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USE OF INTERACTIVE DYNAMIC MODELS IN ILLUSTRATIVE DISPLAY OF DRAWINGS

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Abstract:
The article describes the didactic possibilities of interactive dynamic models and methodological recommendations for their use in the educational process.

Keywords: Geogebra, modeling, construction stages, interactive, dynamic, spatial visualization.

Introduction

The development of information and communication technologies has accelerated their introduction into all aspects of society's life. In particular, the role and importance of information and communication technologies in the educational process is increasing. Today, information technologies, that is, the possibilities of computer modeling, are widely used. Especially in the field of education, computer simulation can help students to learn the material faster, make lessons more interesting and increase interest in learning.

Computer systems used in the educational process include the following visual aids:

1. Interactivity - (visual: "interaction" - "interaction") is a concept that reveals the nature and level of interaction between objects or subjects [1].
2. Communication - (lat. communicatio - generalization, connection) means "information exchange process in cybernetics"[2].
3. Multimedia - "information or content presented simultaneously in different forms: sound, animated computer graphics, video clips"[3].
4. Modeling is a method of reproducing and studying a certain part of reality (object, event, process, situation) based on the representation of the object using its copy or likeness [4] it is said. Especially in the field of education, "computer models, which form an interactive dynamic visual series, have the highest educational potential. They represent a very large class of virtual educational objects, and with their use, educational computer simulation can provide a whole range of educational activities. includes"[5].

In particular, the use of interactive dynamic models in teaching "Drawing geometry and engineering graphics" provides the following opportunities, including:

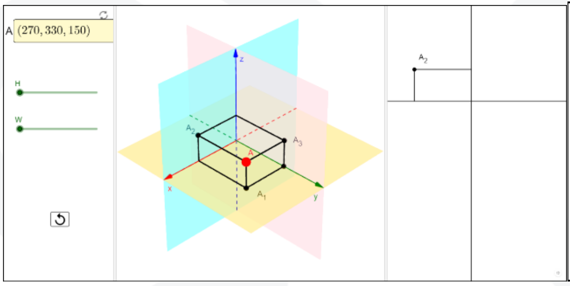
1. It is a convenient tool for students to understand drawings and learn the drawing sequence.
2. The possibility of carrying out small research works (by changing the parameters of the models).
3. Creates opportunities for students to study the educational material independently.
4. The possibility of using interactive dynamic models in the process of distance education.

Today, interactive dynamic models are used in various fields of education. Many researchers[6,7] conducted scientific research on the didactic possibilities of interactive dynamic models in the educational process, developing their methodological support and using them in the educational process.

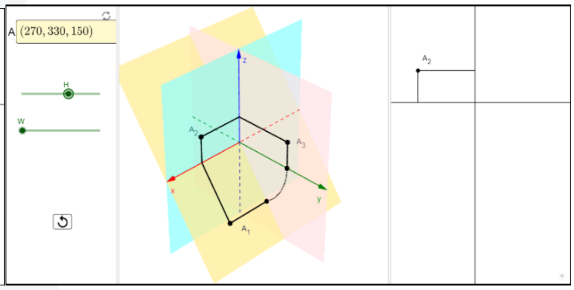
Literature review

One of the interactive dynamic environment software is Geogebra. The juxtaposition of two graphic windows (canvas, canvas 3D) with orthogonal projection of geometric objects in this program develops students' skills of comparison, analysis, synthesis, and spatial imagination. We created dynamic interactive models of drawings of the subject "Drawing geometry and engineering graphics" and used them in the educational process. Below are examples of the didactic potential of these models in the educational process:

Example 1. To transfer the projections of the point A from the spatial view to the eupura, the horizontal projection plane H is clockwise with the OX axis as the center of rotation, and the profile projection plane V is 90 counterclockwise with the OZ axis as the center of rotation. is converted to °. As a result, the plane of H,V,W projections are joined to one plane and form a map (Monge diagram). An electronic version of this drawing was posted on the Geogebra.org website (Fig. 1) a),b),v),g). This resource is accessed through the Internet link[8]. Let's consider the sequence of using this electronic resource during the lesson:



a)



b)

