Using formative assessment in helping students understand geometrical concepts: The case of area

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In the context of **FORMAS** implementation in Greece I participated in a professional development course for mathematics teachers working in lower secondary schools at the **National and Kapodistrian University of Athens** under the coordination of the Professors **Theodossios Zachariades** and **Giorgos Psycharis**.

The project presented here was designed during this course and was implemented at the **9th Junior High School of Acharnes** with students in the **8th grade**.

MATHEMATICS UNIT

✓ GEOMETRY - AREA OF 2D SHAPES

OBSERVATION NOTES

- ✓ Students have difficulty calculating areas, even when they know the formulas.

ACTIONS

- ✓ Design and use of **formative assessment activities** in order to diagnose students' needs and especially to clarify concepts and methodologies after teaching areas of 2D shapes (in particular: square, rectangle, parallelogram, rhombus, triangle, trapezium).
- ✓ Application of differentiated teaching to support students´ learning.

THREE FORMATIVE ASSESSMENT ACTIVITIES

The following presentation concerns three formative assessment activities that were designed for a project of the course and were used in class.

CORRECTION OF A TEST

FORMATION OF ASSESSMENT CRITERIA

PEER-ASSESSMENT

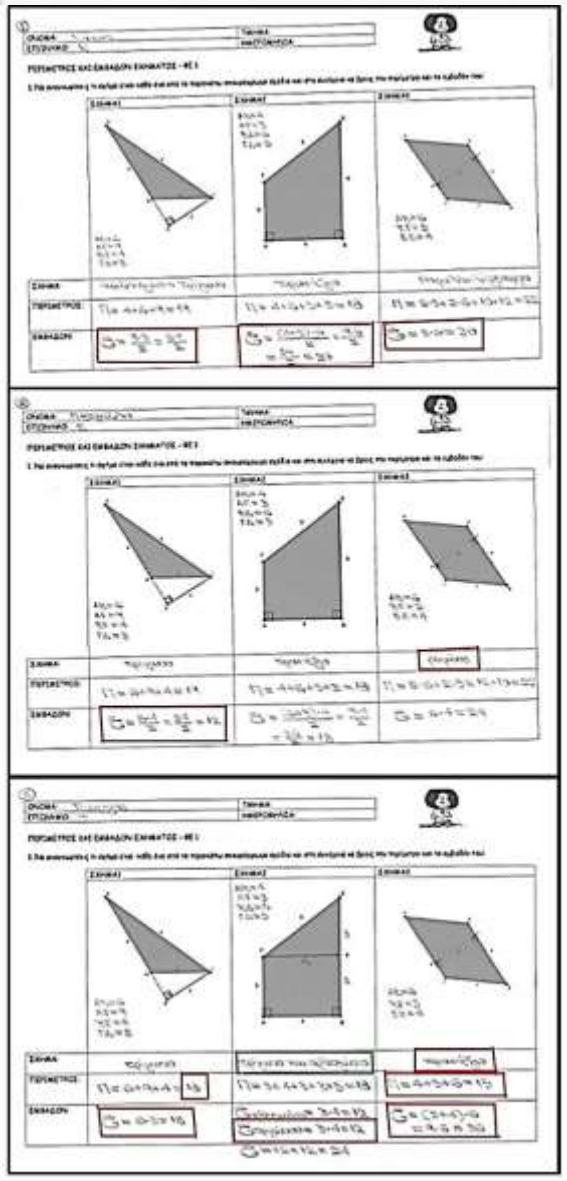
WITH RANDOM SELECTION OF WORKSHEETS

SELF-ASSESSMENT

1st ACTIVITY OF FORMATIVE ASSESSMENT

Students are asked to

- Correct a written test of an imaginary classmate.
- Create assessment criteria for that test.



ACTIVITY

For the sake of the classroom dialogue and the simulation in real conditions, three different work samples with the most characteristic errors are given to the students.

The activity aims (through the change of roles)

- to arouse the interest of the students,
- to involve them in the process,
- to make them ask their own questions,
- to help them identify shapes and use the appropriate formula to calculate the area,
- to help them decide on the correctness of the solutions,
- to make them think about the necessity of having assessment criteria,
- to encourage them to collaborate.

For the teacher the activity is an opportunity to identify learning gaps, mis-conceptions and the students′ needs.

