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# Interactive teaching methods

Adrian Ștefan Gheorghiță

*"Dan Barbilian" Secondary School, 3 Furnaliștilor Street, Galați 800629"*

**Abstract**
In this paper, I aim to present the importance of developing the kinesthetic learning style for understanding the geometric concepts being taught.

**Keywords:** problematization, kinesthetic, geometry, learning.

## 1. INTRODUCTION

In teaching activities, each teacher selects communication methods to ensure that the transmitted message is understood by the student. I believe that mathematics is an elegant discipline because it leads to the most beautiful results. The clarity of received information enables students to decode its content and operate with it afterward. In mathematics, information is structured so that, regardless of the given data, students can find solutions if and only if logical arguments are employed. Face-to-face communication is the medium through which most emotions are directly conveyed. This allows human beings to benefit from the stimulation of emotional intelligence, which is exponentially superior to cognitive intelligence. While heuristic conversation has the advantage of rapidly transmitting information to the receiver, it often limits the development of emotional intelligence.

The challenge for today's teachers is to convey information that aligns with cognitive thinking while also positively stimulating emotional intelligence. Mathematics plays a major role in building a person intellectually because it is based on inductive-deductive principles that involve analysis and synthesis, as well as demonstrative methods. Teaching mathematics does not rely solely on heuristic discussion. Mathematical problematization helps students transition from a level of mechanical knowledge to one of logical understanding. The sum of these factors represents a favorable premise for creating a student's academic profile.

Homework is a necessary condition for reinforcing knowledge through practice. However, it is often perceived by students as a burden, and their motivation to engage in solving it is minimized. Moreover, if it is assigned at the end of the class, it limits students' attention in the final minutes when the teacher is still delivering instruction. As a teaching strategy, I have experimented with introducing homework at the midpoint of the lesson and solving part of it during the remaining time. In this way, a portion of the tasks is tackled with greater interest by the students until the last minute of the class, significantly reducing the amount of homework.

## 2. ELEMENTS OF APPLIED GEOMETRY

We ask ourselves: what can be measured in an angle? The vertex is a point, which has no dimensions; the sides are rays that extend infinitely, so they cannot be measured. Therefore, we will measure the opening of the angle. Based on this opening, we can determine if one angle is larger than another.

*Fig. 1. Positioning the protractor*

*Fig. 2. Marking the corresponding measurement*

To measure an angle, align the protractor so that its center mark is positioned at the vertex of the angle and its base (the line from 0 to 180 degrees) lies along one of the sides of the angle. The other side will indicate the measurement of the angle in degrees.

*Fig. 3. The opening of the angle*

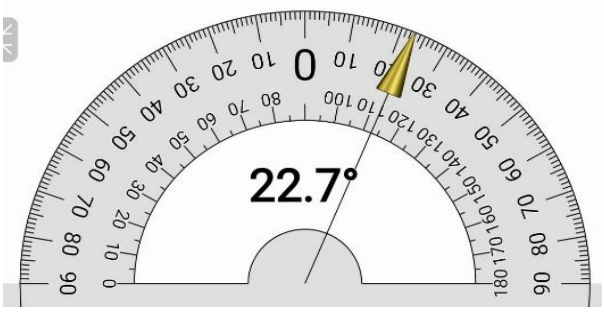


*Fig. 4. Using an application on a phone for submultiples of a degree*

Three or more angles are considered angles around a point O if they have the following properties:
a) They all share the same vertex (point O).
b) Any point in the plane that does not lie on any of the sides of the angles belongs to the interior of only one angle.

The sum of the measures of the angles formed around a point is always equal to 360 degrees.

*Fig.5. Solving on the classroom floor*

The three medians of a triangle are concurrent at a point called the centroid, denoted by G. The centroid is located on each median one-third of the way from the base and two-thirds of the way from the vertex of the triangle from which the median extends. The centroid of a triangle also represents its center of gravity.