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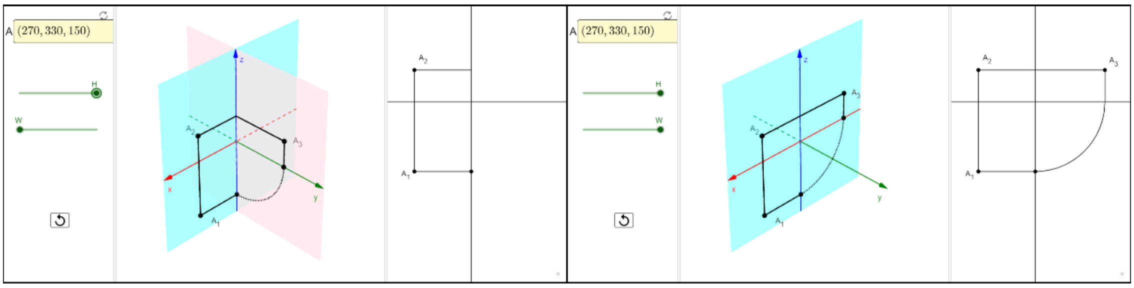

c) d)

Figure 1. The sequence of the process of transferring a given point A from a spatial view to an epur.

First, the teacher (or student) visits the Geogebra website and activates the electronic resource using the provided internet link. Three graphic windows will open in the program window. In the first window, there are controls ("Input field" for writing the coordinates of point A, "Digital scales" for turning the horizontal (H) and profile (W) planes by 90 °), in the second window there is a spatial interactive model of point A, and in the third window there is an epure of point A (Monge drawing) is placed.

The teacher (or student) moves point A of the spatial interactive model to different octants using the mouse. The purpose of this is to form students' skills of spatial perception of the location of point A in the 8th octane (Fig. 1, a).

After that, the teacher demonstrates the process of forming the contour of the point A located in the I-octant by turning the horizontal (H) plane and then the profile (V) plane by 90 °. The plot of point A in 8 octanes is shown and analyzed to the students in the same order. In addition, it is recommended that students independently compile this epyur in different octants.

Example 2. The interactive model prepared on the topic of "Finding the true size of the intersection line and cross-sectional surface of a cone with its base lying on a horizontal plane with a frontal projection plane" is placed on the geogebra site, which students visit via the Internet link [9].

In the interactive model, the following numerical scale is used to change the parameters of the Q plane:

1. To change the values of the deviation angle formed by the plane Q with the plane of horizontal projections H.
2. Q to change the horizontal trace of the plane by the x-axis value.
3. To manage the construction stages of the epur.

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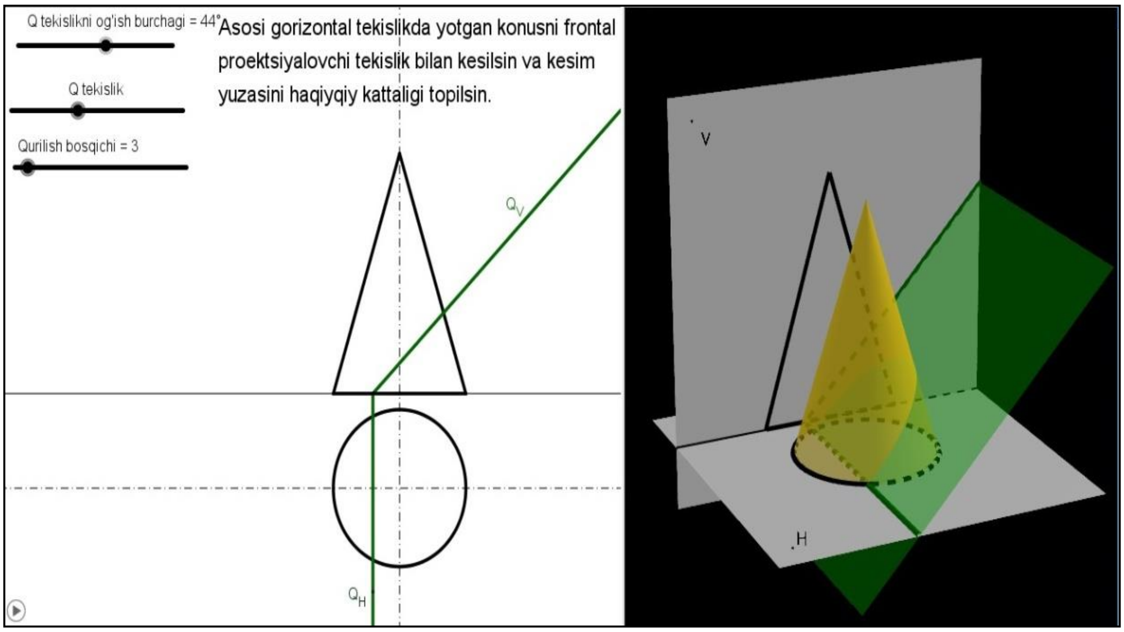

Picture 2. An interactive dynamic model on the topic of finding the line of intersection with a plane projecting a cone.

