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Engaging and collaborative teaching methods

Adrian Ștefan Gheorghiță[1,*]

[1] *"Dan Barbilian" Secondary School, 3 Furnaliștilor Street, 800629 Galați*
* *Corresponding author: adrian85mate@yahoo.com*

Abstract
The paper highlights the importance of combining traditional teaching with digital methods to stimulate students' logical thinking, creativity, and autonomy.
Keywords: digital teaching, GeoGebra, interactivity, emotional intelligence.

1. INTRODUCTION

In the era of technology, teachers have the opportunity to make teaching more accessible through innovative and visual methods that capture students' attention and facilitate a clear understanding of the content. The use of educational software, instructional videos, or PowerPoint presentations offers multiple advantages: the material becomes more engaging, larger volumes of information can be conveyed in a relatively short time, and students' attention is more easily maintained.

Assessment can be conducted through quizzes or Kahoot tests, reducing the anxiety associated with traditional evaluations and transforming learning into a multi-level game-like experience. Additionally, certain platforms offer free opportunities for self-assessment and online practice. In recent years, CampionMate has stood out by attracting hundreds of students who solve math exercises daily.

Another useful tool is the educational software GeoGebra, which combines functionalities dedicated to both algebra and geometry. It allows the construction of two-dimensional and three-dimensional figures, the creation of interdependencies between elements, and the dynamic manipulation of objects. In this way, students gain a clearer and more intuitive understanding of how to solve problems.

Although the benefits are numerous, there are also certain limitations that must be considered when using technology as a teaching tool. The rapid succession of images can overload the human brain due to the large amount of information presented in a short time. In such cases, the brain may refuse to activate logical processing mechanisms and may enter a semi-hypnotic state.

Consequently, completely replacing traditional teaching—which is based on dictation, writing, and an individual work rhythm—with exclusively digital teaching is not a healthy approach in education. A balanced synergy between the two forms of teaching can lead to sustainable progress in the instructional-educational process, and learning outcomes can increase both quantitatively and qualitatively.

The educational goal of teaching mathematics is to develop strong problem-solving skills by enhancing logical thinking mechanisms. The real challenge lies in cultivating these competencies in students. Capturing and maintaining attention for an extended period depends not only on the teacher's skill but also, to a large extent, on stimulating the student's emotional intelligence. Emotional intelligence represents a higher level of engagement and understanding in the educational process.

Mathematics is a universe of reasoning, built on clear cause-and-effect relationships. For students, it can evoke a wide range of emotions, from fear of failure to the satisfaction of success. In

this context, the teacher's role becomes fundamental: they are responsible for guiding students through the process of understanding and supporting them in overcoming obstacles.

Applying punishments through low grades, negative labeling, or setting unrealistic expectations only inhibits progress. Instead, mathematics should be taught in an environment that respects each student's learning pace and style. Such a framework facilitates meaningful learning and contributes to the long-term development of confidence.

Over time, each student can develop their own way of reasoning, demonstrating, and interpreting mathematical concepts. The fear of making mistakes can gradually be replaced by curiosity and a genuine desire to understand. Therefore, it is essential to promote methods that stimulate creativity, flexibility, and adaptability, thereby supporting the development of adults capable of thinking independently and making well-founded decisions.

2. USING GeoGebra SOFTWARE

The educational software GeoGebra offers a range of tools that allow the solving of algebra, geometry, or mathematical analysis problems from a graphical perspective based on equations, formulas, and various parameters. Below, I will present different problems in which I have used GeoGebra in teaching.

1. On the lateral faces of the rectangular parallelepiped $ABCDA'B'C'D'$, with dimensions $AB = 6\ cm$, $BC = 4\ cm$, $AA' = 8\ cm$, an adhesive tape is applied connecting points A and C'. Calculate the minimal length of the tape (Fig.1).