ACTIVITY

Students try to

- identify errors,
- find the correct answers,
- justify their corrections,
- suggest assessment criteria,

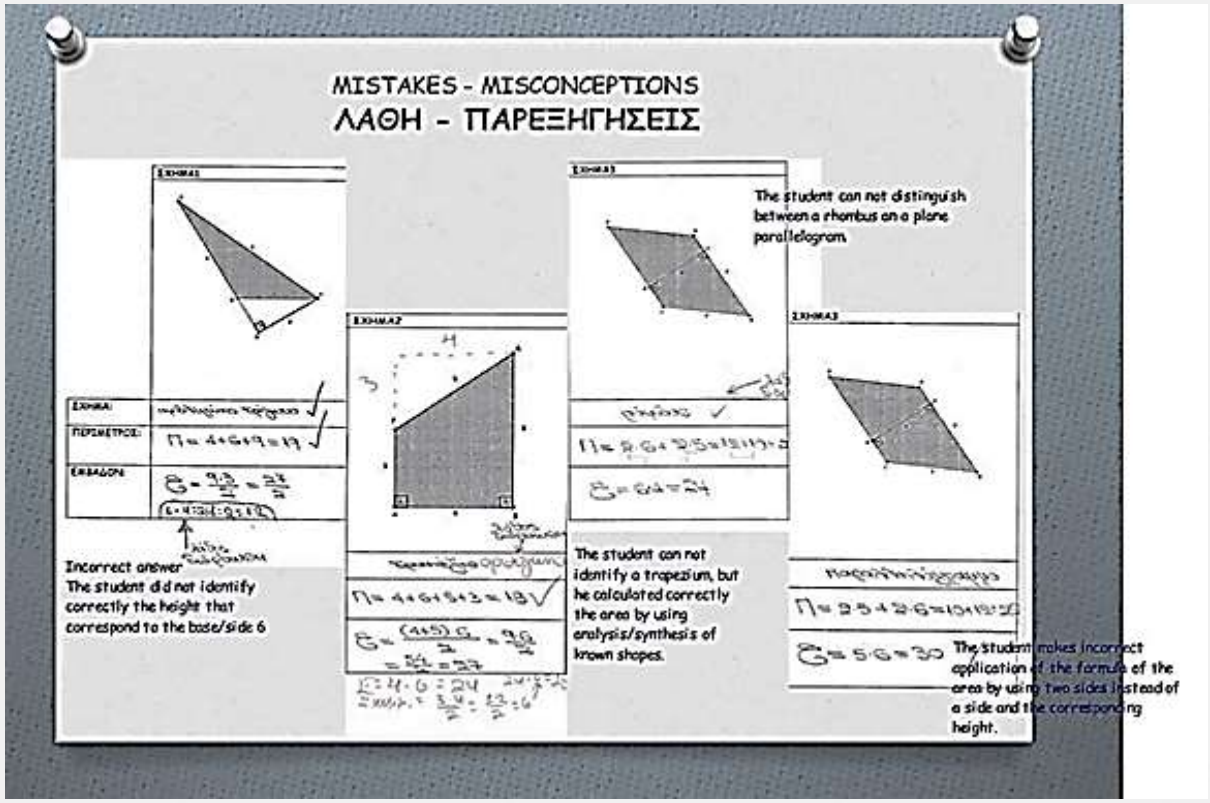
They work in groups of two.

There is a differentiation in the individual assistance provided.

Guiding questions (e.g.What angle does the height form with the corresponding base?), suggestions (e.g.You can rotate the page and see the shape at a different angle.), worksheets with auxiliary material (shapes, area formulas).

HIGHLIGHTS OF THE ACTIVITY

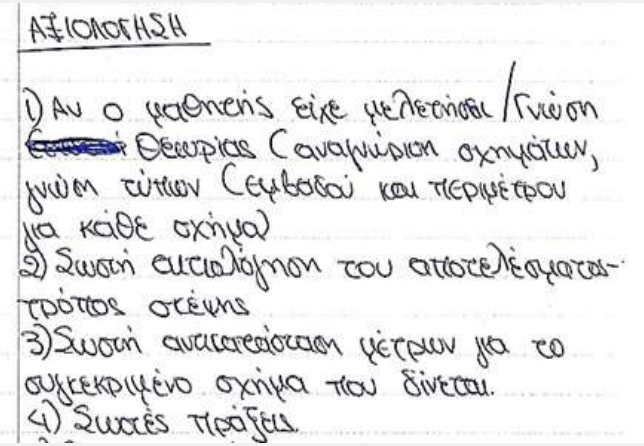
- ✓ The way of working and the mistakes of the students are revealed to a great extent.



- ➢ The teacher records her observations of students′ work during and after the end of the activity. That gives her a better picture of what the student know and can do.

