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DEVELOPMENT OF A METHODOLOGY FOR TEACHING MATHEMATICS IN COLLEGES USING THE DYNAMIC PROGRAM «GEOGEBRA»

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Abstract

The article discusses the features of the organization of the educational process using the dynamic GeoGebra environment. A description is given of the methodological and technical stages of developing an interactive worksheet as an effective didactic tool. The content of the work presents examples of tasks from the "Similarity of Triangles" section in geometry and an algebraic task.

Keywords: math packages, canvas, object panel, toolbar, keyboard, coordinates.

Introduction

Recently, computer programs are used more often for teaching various educational subjects. The use of various software packages during the study of mathematical subjects has become especially relevant. Among the main classes of mathematical packages are:

- computer algebra, an open system designed to perform numerical and symbolic calcula-tions, and to construct two- and three-dimensional images, as well as for the construction of two-dimensional and three-dimensional images (Maple, Mathematica, MatLab, Mathcad etc.),
- dynamic geometry, an interactive geometry environment (IGS) for building geometric models that performs dynamic measurements and calculations of their various parameters and characteristics (GeoGebra, Cabri Geometry, C.a.R., GeoNext, DG, Mathematical Designer etc.).

Almost any interactive geometry environment allows you to perform constructions quickly and accurately, to build models in plane and space, as well as to perform research using manual or automatic changes in the position of objects.

A special place among such programs is IGE GeoGebra, which allows you to create dynamic drawings, diagrams, models for teaching geometry, algebra, physics and other subjects. The main idea of this program is an interactive combination of geometric, algebraic and numerical representation. It establishes a connection between geometry, algebra and mathematical analysis.

On the one hand, GeoGebra is an interactive geometric program, and on the other hand, you can enter equations and coordinates at the same time [1, 2].

Conflict Setting

The modern period of informatization of education determines the development of new approaches and the need for improvement of mathematics teaching methodology in public educational institutions.

The effectiveness of the implementation of information and communication technology (ICT) tools in the educational process lies in the fact that:

- on the one hand, it mainly contributes to the deepening and expansion of students' theoretical knowledge base, giving practical value to learning results, strengthening educational and cognitive activities, creating conditions for individual abilities, based on this, for the development and full disclosure of the student's independent way of thinking,
- on the other hand, it qualitatively changes the role of the teacher. The teacher becomes a partner who organizes, supports and evaluates the student's educational work.

Materials and methods

How to work with GeoGebra tools?

- First activate the tool.
- When opening the program for the first time, it is in English language (Fig. 1), but we can change it very easily. All commands, tips and tools. For example, we can get the Armenian language through Options→language→Armenian.

First, we introduce students to the main window of the GeoGebra program, in the upper part of which the menus and the "Toolbar" are presented. (Fig. 2).

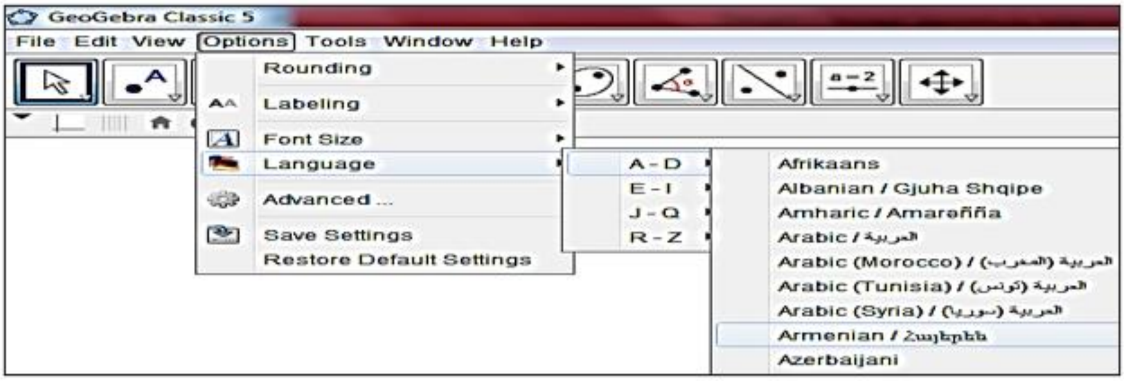

Fig. 1 Steps to choose a language

The first line at the top - the menu has a list of File, Edit, View, Settings, Tools, Window, Help – holds out the "Main Menu". By running it with the cursor, we can see lists of commands appear. Using it with the cursor, we can see lists of commands.

