Understanding Similarity with the Help of GeoGebra

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ABSTRACT: The tools offered by GeoGebra allow fast construction of interactive applications necessary to achieve objectives in teaching geometry. The paper presents several ways of using GeoGebra in teaching and deepening the notion of similarity and its properties.

1. INTRODUCTION

One of the fundamental notions of geometry is similarity. GeoGebra offers excellent facilities for the understanding, practice and deepening of the mathematical concepts related to similarity. I refer to the tools to build geometric figures, to the transformation of these figures and in particular to k omotetia report, but the other facilities provided are not negligeable either: measuring distances, areas and angles, the slider, animation, check box.

This paper offers examples of the use of GeoGebra to achieve the following operational objectives:

- to recognize similar figures by comparing corresponding sides reports
- to recognize similar figures by comparing measures corresponding angles;
- identification of similar triangles using the similarity of triangles;
- applications of the similarity of triangles.

Using GeoGebra allows the use of student-centered learning methods. The discovery, analysis, extrapolation are the methods a students uses to explore the material to be presented below.

2. Recognition of similar figures - the length report

By the building facilities it offers (the construction of a segment, of a regular polygon, an arc, of a conic, etc.), GeoGebra is an excellent programme for drawing geometric figures.

In the GeoGebra work window a construction of any form is drawn. The transformations features offered by the programme are used: rotation, translation, symmetry for the shape change. Insert a cursor k values from -1 to 2 and use center O omotetia and k ratio to obtain a figure similar to the one given.

Comments:

- It is advisable that the figure constructed be suggestive and contain various elements: segments and angles, arcs, circles, etc..

- Cursor presence aims to exemplify the various situations in which two similar figures can be found . Subunit values expressed show Figure decrease, the supraunitar values express the increasing of the figure. Negative values are useful for the identification of different positions in which similar figures can also be found.
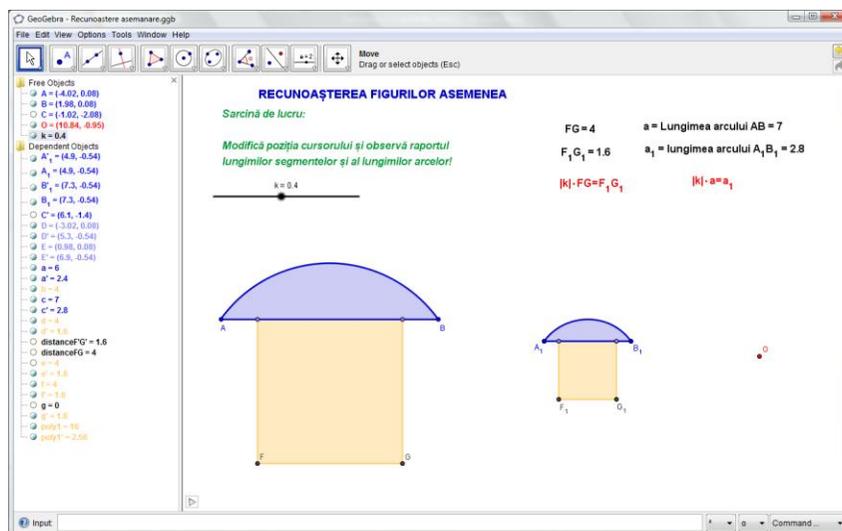

Fig. 1 Exemplifying the concept of similarity is illustrated in this imagine

The change in the position of points leads to a change of other parts of the figure. These shape changes are noticeable in both figures. It should be noted that the ratio remains constant and equal to the corresponding value indicated by the cursor.