HIGHLIGHTS OF THE ACTIVITY

- ✓ Creating assessment criteria helps the students in two ways:
  - To understand their mistakes concerning the calculation of the area.
  - To know what they have to do while solving the exercise.


ΑΞΙΟΛΟΓΗΣΗ

1) Αν ο μαθητής είχε μελετήσει / γνώση ~~[illegible]~~ θεωρίας (αναγνώριση σχημάτων, γνώση τύπων (εμβαδού και περιμέτρου για κάθε σχήμα)
2) Σωστή εκτέλεση του αποτελέσματος-τρόπος σκέψης
3) Σωστή αναγραφή μέτρων για το συγκεκριμένο σχήμα που δίνεται.
4) Σωστές πράξεις

The student

- Has studied.
- Can identify the shape.
- Uses the correct formula.
- Does not make mistakes when calculating.
- Identifies correctly the corresponding height.
- Explains and justifies correctly the results.

- ➢ Students gain a better understanding of the requirements expected and improve their knowledge on area of 2D-shapes.

2nd ACTIVITY OF FORMATIVE ASSESSMENT

Peer-assessment with random selection of worksheets.

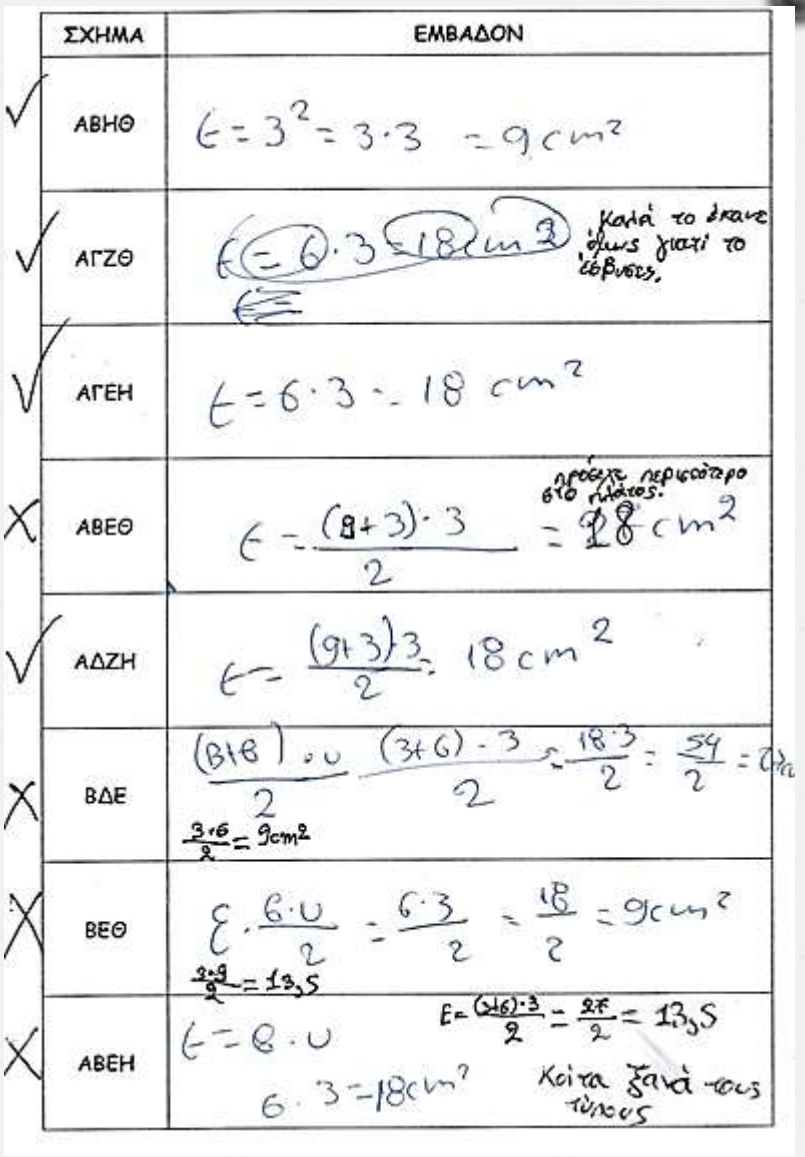
ACTIVITY

Students are given an individual worksheet to find the areas of 2D shapes. It contains an exercise from the textbook with a complex shape.

All worksheets are put in a box (with the student's name hidden).