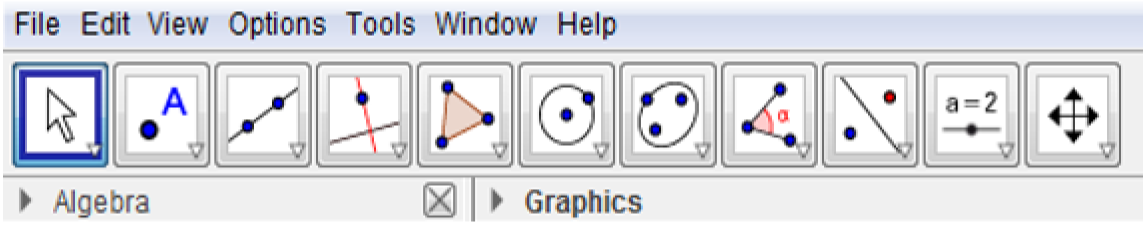

Fig. 2 "Menu" and "Toolbar"

The next row of squares with pictures is called the Toolbar, which contains the tools used.

By clicking on the small triangle in the lower right corner of each tool, we can select the necessary tool from the appearing list (Fig. 2).

The main part of the window is the "Canvas", the field of constructions. The "Objects panel" on the left side of the canvas is used to register constructed objects (points, lines, segments, vectors, equations, etc.). An object built on the canvas or its assignment can be made invisible or shown [2].

Using the geometric tools provided in the Toolbox, we can draw geometric shapes on the graphics part of the canvas. At the same time, the corresponding coordinates and equations in the "Objects panel" will be displayed in an algebraic representation.

On the other hand, you can directly enter algebraic data, commands, and functions in the input line using the keyboard. In this case, all images will be displayed simultaneously in the graphic part.

The purpose of the article is not to present all the tools and commands of the program, but to use some of them in solving various mathematical problems.

Research Results

Problem 1: A triangle ABC is given and it is known that the segment connecting the points D and E ($D \in AB$ and $E \in AC$) is parallel to the side BC. Prove that triangles ABC and ADE shown in figure (3) are similar.

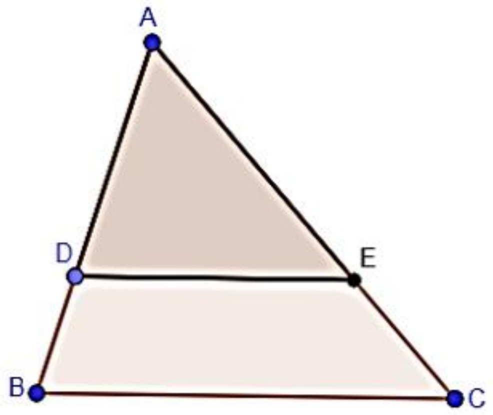

Fig. 3 Given triangles ABC and ADE

The similarity of the mentioned triangles can be proved using the following properties:

1. according to the ratio of surfaces: ($S_{\Delta ABC}/S_{\Delta ADE} = k$^2) (Fig. 4),
2. according to the ratio of the perimeters: ($P_{\Delta ABC}/P_{\Delta ADE} = k$) (Fig. 4),
3. by definition, the angles of such triangles are equal (Fig. 5).

In order to calculate the similarity coefficient of triangles, it is necessary to fill the input windows while changing the positions of points A, B and C (Fig. 4).

