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GEOMETRIC TASKS AND THE ROLE OF FIGURES IN THE TEACHING AND LEARNING PROCESS AT THE MIDDLE LEVEL

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Abstract: In this work we propose to present geometric activities corresponding to the High School level in Chile. We will analyze them from the Cognitive and Didactic perspectives put into play in them. We will also compare the tasks that we have proposed with some tasks proposed in the official texts of the Chilean Ministry of Education, through two examples. From the point of view of the didactic analysis, we will focus on the methodology for the management of a workshop experience, in accordance with the foreseen geometric objective, on theoretical notions of Didactics as Science, especially, the notions of Didactic Contract, the Key didactic medium of the Theory of Didactic Situations TSD of Brousseu. We hope to highlight the mastery of geometric knowledge of the teachers participating in the experience.

DEVELOPING

We approach the teaching and learning process of geometry from the cognitive point of view, which states that geometric tasks at all levels require a multiple cognitive activity: it requests the gaze, the gesture, the language, since in Geometry it is necessary build, reason and see, all inseparably. (Duval, 2005).

These demands undoubtedly pose difficulties for students to successfully face the tasks proposed in class. As teachers (as) also have difficulties to pose, select or create true geometric tasks to promote learning.

In this work in the tasks we will present figures that demand the raising of conjectures, then the test or the demonstration according to the educational level in which it is taught.

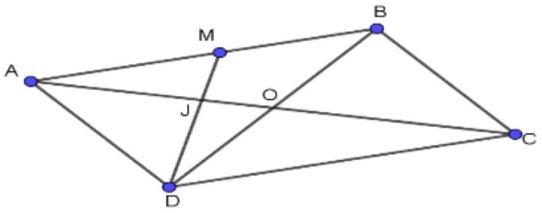
We will also point out how our activities are far from the activities proposed in some official Middle School textbooks.

The methodology that must be put into practice is that of the Workshop in addition to personal or group work, so that the participants have space for exchanges in a kind of scientific debate.

Next, we present the activities which are located in the geometric paradigm of geometry II, whose model is Euclid's geometry, where the figures are ideals, and the means of proof or demonstration are theorems, properties and definitions. Measurement is not allowed, this is the geometry that is suggested to work at the secondary level.

For basic teaching, the suggested paradigm is that of Geometry I, where the figures are materials: templates or patterns on paper, cardboard or others as means of verification.

- **Activity 1**



In the figure, ABCD is a parallelogram, and M is the midpoint of AB.

a) Reproduce the figure.

b) What do segments AO and DM represent in triangle ABD?

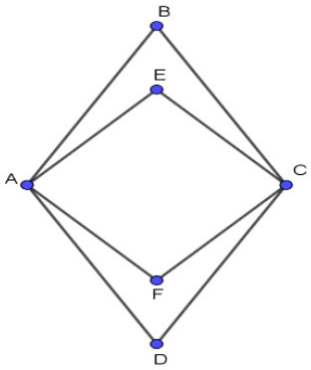
c) What can be said about point J

Justify the answers.

For the solution of the activity, the didactic contract or agreement of the teacher of the workshop with the participants establishes that the size of the figure is not interesting, they can make it bigger. What matters is that they respect the hypotheses. The accepted geometrical instruments are the ruler (not graduated) and the compass.

The objective of this activity is to recognize the properties of the diagonals of a parallelogram and the transversal of gravity or median of a triangle. To then reproduce the figure regardless of size.

- **Activity 2**



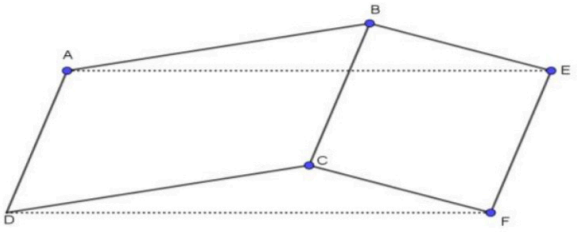
In the given figure ABCD and AFCE are two rhombuses

a) Reproduce the figure

b) Prove that the points B, E, F, D belong to the same line

The objective of activity 2 is to recognize the property of the diagonals of a rhombus, to recognize the isosceles triangles inside the figure and to apply the property of the basal height of the isosceles triangle.

- **Activity 3**



The given figure ABCD and BCEF are parallelograms

a) Reproduce the figure

b) Make a conjecture about the segments AD and EF

c) Prove such a conjecture

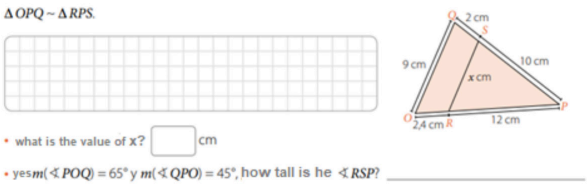
In the search for solutions to these problems, a large number of participants in the experience have been inclined to situate themselves in Geometry I, that is, they have resorted to measurements, tracing the figures and making use of folds.

In addition, they have shown insufficient knowledge of properties, which has made it difficult for them to work on geometry II, where knowledge of properties and theorems is fundamental.

The difficulties presented to the participants in the experience seem to be related to the type of problems posed by school textbooks, in which the tasks are arithmetic or algebraic to the detriment of geometric objects and their properties.

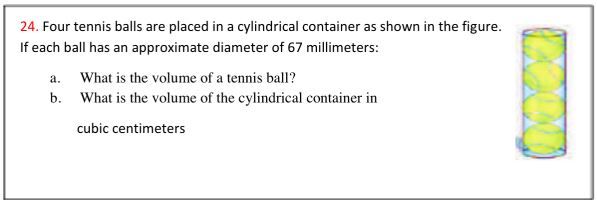
Below are some problems taken from official textbooks.

First half problem taken from the activity booklet, page 102 on Similarity of triangles.



Clearly this is an arithmetical problem, where it is enough to state a proportion between the measure of the segments. The role of triangle similarity criteria or that of Thales' Theorem is lost

Problem taken from the 4th grade student's textbook, on Geometric Bodies, page 264.



It can also be verified that it is an arithmetic problem on volume calculation.

In the official textbooks of the Ministry of Education (MINEDUC) of Chile, the problems of the geometry thematic axis, in general, do not have a geometric objective, the figures have a supporting role to request arithmetic calculations. This contributes to the lack of knowledge of geometric objects and their

properties, which prevents the possibility of raising conjectures by visualization and then testing or demonstrating them. Consequently, geometric reasoning is also impaired.

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