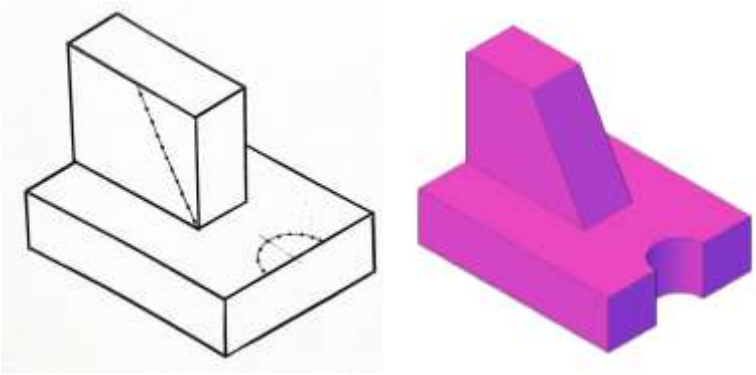

Figure 4

If designing means shaping a given part by cutting or trimming it to reduce its weight and improve convenience, then, in addition, students can also be given the task of assembling separate parts of a detail into a single whole based on specific conditions (Figure 4). That is, the parts of the detail should be mentally arranged in such a way that they form a complete piece. The connection points are indicated with dots. This makes the drawing even more understandable for students.

Presentation of Graphic task ***Solution of the Graphic task***

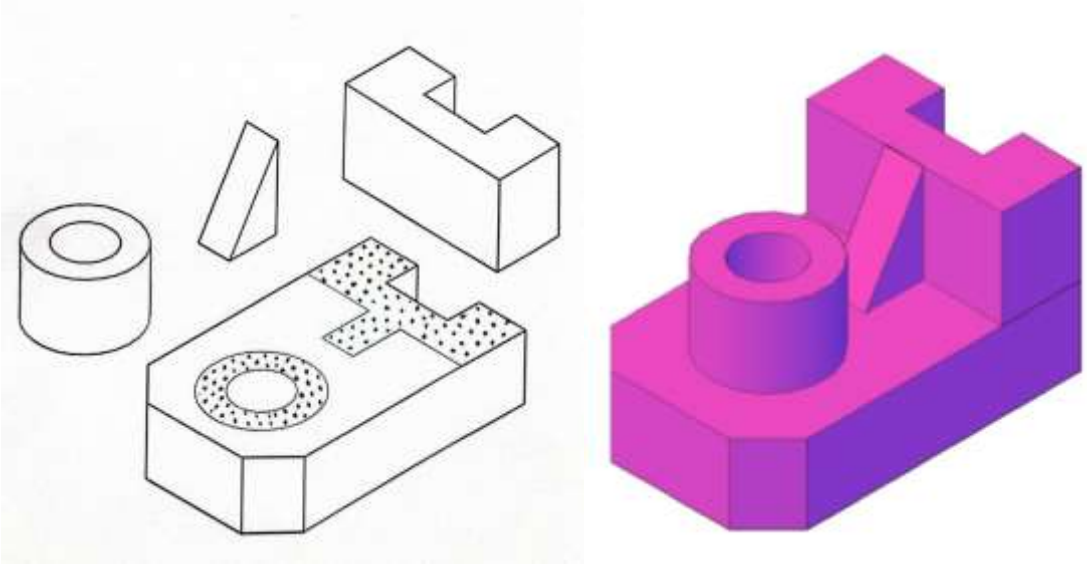

Figure 5

In the teaching of design problems in technical drawing, it is also the teacher's main task to develop and implement exercises aimed at shaping and improving spatial imagination. The teacher must select such tasks that, during the drawing process, students gradually enhance their spatial perception while simultaneously improving their design skills. For example, students should mentally rotate a given detail so that its hatched surface becomes parallel to the frontal projection plane, and then draw the three views of the detail accordingly (Figure 5).