1) $a) S_{\Delta ABC} = 13{,}5;\ \ S_{\Delta ADE} = 6;\ \ k^2 = \frac{S_{\Delta ABC}}{S_{\Delta ADE}} = 2{,}25$ $b) S_{\Delta ABC} = 22{,}5;\ \ S_{\Delta ADE} = 10;$
$k^2 = \frac{S_{\Delta ABC}}{S_{\Delta ADE}} = 2{,}25.$

2) $P_{\Delta ABC} = 19{,}26;\ \ P_{\Delta ADE} = 12{,}84,\ \ k = \frac{P_{\Delta ABC}}{P_{\Delta ADE}} = 1{,}5.$

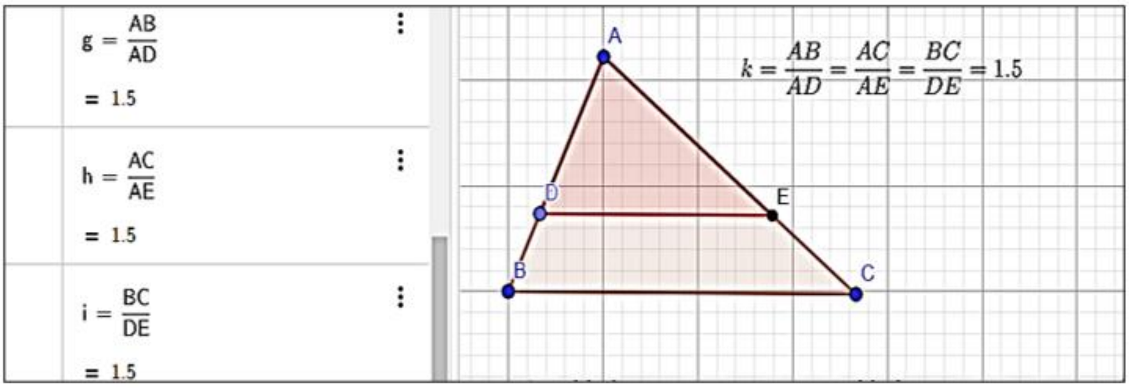

Fig. 4 Similarity of triangles according to ratios of areas and perimeters

The corners of triangles $DE \parallel BC \Rightarrow \Delta ABC$ and ΔADE are equal respectively. According to such triangles, $\Delta ABC \sim \Delta ADE$.

Solving algebraic text problems using the GeoGebra dynamic environment by drawing geometric images on computer screens makes the organization of the educational process more meaningful.

Consider solving an algebraic text problem with IGS GeoGebra.

It gives you a chance to create dynamic diagrams while solving an algebraic text problem, while presenting an interactive combination of geometric, algebraic and numerical representation of the problem condition and solution, which makes the solution of the problem clearer and more visible.

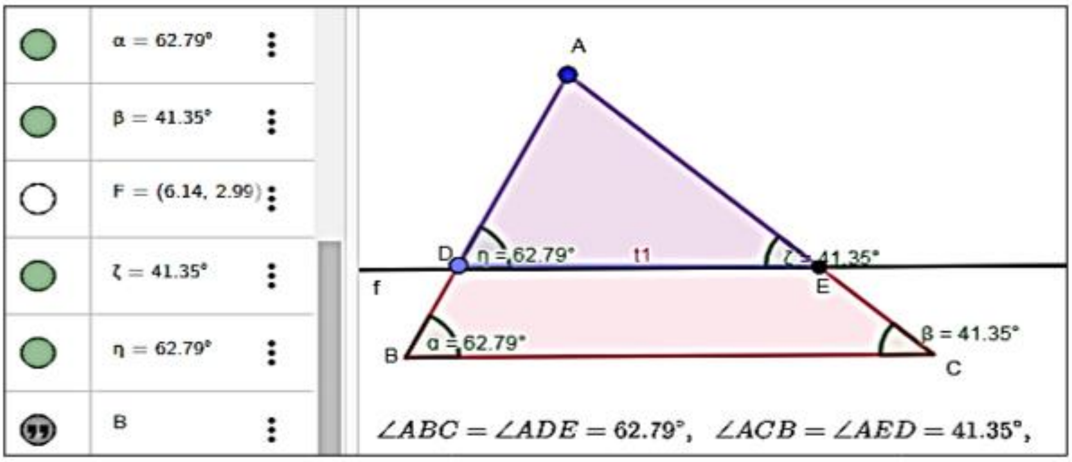

Fig. 5 Like the corners of triangles

Problem 2. Two cars left the village at the same time for the city, which is 180 km away from the village. One car arrived in the city 45 minutes later than the other because its speed was 20 km/h slower. How fast was each car?