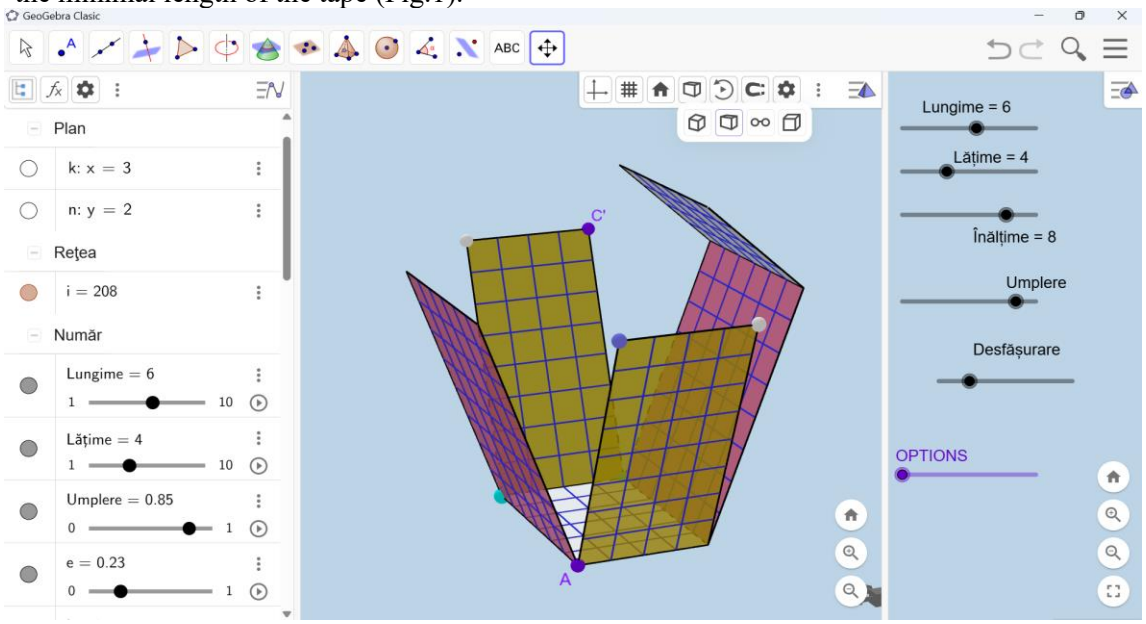

Fig. 1. Unfolding of the parallelepiped

Solution: The minimal length of the tape (the diagonal of the unfolded rectangle) is:

$$d = \sqrt{(AB + BC)^2 + (AA')^2} = \sqrt{10^2 + 8^2} = \sqrt{100 + 64} = \sqrt{164} \approx 13 \text{ cm}.$$

2. Consider the function $f(x) = ax^4 + bx^2 + m$, where a, b, and $m$are coefficients adjusted using sliders in GeoGebra. In the same window, the graph of the derivative $f'(x) = 4ax^3 + 2bx$ is also displayed. Using only the interpretation of the graph (Fig.2):

a) Approximately determine the intervals where the function is increasing and decreasing.
b) Determine the extrema by finding approximate values for which $f'(x) = 0$.
c) Determine the inflection points. Provide approximate coordinates.

Conclusion: It can be observed that the inflection points appear symmetrically.