The teacher asks various questions at the beginning of the lesson. How are conic sections formed? What conic sections do you know? Through these questions, he creates a problematic situation in the audience. Students discuss the problem and find its solution. The teacher summarizes the students' answers and shows the formation of conic sections through an interactive dynamic model. This topic is explained in the following sequence:

Step 1. The position of the cone and flour in the projection plane is displayed in a three-dimensional (3D) view. By observing the 3D model, the student determines that its base lies in a horizontal plane.

Step 2. The teacher analyzes the spatial situation of the cone by comparing its spatial view with its orthogonal position.

Step 3. It shows the traces of the plane Q in the plane of projections, the angle of deviation of the plane relative to the horizontal plane, and the way the plane Q intersects the cone in different situations. When the scale No. 1 is moved to the right or left, the angle of deviation of the Q plane, and through the scale No. 2, it is possible to cross the cone in different situations, and through the scale No. 3, the resulting cross-sectional surface is shown in the sequence of the construction stage. - sequence is presented (Fig. 3).

Step 4. From this stage, the construction of the problem in the epur is carried out step by step. The situation where the Q plane intersects the cone using a numerical scale is

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changed in different ways, and each situation is presented starting from the beginning of the construction sequence.

In the later stages of the problem, the cross-sectional surface of the cone and its real size were shown in different ways, for example, by changing the parameters of the cross-sectional surface of the cone and its real size. Q can represent the resulting cross-sectional surface and true size when the plane intersects the base of the cone or is outside of it. Algorithms for finding the cross-section surface in both cases should be shown from the beginning.

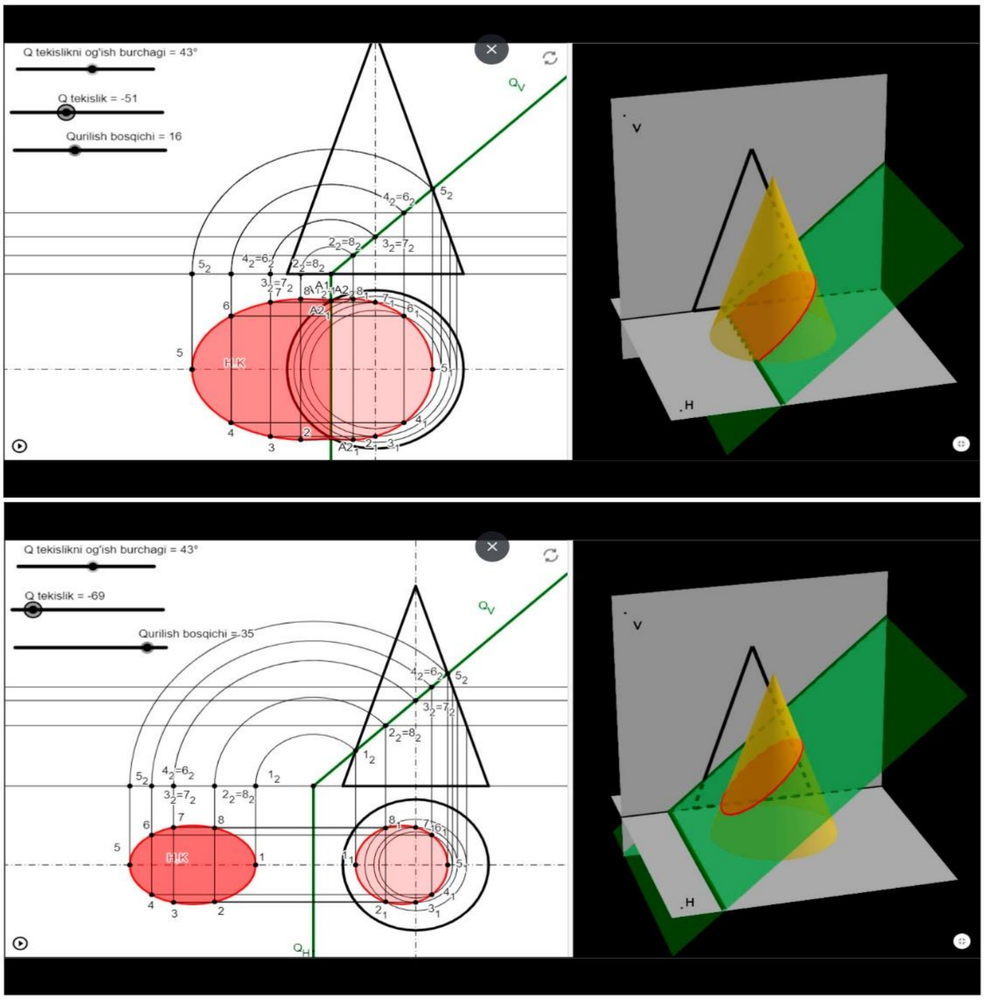

Figure 3. Steps of building an interactive dynamic model on the topic of finding the line of intersection with a plane projecting a cone.