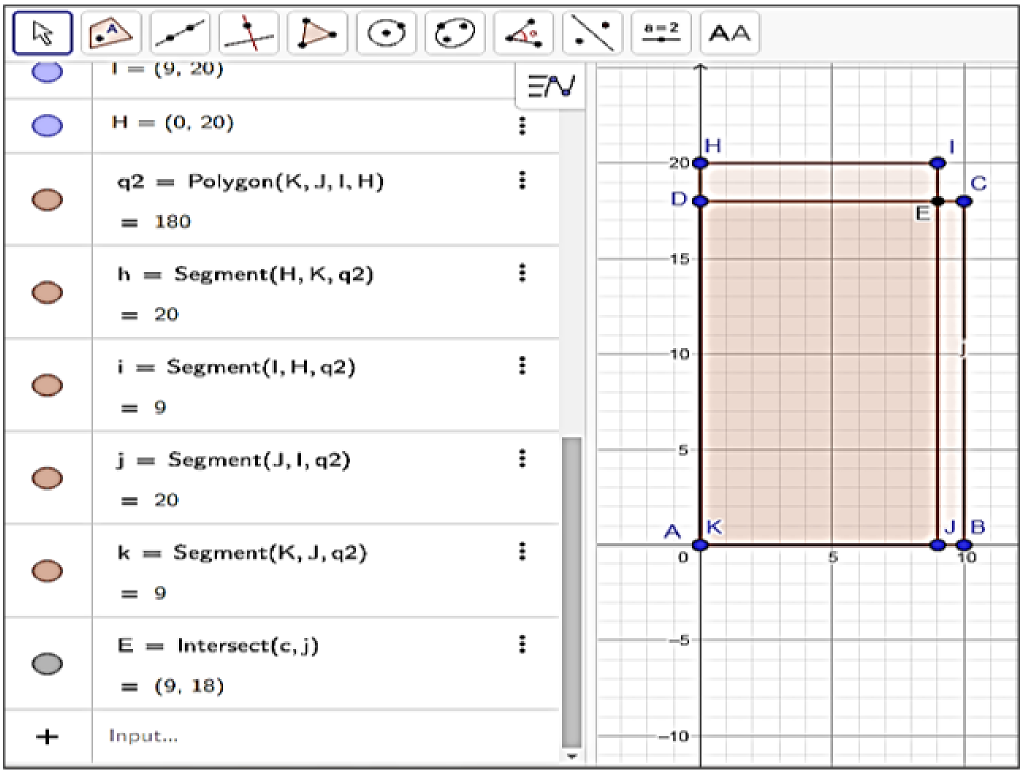

Fig. 6 Representation of the problem conditions on the canvas

Let's define a rectangular coordinate system vOt, where the horizontal Ot axis will indicate the time expressed in hours, and the vertical Ov axis will indicate the speed corresponding to time t, expressed in km/h.