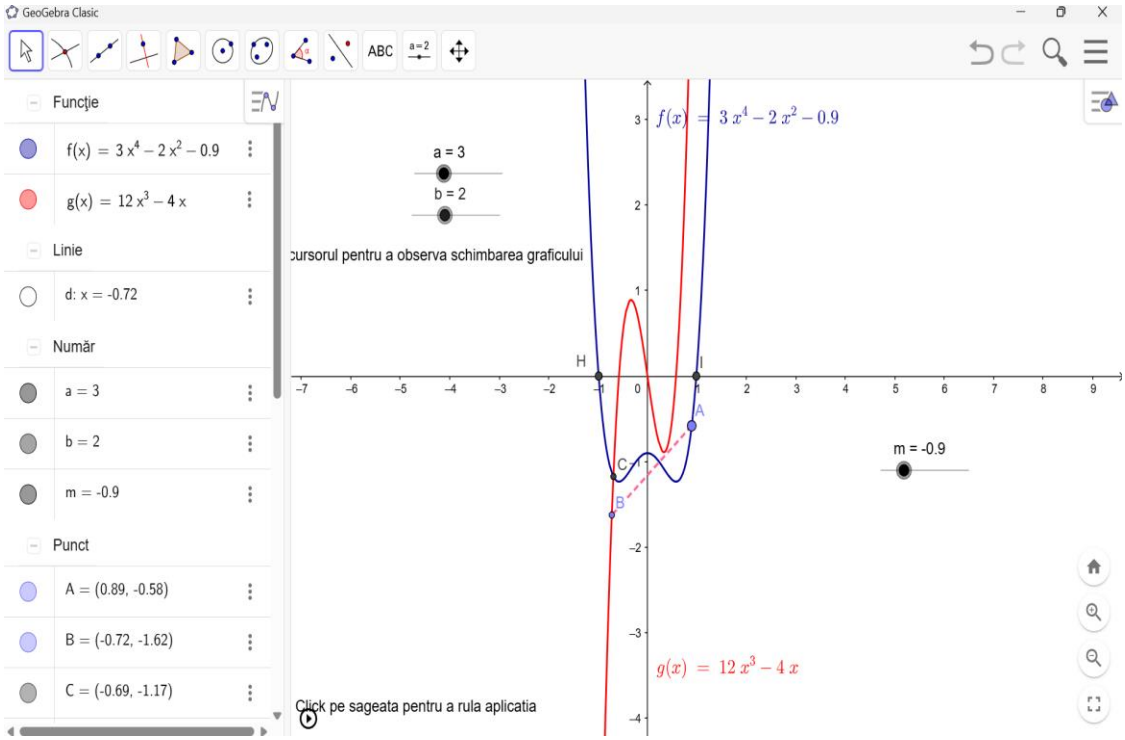

Fig. 2. Graph of the quartic function and its derivative

3. Consider two planes $\alpha = (ABCD)$and $\beta = (ADFE)$ that intersect along the common edge AD. In plane α, construct the perpendicular $GI \perp AD$, with $G \in AD$, and in plane β, construct the perpendicular $HG \perp AD$. Show that the dihedral angle formed by planes $\alpha$and $\beta$is the angle $\widehat{HGI}$ (Fig.3).

Solution: Project points $H$and Ionto the common edge AD. Observe that point $G$is the intersection of the two perpendiculars. According to the definition of a dihedral angle, the angle between planes is the angle formed by two perpendiculars to the common edge; therefore, $\widehat{HGI} = \theta$.

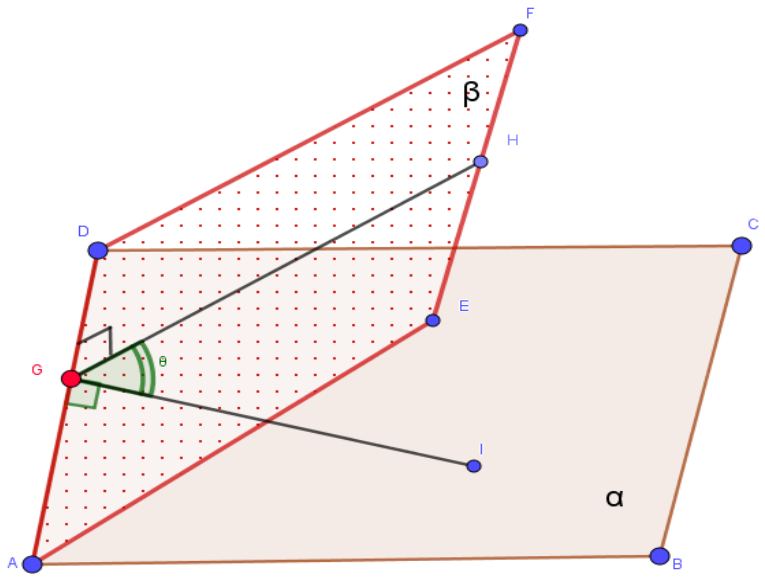

Fig. 3. The dihedral angle

3. EMOTIONAL INTELLIGENCE IN STUDENTS

In addition to their knowledge base, a teacher must possess a set of moral values that earn students' respect and foster their voluntary dedication to mathematics. Since teachers most often convey information orally, it is necessary to employ appropriate pedagogical tact, treating each student with empathy.

Comparing one student's abilities to another's using labels such as "weak student" or "good student" is considered a failure. Such classifications cast doubt on a student's capacity to adapt to different tasks and complete them within a certain timeframe. This labeling inhibits the student's will to overcome learning obstacles. We never approach a problem with the same mindset as we did the day before.

Therefore, students require different amounts of thinking time but should be encouraged to revisit problems and overcome difficulties. The teacher's intervention in the teaching process should be gradual. Introduce new concepts using heuristic conversation and solve problems through problematization and demonstration methods. The help provided to the student is gradually reduced until they are able to independently apply the demonstration to solve problems.

The way a teacher addresses students can be the key to successful collaboration or may generate disagreement. Teachers who use creative language tend to bore students less. For example, instead of saying, "Everyone, pay attention to me!", a teacher might say, "Let's see what color your little eyes are" (Fig.4).

Fig.4. Words that matter (https://www.weareteachers.com/positive-language-in-the-classroom/)

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