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VIZUALIZÁCIA VO VÝUČBE MATEMATIKY – KONCEPT PERCENTUÁLNEHO POČTU

VISUALIZATION IN MATH TEACHING – CONCEPT OF PERCENT

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ABSTRAKT. *V článku prezentujeme geometrický prístup k výpočtu percent. Na základe geometrickej úmery riešime vybrané úlohy percentuálneho počtu pomocou geometrického softvéru. Príspevok je koncipovaný s dôrazom na vizualizáciu tohto štandardne vyučovaného počtu.*

KĽÚČOVÉ SLOVÁ*: percento, graficky, aplet, Geogebra, vizualizácia, predstavivosť, názornosť*

ABSTRACT. *We present a geometric approach to calculation of percent. Based on the geometric theory of portion selected tasks are solved by using of special diagrams sketched in geometric software. The contribution is concerned with aim to emphasize the visualization in standards of percent teaching.*

KEY WORDS: *percent, graphics, aplet, GeoGebra, visualisation, imagination, spartial imagination, ICT, math education*

CLASSIFICATION: *D44*

Introduction

In the preface of [1] the author states that "*students of elementary and secondary schools, so students and teachers of mathematics have a relatively underdeveloped geometric imagination …*".

Of course, this statement belongs to a resource that is already more than 20 years old, but the problem is still current.

In the last period one can observe that goals of researches are questions related to a geometric and spatial imagination [3], [4], [5], [8], [9]. A domain of visualization exploiting ICT plays also important role is math education [6], [7].

Implementation of ICT in math education significantly promotes the development of those phenomena [12], considering with didactic problems [14]. Linking ICT with a pragmatic approach to math education through real-world problems [2], [10], [11], suitably supplemented with discovery methods and problem-solving [13] gives a teacher many features to enhance an effectiveness of teaching.

Visualization in teaching - the concept of percent

It is not the aim of this article to analyze in detail results of several studies in area of the illustration and visualization in math education. Based on the idea that "*a graphical representation of arithmetic relations historically preceded the algebraic expression*" [1], we present a graphical method for calculating of the percentage. This graphical solution can be accepted as possible alternative to the current situation where method of teaching in primary school is based on numerical calculations.

It is trivial knowledge that percent means *per hundred* and the formula for percentage is the following

$$\frac{part}{base} = \frac{\%}{100}. \qquad (1)$$

On the other side is non- trivial fact that this formula can be represented geometrically by diagram

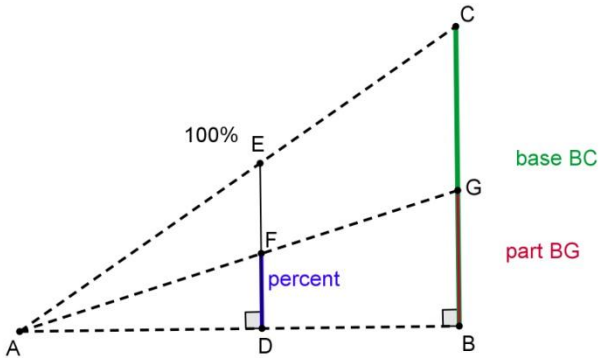

Figure 1: Diagram – percent in graphic

The proof is simple.

We apply the trigonometric function *tan* to triangles *ADF, ABG* and we obtain

$$\tan(\angle FAD) = \frac{|DF|}{|AD|} = \frac{|BG|}{|AB|}.$$

Similarly we derive that $\tan(\angle EAD) = \frac{|DE|}{|AD|} = \frac{|BC|}{|AB|}.$

It is easy to obtain the equality $\frac{|DF|}{|DE|} = \frac{|BG|}{|BC|}. \qquad (2)$

In a notation described in formula (1) we derive $\frac{|DF|}{|DE|} = \frac{percent}{100\%} = \frac{part}{base} = \frac{|BG|}{|BC|}.$ □

Remark. The denominators $|AD|, |AB|$ in diagram don't play any role in (2). This fact allows us to put the lengths of these segments arbitrary.