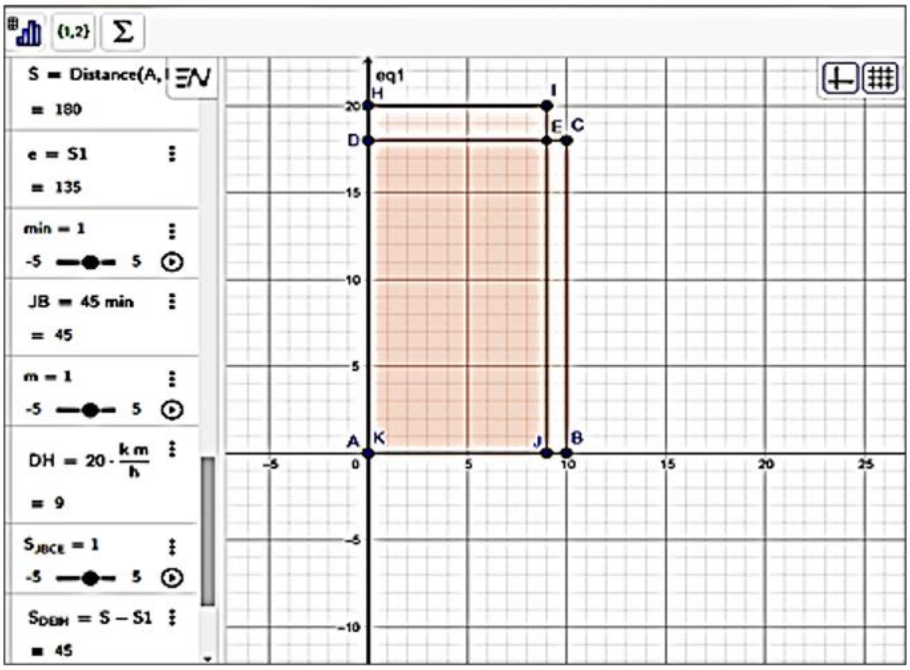

Fig. 7 Objects panel and geometry view

$JB = 45\ minutes\ = \frac{3}{4} hours; S_1 = 135km, DH = \frac{20km}{h}$; $S_{DEIH} = S_{JBCE} = 180 - 135 = 45km; S_{DEIH} = 20t = 45 \Rightarrow t$=9/4=2,25 (h) $(KJ)S_{JBCE}$=$\frac{3}{4}x = 45 \Rightarrow x = 60(km/h)\ (KD)AH = 80(km/h)$. Answer: $60(km/h), 80(km/h)$

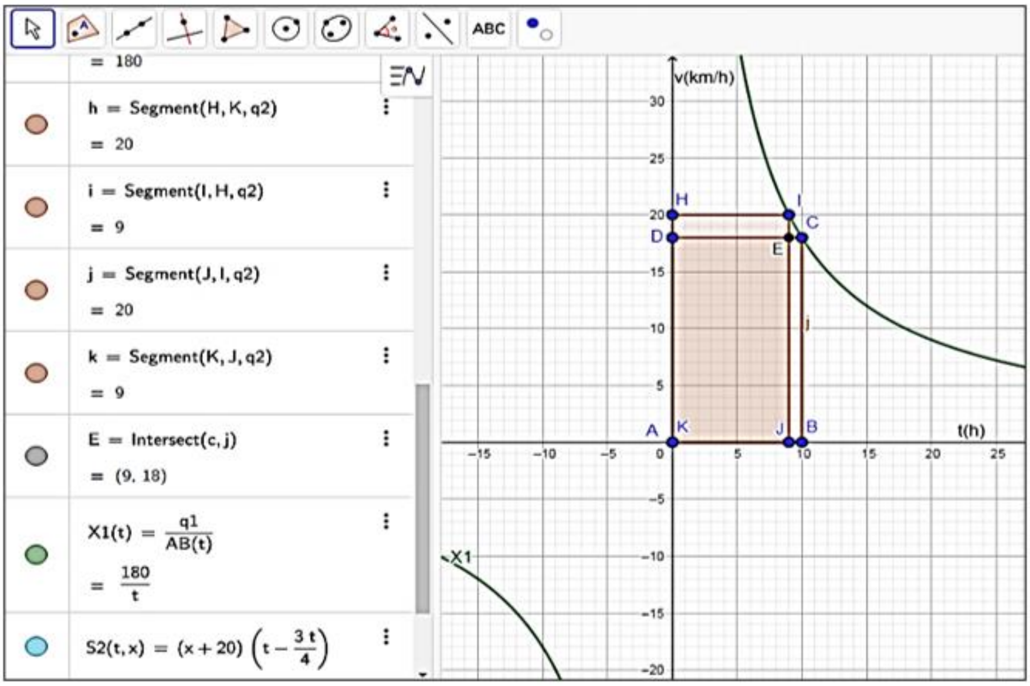

Fig. 8 Geometric representation of the problem

According to the well-known formula $s = vt$, the distance traveled by vehicle II is determined by rectangle $ABCD$, and by $KJIH$, the distance traveled by vehicle I is determined.