In this electronic resource, the background of the 3D graphic window should be neutral, and the three-dimensional model should be in bright colors. As a result, the three-dimensional model stands out and attracts the student's attention. The elements of the model are in different colors, i.e. the cone is yellow, the cutting plane

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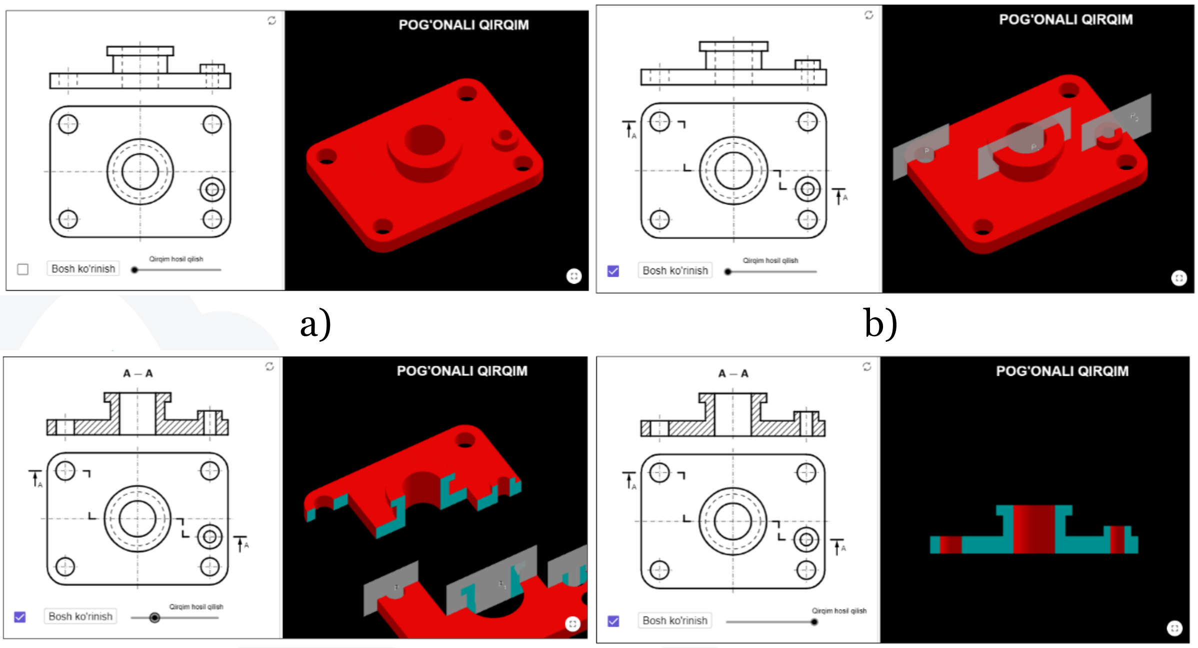
is green, and the cross-sectional surface of the model is red, which makes it easier to distinguish the geometric elements in the drawing from each other.
Changing the three parameters of the interactive dynamic model above. As a result, the teacher demonstrates all types of cone sections through one such electronic resource.
Example 3. If a shear has two or more cutting planes, it is called a complex shear. If the cutting planes are parallel to each other in a complex cut, such a cross section is called step cut. The Geogebra.org website provides an interactive model on the topic of step shear (Fig. 4, a), b), c), d). This electronic resource is used in the educational process in the following sequence:



a) b) c) d)

Figure 4. The sequence of the process of creating a step-by-step haircut.

This interactive model is activated via a web link[10]. The first graphic window shows its orthogonal projection, and the second graphic window shows its spatial model. The teacher introduces students to the definition of simple and complex cuts on the topic. Explains how to create a step cut. When the toggle button in the first graphics window is activated, the horizontal traces and spatial model of the step shear cutting planes appear in the drawing. At this stage, the teacher rotates the spatial detail and shows it to the students. Students compare the intersections of the cutting planes with their drawings. This demonstration develops their spatial imagination and helps them learn the learning material easily. After that, slide the slider labeled "Build stages" to the right.

