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Research Article

METHODS FOR DEVELOPING STUDENTS' DESIGN SKILLS

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ABSTRACT

Develop students' design skills using graphics software and 3D printers and other software. In addition, theoretical information on the development of design skills is provided.

KEYWORDS

Technology, creativity, design, projection, method.

INTRODUCTION

The President of our country, Sh. M. Mirziyoyev, adopted the Law on Youth, which defines the rights, interests, and duties of the youth of our country. Furthermore, the Action Strategy for the five priority areas of development of the Republic of Uzbekistan for 2017-2021 includes tasks such as "Improving state youth policy, including nurturing physically healthy, mentally and intellectually developed, independently thinking, determined youth with a firm worldview, loyal to the homeland, and increasing their social activity in the process of deepening democratic reforms and developing civil society."

Expressing confidence in the youth and emphasizing that they are our future, President Sh. M. Mirziyoyev stated in his speeches: "Indeed, only you, our dear youth, who have thoroughly mastered modern knowledge and professions, think independently, and live with a sense of involvement in the fate of the nation, can boldly step forward and solve the tasks that life places before us today."

The subject of technical drawing plays an invaluable role in the preparation of such well-rounded specialists. This is because technical drawing is directly connected with technology and its progress. One of the primary tasks of technical drawing is to train young

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people who master the established standards and rules for drawing, possess graphical literacy, have strong spatial imagination and thinking, and can think creatively, mastering the fundamentals of design.

It is known that scientific and technological development is largely based on technical design. The advancement of technology is impossible without drawings. Therefore, during the process of teaching technical drawing and performing each graphic task, it is necessary to instill elements of creative thinking (design) in students. For example, when drawing views (projections) of a part, students should be asked questions such as: Why are these elements needed? Could it be done differently? This encourages cooperation with students in finding solutions, arranging the graphic work on the drawing sheet independently (composing), and achieving an aesthetically pleasing design that meets design standards.

Any mechanism related to design is associated with creative thinking, that is, creating innovations.

The term "creativity" is derived from Arabic, meaning creation, discovery, or bringing something into existence. Creativity refers to generating something new and useful within a specific context and time. In general, anything produced beyond the known is considered a product of creativity. Innovation, in turn, refers to a technical thinking product that introduces a new element not previously known, even if it contains familiar materials.

The emergence of 3D printers capable of printing in 3D format in the field of engineering graphics has significantly expanded human capabilities in various scientific and practical activities. Now, it is possible to create different components and parts of varying complexity at home. For such work, polymer materials, which can easily be purchased in stores or ordered online, are used.

To print the aforementioned parts on a 3D printer, learners must acquire basic knowledge and skills in design. Creating such design elements requires in-depth study of the principles and rules of technical drawing. Alongside technical drawing, knowledge of engineering and computer graphics is also essential for using relevant software.

What is a 3D printer, and how does it work?

Simply put, a 3D printer is a device that creates three-dimensional objects through layered printing. First, the model is developed in special software and then converted into a G-code. It is divided into horizontal layers and transformed into digital code, which serves as a command for the printer, instructing where and how to apply the material.

The printer's print head is a complex design that moves horizontally. A volumetric figure is formed by applying material across several planes simultaneously. The object is created on a special work surface that ensures the polymer adheres and is secured.

As each layer is applied, the surface is lowered by the thickness of one layer, and the print head applies the next layer until the object is fully formed. (Figure 1).

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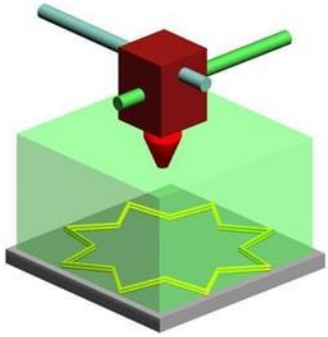

Figure-1.

Nowadays, 3D printing has found applications in all areas of human activity, from construction to medicine. These include:

SLA Technology

To better understand the use of polymer materials, let's explore several methods, one of which is SLA (Stereolithography) technology:

1. Polymer or resin is poured into a container and hardens under the influence of laser beams.

2. Once the system is activated, the laser starts moving along the axes.

3. At specific contact points with the laser, the polymer solidifies, changing its structure.

4. After each layer, the container lowers, forming a frame.

What is Resin?

Resins are organic substances that occur naturally in plants. They are sticky liquids with a transparent or dark brown color. Some plants contain resins in their sap. Although resins are initially liquid and sticky, they can harden through chemical treatment. The hardness of resins varies depending on the plant that produces them. They are insoluble in water but dissolve in alcohol. Different types of resins exist, each with a unique chemical composition.

What is a Polymer?

Polymers are large molecules composed of repeating structural units called monomers, connected by covalent bonds. These long chains, formed through a process called polymerization, consist of more than 10,000 atoms and have high molecular weight.