The algorithm for passing the distance traveled is shown in Fig. 6. The next step is to determine the areas of all rectangles - shown in Fig. 7.

In the input window, we enter the lengths of the sides of the rectangles $ABCD$ and $KJIH$ so that their areas are equal to 180 (according to the $s = vt$ banana-form). After which the surfaces of the resulting rectangles are automatically filled in, and it is shown that: $S_{ABCD}= S_{KJIH} = 180, \quad S_{DEIH} = S_{JBCE}$

The geometric interpretation of the solution of the above problem (the stages of solving the problem are shown in Fig.6 and Fig.7) is shown in Fig.8.

It is also remarkable that the program considers the inverse relativity of time and speed and automatically constructs that curve [3].

Conclusion

As a result of solving and researching the mentioned problems in the IGS GeoGebra interactive environment presented in the article, we came to the following conclusions:

1. Mathematical problems and non-traditional description of their solution processes using the GeoGebra program make it possible to make the presentation of the material attractive and interesting.
2. While filling in the input window, it is possible to change the initial data of the problem at the same time and compare the results, thanks to which many patterns become visible and verifiable.
3. Thanks to the automatic algebraic calculations performed in the input panel, it becomes possible to avoid the delay in the process of solving the problem and save time.
4. The problems with the GeoGebra program presented in the article, with the described solution steps, can be a methodological basis for solving similar problems, as well as for teachers to organize open classes.

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ՄԱԹԵՄԱՏԻԿԱՅԻ ԴԱՍԱՎԱՆԴՄԱՆ ՄԵԹՈԴԱԲԱՆՈՒԹՅԱՆ ՄՇԱԿՈՒՄԸ ԲՈՒՀԵՐՈՒՄ՝ «GEOGEBRA» ԴԻՆԱՄԻԿԱԿԱՆ ԾՐԱԳՐԻ ԿԻՐԱՌՄԱՄԲ

Վարդանյան Վ.Զ., Հարությունյան Ի.Վ., Գալստյան Գ.Ա., Ադամյան Ս.Ա.
Շուշիի տեխնոլոգիական համալսարան

Դիտարկվում է «GeoGebra» դինամիկ միջավայրի կիրառմամբ ուսումնական գործընթացի կազմակերպման առանձնահատկությունները: Տրվում է ինտերակտիվ աշխատանքային թերթիկի՝ որպես արդյունավետ դիդակտիկ գործիքի մշակման մեթոդական և տեխնիկական փուլերի բնութագիրը: Ներկայացնում են խնդիրների լուծման օրինակներ:

Բանալի բառեր. մաթեմատիկական փաթեթներ, կտավ, օբյեկտների վահանակ, գործիքադարակ, ստեղնաշար, կոորդինատներ:

РАЗРАБОТКА МЕТОДОЛОГИИ ПРЕПОДАВАНИЯ МАТЕМАТИКИ В ВУЗАХ С ИСПОЛЬЗОВАНИЕМ ДИНАМИЧЕСКОЙ ПРОГРАММЫ «GEOGEBRA»

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Рассмотрены особенности организации учебного процесса с использованием динамической среды «GeoGebra». Дается описание методологических и технических этапов разработки интерактивного рабочего листа как эффективного дидактического средства. Представлены примеры решения задач с применением GeoGebra.

Ключевые слова: математические пакеты, полотно, панель объектов, панель инструментов, клавиатура, координаты.

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