How to calculate the percent with the diagram on Fig. 1 we present in examples by using Geogebra aplets.

Example 1

There are 300 cats in the village and 75 of them is black. What is the percentage of black cats in that village?

Comment. We put the diagram in Cartesian coordinate system. If the length of the segment AB is *300*, the length of *BG* is *75*, the segment *AG* intersect the "scale" segment *DE* in a point *F*. The length of segment *DF* represents the percent.

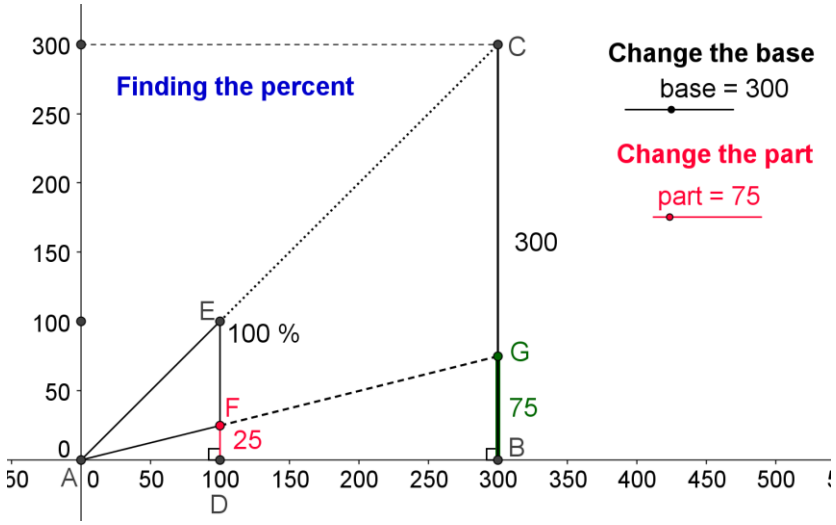

Figure 2: Graphic solution of the Example 1 by using GeoGebra aplet

Example 2

A golf shop pays its wholesaler $40 for a certain club, and then sells it to golfer for $75. What is the markup rate?

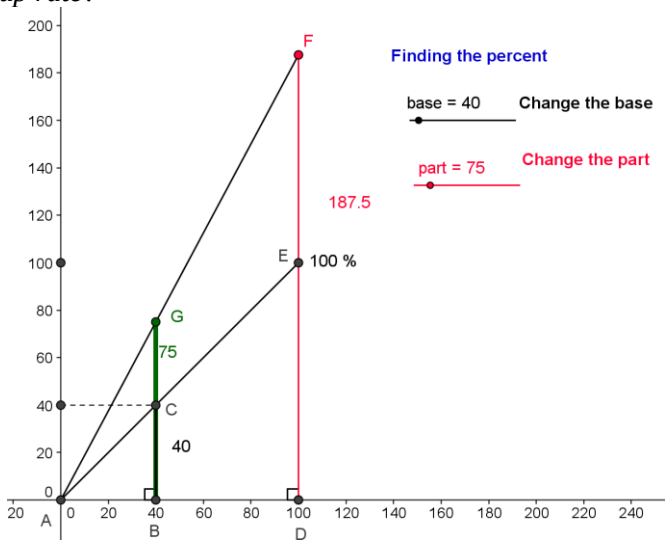

Figure 3: Graphic solution of the Example 2 by using GeoGebra applet

Comment. We again put the diagram in Cartesian coordinate system. If the length of the segments AB, BC is *40*. On the halfline BC lays the point G and holds $|BG| = 75$. The scale we localize on the halfline DE with the length *100* which is equal to the length of segment AD. The line AG intersects the halfline DE in the point F and holds $|BF| = 187.5$ The markup rate is $187.5 - 100 = 87.5\%$.