Polymers are classified into two main types based on the method of synthesis:

1. Addition Polymers: When monomers with double bonds between carbon atoms undergo addition reactions, they form addition polymers.

2. Condensation Polymers: During some polymerization processes, when two monomers join, a small molecule like water is released, forming condensation polymers.

The physical and chemical properties of polymers differ significantly from those of their monomers. Additionally, the properties of polymers vary depending on the number of repeating units. Polymers are abundant in the environment and play a crucial role in various fields.

What is the Difference Between Resin and Polymer?

The primary difference between resins and polymers is their molecular structure and origin. Resins are organic substances that naturally form in plants, while

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polymers are large molecules made of repeating monomer units. Resins have lower molecular weight compared to polymers, which possess high molecular weight. Resins are sticky liquids with transparent or dark brown hues, while polymers can be either solid or liquid.

SLA technology offers high precision and material quality, producing detailed objects. However, it is relatively expensive.

SLS Technology

The Selective Laser Sintering (SLS) method uses laser beams to create objects layer by layer. A roller mechanism is installed in the center of the equipment with a platform that holds the material. Special polymer material is applied to the platform to create the part.

After applying a thin layer, the laser fuses the polymer particles evenly, forming a solid layer. This process repeats through multiple cycles until the final shape is achieved.

This method is slightly more complex but still delivers high precision. Compared to other technologies, SLS technology is more affordable.

Figure 2. DLP Technology

1. DLP Printing

2. DLP (Digital Light Processing) printing is a relatively new invention in the field of 3D modeling, but its principle is practically identical to the previously mentioned methods. It is important to understand that in DLP printing, an LED strip serves as the primary tool instead of a laser, as in SLA technology. This not only speeds up the process and ensures excellent quality but also helps save on equipment costs. The version presented is an improved one and holds a leading position. (Figure 2).

3. EBM Technology

4. Another variant used in 3D printing is EBM (Electron Beam Melting). This technology involves using directed beams from emitters (electron guns). Due to the high temperature generated by the electron beam, the material starts to melt, allowing the formation of products with various configurations and sizes. The temperature can rise up to 1000°C, enabling the processing of certain metals.

5. The main advantage of this method is its high speed and productivity, which is especially useful for large-scale manufacturing and fast production.

6. Controlling the 3D Printer

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7. To ensure the interaction of all systems, it is essential to properly manage the printing parameters and adjust the equipment. Various programs and applications are available to regulate the operation of 3D printers. The main method involves using software installed on a computer to adjust the following parameters:

8. 1. Nozzle temperature – The temperature at which the polymer material is delivered to prepare the model.

9. 2. Bed temperature – The temperature of the print bed to ensure good adhesion of the material to the surface.

10. 3. Material flow rate and intensity – Controls the speed and intensity of polymer delivery to the working surface, improving the application of layers.

11. 4. Operation of electric motors – Controls the movement during printing. (Figure 3).

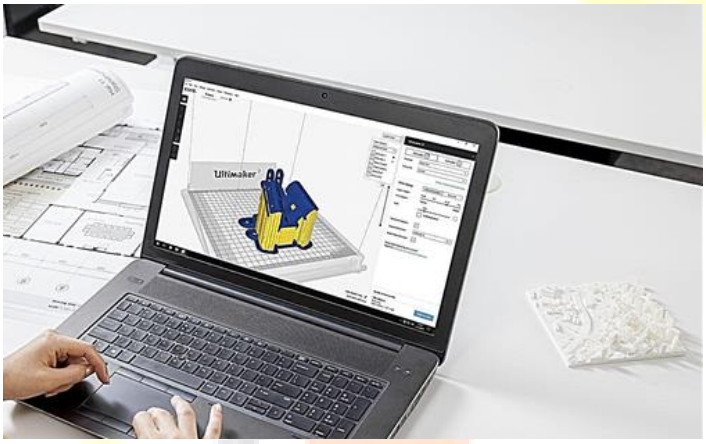

Figure-3

Special Software for Workflow Management with Supervisors

There are also specialized programs that use coding to manage workflows and interact with supervisors.

Models for 3D Printing

To ensure such a complex process, special models are required to build the final product. If you are just starting to master this technology, it is worthwhile to learn how to use standard programs and software. Typically, the package includes installation discs with the basic software and a set of ready-made figures.

You can find software online or create your own designs. This section aims to teach you the basics of layout design. After that, you can try to independently develop your own layout for future parts. The software will automatically convert the file format and send it for printing.

Essential Skills for Using Modern Technologies Effectively

To apply the latest technologies successfully and achieve good results, learners must develop the following skills and knowledge:

1. Ability to visualize spatially
2. Knowledge of technical drawing principles
3. Good experience in engineering and computer graphics
4. Solid understanding of design concepts
5. Familiarity with multiple graphic software programs

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Those who master these skills will be able to achieve excellent results using modern software without difficulty.

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