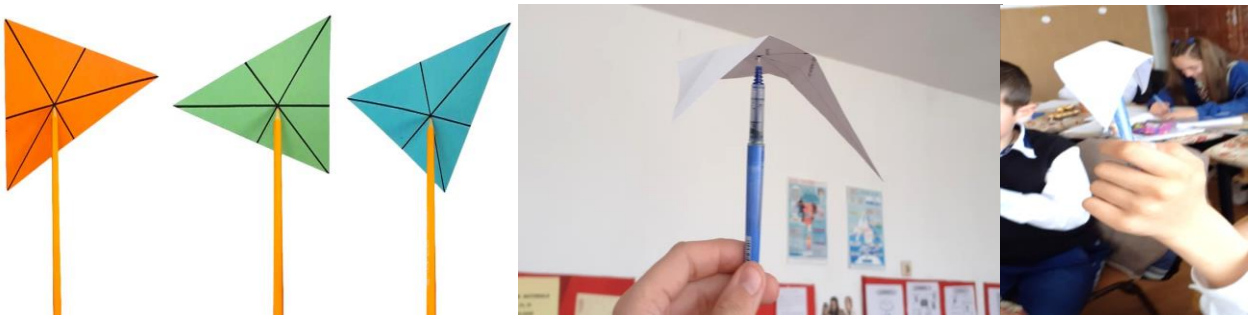

Image source: Mathigon - Properties of Triangles

*Fig.6. The centroid of a triangle*

## 3. GENEALOGY OF QUADRILATERALS

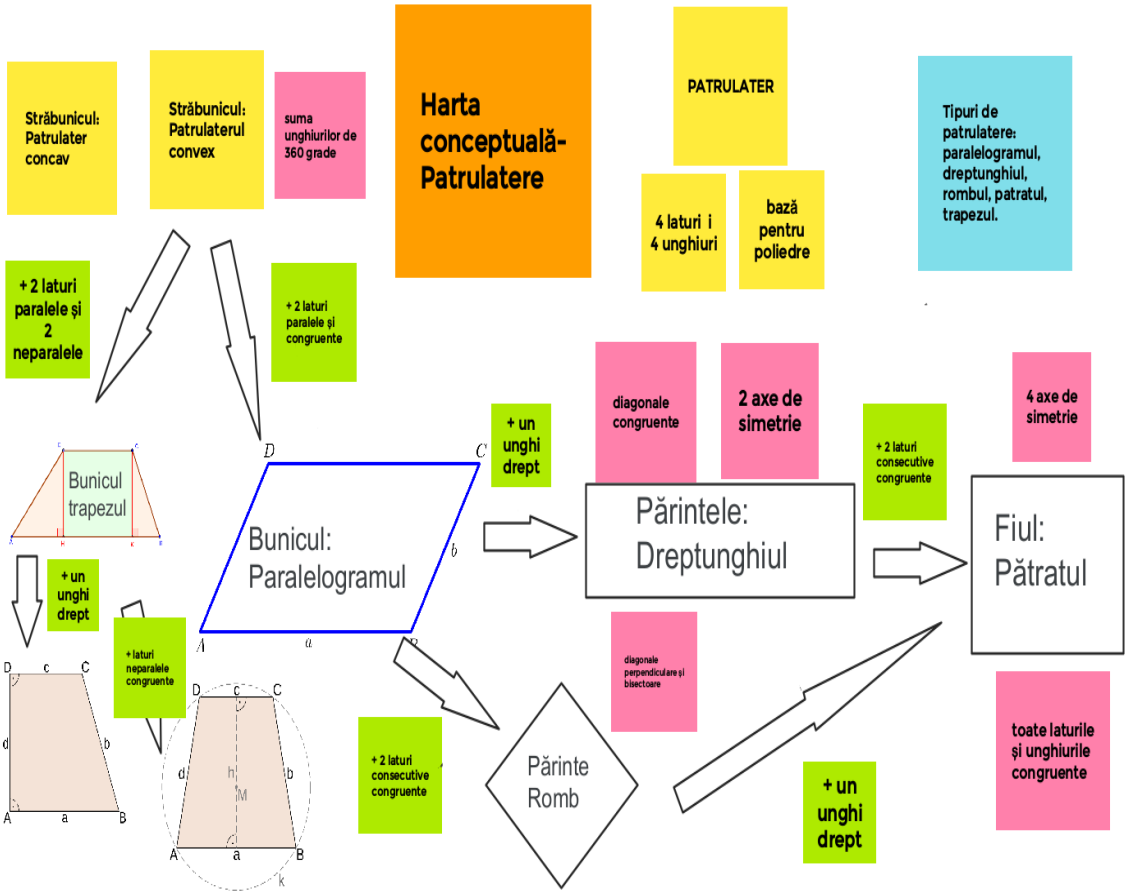


*Fig.7. Genealogy of quadrilaterals*

## 4. MATHEMATICS IN NATURE

To understand the concept of volume, it is necessary to associate it with the capacity of a body. In eighth grade, along with the study of polyhedra and round bodies, students are taught the formulas necessary for calculating the areas and volumes of geometric bodies. In this regard, students become acquainted with the specific theory of space geometry. It is not enough to explain space geometry solely in terms of dotted lines, perspective drawings where the rectangle is constructed as a parallelogram, and the unfolding of geometric bodies; it is also necessary to identify everyday objects that correspond to the studied bodies. Furthermore, to create a clear idea in the student's mind about the elements that make up a geometric body, as well as the relationships of parallelism and perpendicularity present within it, the assignment includes creating pyramids, prisms, etc., from various materials. Thus, students develop their imagination and geometric creativity through kinesthetic learning.

In the images below, I have calculated the volume of some geometric bodies, the volume of displaced soil, and how many liters of water correspond to this volume. In this way, I highlighted the fact that 1 $dm^3$ = 1 liter.

*Fig.8. Mathematics in nature*

## 5. MATHEMATICS IN THE HOMETOWN

Expository teaching methods partially assist in understanding mathematical concepts that involve analysis and demonstration. The consequence is that even if students memorize the information received, they may not be able to concretely apply it to solve problems. Noticing many instances in class where students cannot operate with theorems they have learned, despite being able to reproduce them orally and in writing, I sought alternative methods to revisit the taught content. I experimented with associating mathematical concepts with familiar objects and events from their everyday environment that they know and recognize. Through this method, I captured their attention and succeeded in stimulating their logical thinking.