Presentation of Graphic task

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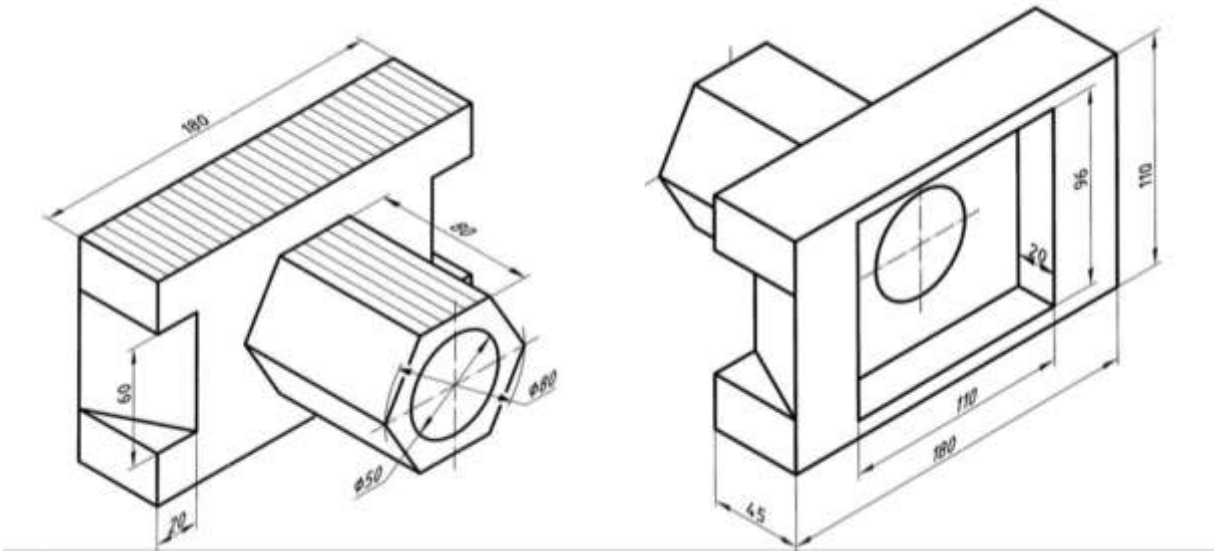

Solution of the Graphic task

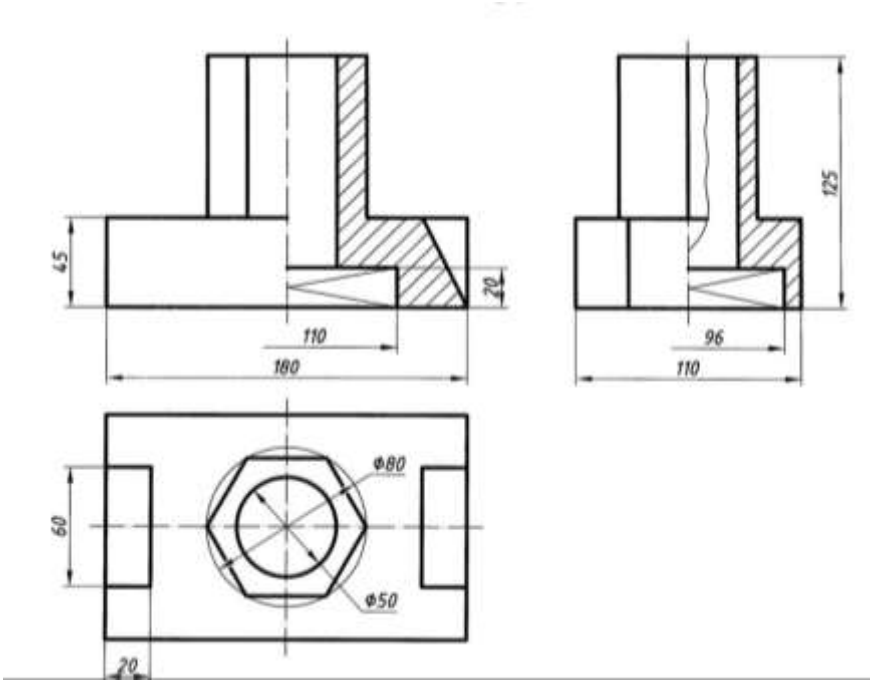

Figure 6

An advanced educator should conduct lessons based not only on practical skills but also on theoretical knowledge. That is:

• Improving educational materials. More practical and theoretical assignments should be incorporated, and electronic resources and visual aids should be utilized.

• Modernizing didactic support. Step-by-step lesson plans should be developed, and visual materials should be used to increase students' interest.

• Enhancing teachers qualifications. Seminars, professional development courses, and experience-sharing programs should be organized to learn modern technologies in design.

These methodological recommendations will help improve the quality of teaching design topics in the drafting subject and foster students creative thinking.

Conclusion/Recommendations. In traditional methods of teaching design topics in school drafting classes, students' creative potential cannot be fully realized. Therefore, it is necessary to reorganize lessons using modern educational technologies and interactive methods.

In the design process, it is essential to develop practical skills alongside theoretical knowledge. To achieve this, an advanced educator should structure the lesson so that within 45 minutes, students receive both theoretical information and practical exercises while also being encouraged to think independently.

At present, the effective use of interactive whiteboards and computer programs in lessons can enhance students interest in the design process and improve the overall effectiveness of the class.

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