Example 3

The snowboard is on sale for 20% off the regular price of $250. Find the sale price of the snowboard.

Comment. We put the diagram in Cartesian coordinate system by analogy. If the segment DF represents the percentage than holds $|DF| = 80$. The lengths of the segments AB, BC we put equal to 250. A halfline AF intersects the segment BC in a point G. Holds that the length $|BG| = 200$ represent the part and the sale price of the snowboard, too.

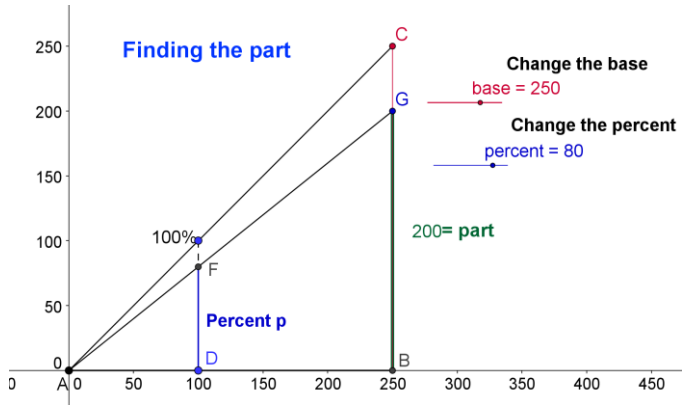

Figure 4: Graphic solution of the Example 3 by using GeoGebra aplet

The more complicated examples can be also solved geometrically. In one diagram we input all numerical values.

Example 4

The price of an item changed from $150 to $120. Then later the price decreased again from $120 to $90. Which of the two decreases was larger in percentage term?

Comment. We put two diagrams in Cartesian coordinate system by analogy to Example 1.

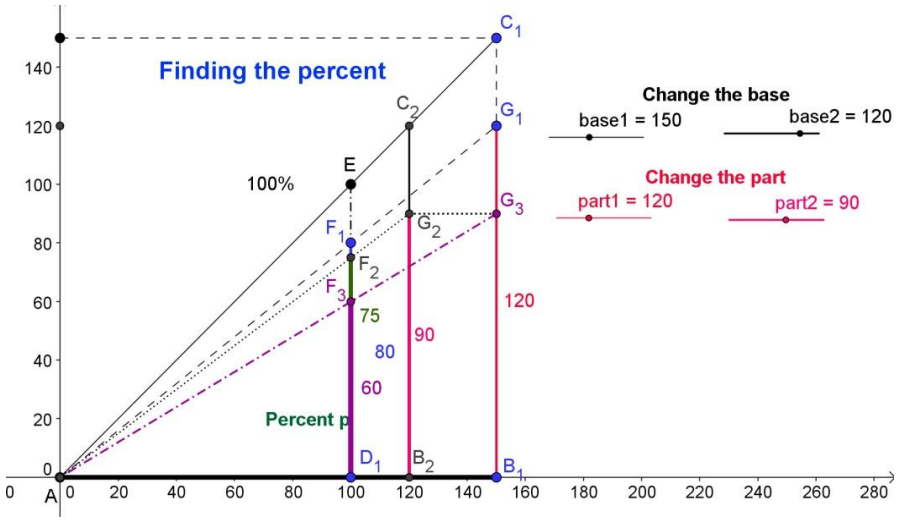

Figure 5: Graphic solution of the Example 4 by using GeoGebra aplet

Both decreases are represented by the lengths of the segments D_1F_1, D_1F_2. In the first case is the decrease in percent 20% and in the second decrease it is 25%. In common the decrease form \$150 to \$90 is in percent 40%. Inserting data in one diagram gives to a student unique possibility to compare the values and their significance.

Discussion

In this paper we have introduced some graphic method in percent calculation. We have demonstrated the solutions of the concrete examples by use interactive applets, programs created in software GeoGebra. We hope this contribution will be an inspiring incentive for math teachers.

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