3. Recognition of similar figures - matching angles

Another feature of congruent figures is congruent angles matching counterparts. This can be illustrated by a polygonal figure. Omoteti is applied to the center O and ratio k, to obtain such a figure. Because there are many pairs of corresponding angles, they can be highlighted by the instrument using the Check Box to Show / Hide Objects".
 By modifying the cursor position there can be obtained different configurations of two similar figures. Each configuration is the pretext for the student to discover and verify the matching of corresponding angles.
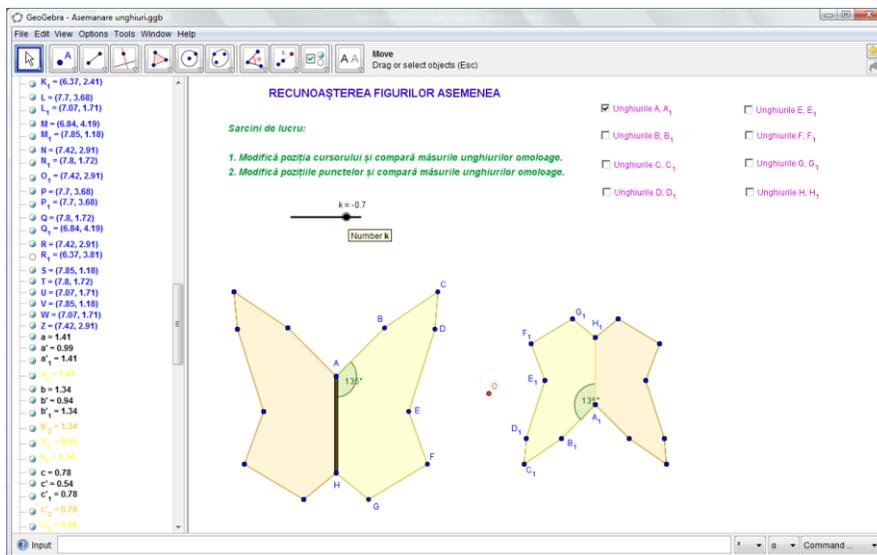
Fig. 2

Changing the polygonal peak positions leads to some other values of the angles measures. But in these new configurations, corresponding measures remain congruent angles. GeoGebra allows the dynamic display of angles measures, a very useful feature, which serves the conclusion that the student can guess.

Elements that can be changed and have variable parameters in this application are: center of omotetiei A report of omotetiei k, peak positions polygon. But regardless of the values of these parameters, angle pairs remain congruent corresponding angles, so it is easy to be observed by marking the application. This is the conclusion which must result from interaction between the student and the application.

3. Triangle similarity

If the similarity of two figures with complex shapes is easily noticeable, regardless of the positions of the two figures, similar triangles are also difficult to observe, except for some particular positions.

The objective of this lesson is also the recognition of similar triangles after measuring angles or sides corresponding calculation reports.
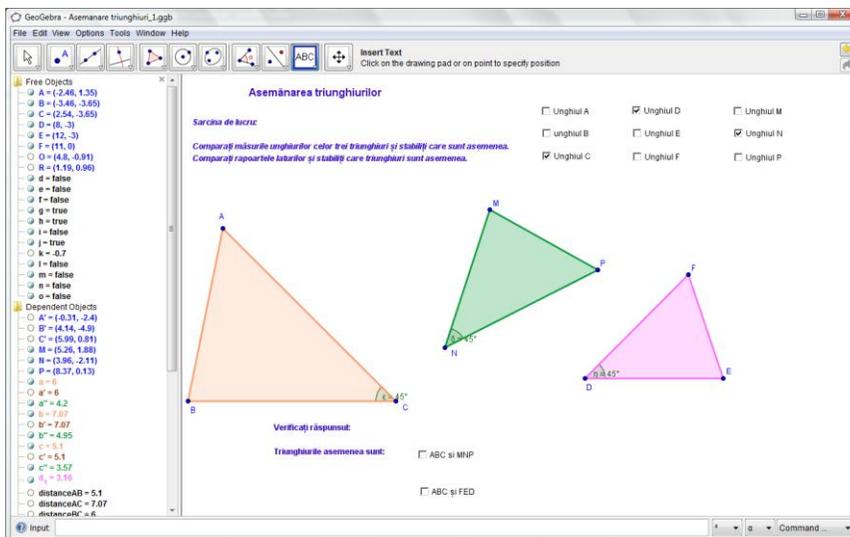
Fig. 3 Applet to introduce the concept of similarity of triangles

GeoGebra window contains three triangles: one fixed (the ABC triangle), another buit with the composition of a rotation center of a omoteti R and center O and ratio k (the MNPtriangle), the third triangle is built open but close in shape to the other two (the DEF triangle). Obviously, the first two triangles are similar. The three triangles each have an angle with the measure of 45○.