As a result, the cross-sectional surface is divided into two parts from the point where the planes intersecting the detail in space. When the button "Head view" is pressed, the detail is turned to the frontal view, and its cross-sectional surface is visible in the general position.

This process helps students understand how step shear is formed.

Electronic interactive models were prepared on all subjects of the curriculum in the subject "Drawing geometry and engineering graphics" and posted on the author's personal profile (Fig. 5). The resources posted on the teacher's profile have the following advantages in teaching "Drawing geometry and engineering graphics":

1. The resources placed in the portfolio (2D and 3D models) are visible to the student in full or small screen mode.
2. The student can control the stages of construction of the drawing with his own hand (using numerical scales).
3. Text, interactive model, video, pictures, and other information related to the topic will be posted on the "Geogebra Book" web page.
4. The student can independently build an interactive model of the task given to him using the online programs of the site (for spatial visualization).

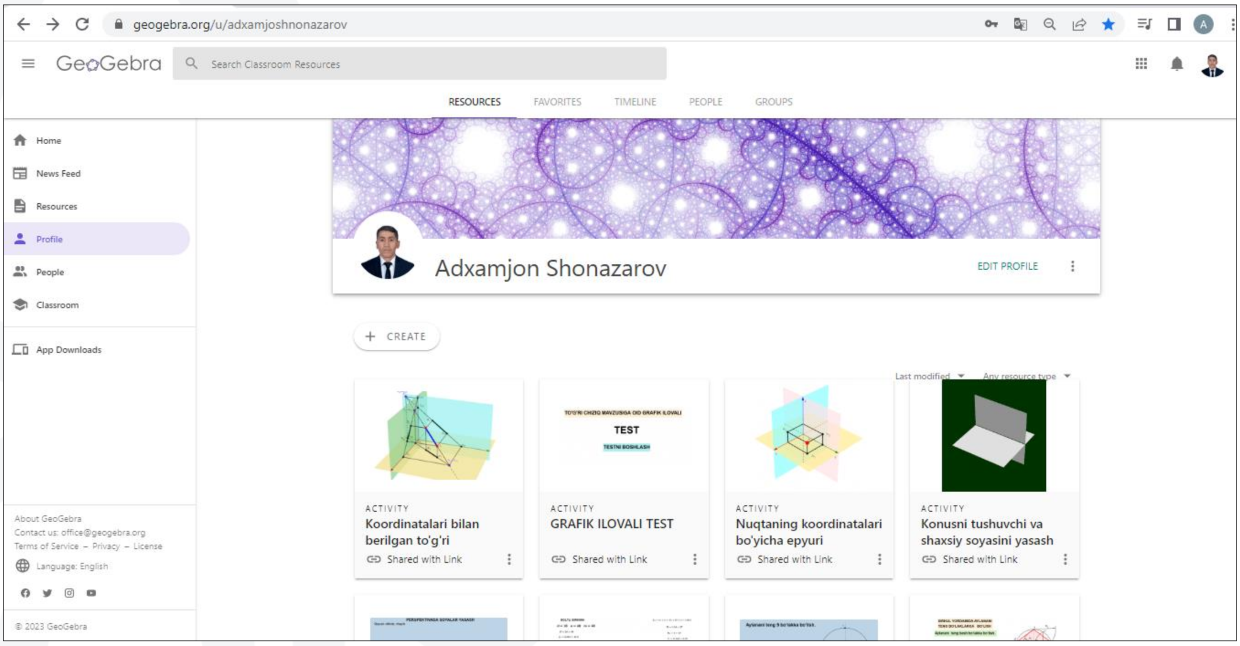


Figure 5. Teacher profile

Conclusion

It can be seen that the Geogebra program is a convenient tool for creating interactive dynamic models, visualizing educational material during the educational process, and developing students' knowledge, skills, and abilities.

Based on didactic requirements, dynamic interactive models of all subjects of "Drawing geometry and engineering graphics" were created and placed on the Geogebra.org site for use in the educational process. In order to determine the effectiveness of interactive dynamic models in the educational process, control and test groups were selected in a higher education institution. 305 students were involved in the experimental work. The results of 154 experimental and 151 control groups were taken as a basis for calculating the results. In order to objectively evaluate the effectiveness of the research, respondents were also randomly selected for the control group. The performance indicators of students of the control and experimental groups of "Drawing geometry and engineering graphics" are analyzed. According to the results of the analysis, it was found that the students of the experimental group have high educational indicators. It was concluded that if these interactive dynamic models are used in the classes of "Drawing geometry and engineering graphics", the knowledge, skills and abilities of students will be developed.

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