Below, I have presented some images from the students' hometown, in which I specified the necessary conditions for demonstrating certain mathematical relationships.


*Fig. 9. The perpendicular line to a plane*

*Fig. 10. Parallel planes*

## 6. CONSTRUCTING GEOMETRIC BODIES FROM VARIOUS MATERIALS

Sensory stimuli engage the body in a more pronounced reception of the information received. The satisfaction of being an integral part of the learning process contributes to the developmen of emotional intelligence. The use of learning tools that involve the physical manipulation of objects facilitates the acquisition of information by students who predominantly have a kinesthetic learning style. Additionally, the stimulation of inductive-deductive thinking processes is achieved through the real-world use of geometric bodies.

*Fig. 11. Human pyramid*

*Fig. 12. Constructing geometric from various materials*

## 7. RELATIVE POSITIONS OF A LINE TO A PLANE

It is important for students to logically operate with theorems learned. Using the kinesthetic learning style stimulates imagination and increases the chances of long-term retention.

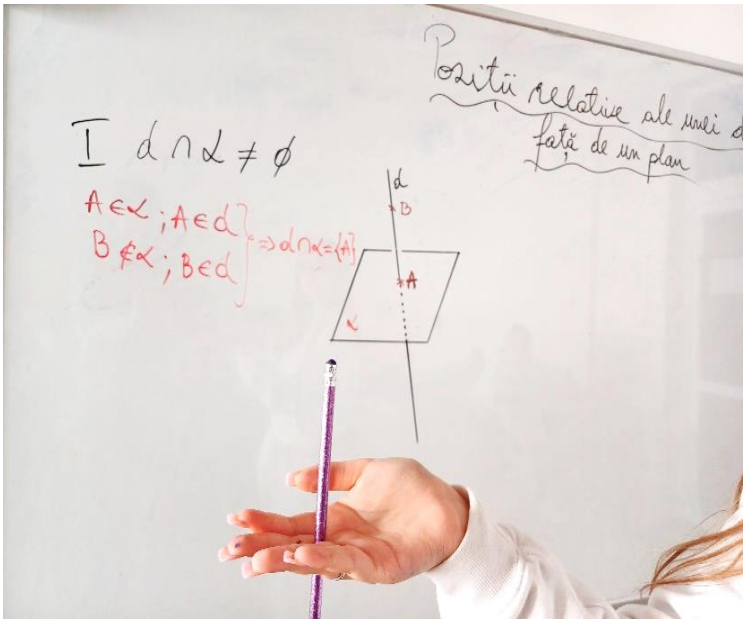


*Fig.13.The line intersects the plane*

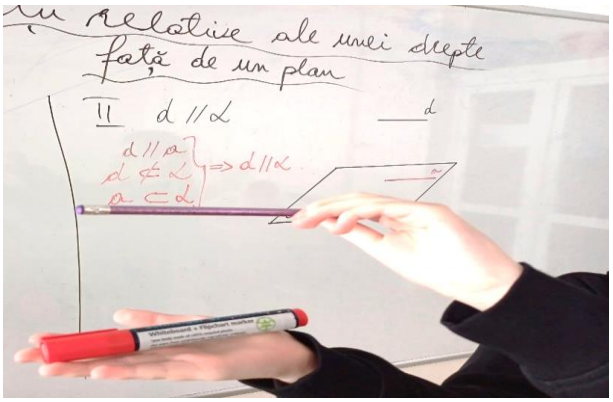


*Fig.14. The line parallel to the plane*

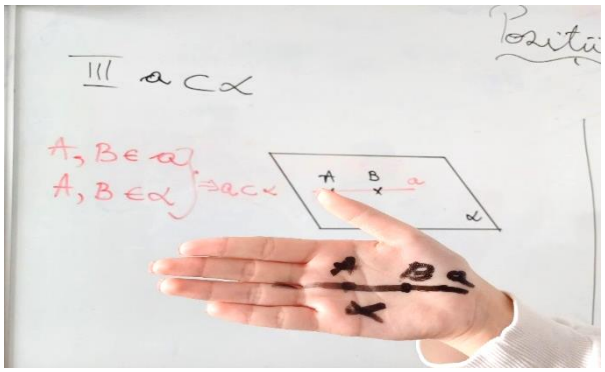


*Fig.15.The line is contained in the plane*

## 8. AMPLIFICATION AND SIMPLIFACTION OF FRACTIONS

Amplification and simplification of fractions becomes an issue when operations are confused, as well as due to the position of parentheses.

Amplification

*Fig. 16. Amplification*

Simplification

*Fig. 17. Simplification*

## 9. HOMEWORK VERIFICATION THROUGH SAMPLING

Correcting homework can take up a significant portion of the teaching time allocated. In many cases, the accuracy of homework can be assessed through sampling. If the number of correct cases is higher, then the probability that the obtained result is correct is increased. Comparing results allows for the possibility of revisiting the exercise using at least two methods. The involved students are encouraged to defend their results even if they turn out to be incorrect, with the aim of extending the analysis of those results.

*Fig.18. Verification of homework*

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