The student has two tasks:
1. To compare the angles of the three triangles in order to determine which of them are similar. For this, there are checkboxesthat allowmeasures that allow viewing angles' measures
2. Compare sides of triangles and the calculation of the reports of sides lengths.

The conclusions drawn from students' observations and calculations, may be checked at the bottom of the screen, where the choice is explained by the corresponding relations.

The presented applet enables presentation of the concept of triangles similarity allowing students to observe the corresponding angles congruent and proportional sides.

It is possible to highlight cases of similarity by comparing two pairs of congruent angles respectively (the similarity UU), the two pairs of sides proportional and congruent angles between edges (the similarity LUL), or the proportionality of corresponding sides (LLL similar case).

Because of the dynamic way text constructionthere is a possibility to change the initial configuration, which may lead to define other work targets.

Changeable elements are triangle DEF peak positions, the center of rotation, the omotetia center, the omotetia report. Changing these factors leads to the building of other possible configurations for the consolidation of concepts studied.

A possible task is the finding of a pattern of DEF triangle so that it becomes similar to the ABCtriangle. This is possible by changing the peak position of the triangle. Certainly, it

is difficult to find exactly corresponding positions, so an approximate solution is to be taken into account.

5.   Parallelism and similarity

A special case of similarity is given by parallel drawn to a side of a triangle , case defined by the Thales theorem and by the fundamental theorem of similarity.The multitude of problems and applications resulting from these theorems requires a careful approach to this case.

GeoGebra window contains two parts: a text that presents the figure, tasks, the interactivity result and a small test , an interactive area containing a triangle and a parallel drawn to one side of the triangle. The parallel position and the triangle shape can be altered with the help of the two points identified by size and color.

Position of D determines the ratio of similarity, the disposal of point B, changes the shape of the figure, showing that the rule does not depend on the form of the given triangle.
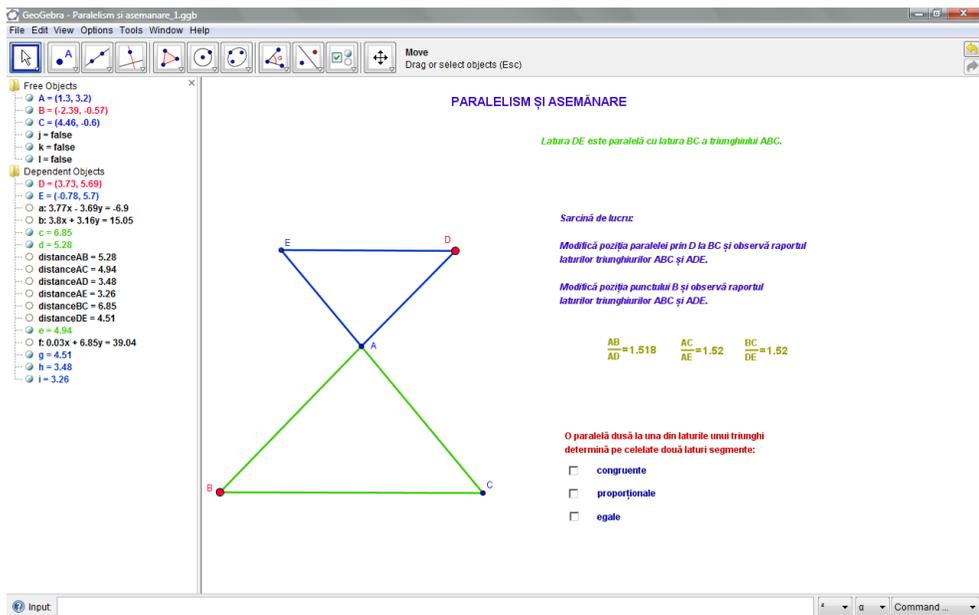

Fig. 5 Applet for the Thales Theorem justification

The article is not intended to exhaust the topic that is broad and allows the development of many applications. GeoGeogebra programme with the tools it offers is the perfect tool for developing interactive applications for the necessary geometry and a lot more.

Contents:

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