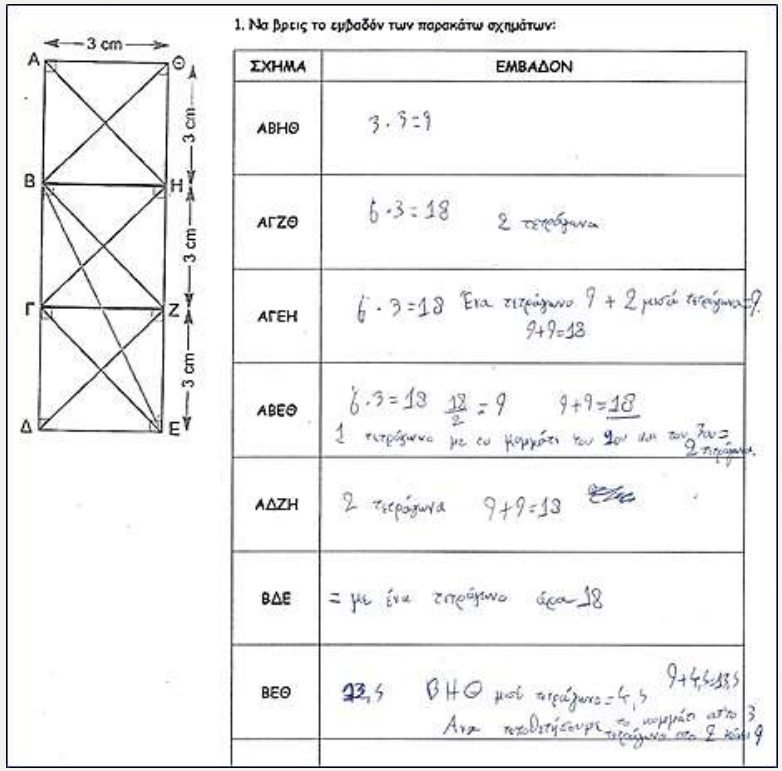
The correct solutions are presented by students.
Visual aid is provided by coloring the required shapes on the (interactive) whiteboard.

Each student chooses randomly a worksheet from the box.
The student corrects, assesses, grades the exercises and gives feedback.



HIGHLIGHTS OF THE ACTIVITY

- ✓ Some students find the requested area by adding or subtracting areas of basic 2D shapes (such as squares, rectangles or triangles) and not by using the area formula of one shape (in this case, a parallelogram or a trapezium). They develop strategies and make suggestions to fellow-students.



1. Να βρεις το εμβαδόν των παρακάτω σχημάτων:

ΣΧΗΜΑ	ΕΜΒΑΔΟΝ
ΑΒΗΘ	3 · 3 = 9
ΑΓΖΘ	6 · 3 = 18 2 τετράγωνα
ΑΓΕΗ	6 · 3 = 18 Ένα τετράγωνο 9 + 2 μισά τετράγωνα = 9 9+9=18
ΑΒΕΘ	6 · 3 = 18 18/2 = 9 9+9=18 1 τετράγωνο με εμβαδόν του 2ου και του 3ου = 2 τετράγωνα.
ΑΔΖΗ	2 τετράγωνα 9+9=18
ΒΔΕ	= με ένα τετράγωνο έχει 18
ΒΕΘ	23,5 ΒΗΘ μισό τετράγωνο = 4,5 9+4,5=13,5 Άρα περιλαμβάνουν το μισό από 3 τετράγωνα και 2 κάτω 9

Πρέπει να προσπαθήσεις περισσότερο και να διαβάσεις τους τύπους των εμβαδών. Μπορείς να κόψεις και να ράβεις τα σχηματάκια σε βοηθάνε.

You must try more and study the formulas. You can cut and supplement the shapes. It might help you.

- ➢ Students become actively involved.

HIGHLIGHTS OF THE ACTIVITY

- ✓ The feedback comments given by the students indicate a reflection on their individual learning.

Διακρίνω πως γνωρίζεις τους τύπους των εμβαδών, βέβαια, κάποιες φορές μπερδεύεσαι. Θα σου σύστηνα να ξαναδιαβάσεις τους τύπους των εμβαδών και να είσαι πιο προσεκτικός στις πράξεις. Τέλος, προσπάθησε να ρυθμίσεις τον χρόνο σου έτσι ώστε να σου είναι επαρκής!

I can see that you know the formulas of areas, but sometimes you get confused. I would recommend you to study again the formulas and to be more care ful when calculating.Finally, try to adjust your time so that it is sufficient for the exercises.

Περισσότερη γράψε εξήγηση όταν χρησιμοποιείς διαφορετική από τον τύπο μέθοδο για την επίλυση του προβλήματος.

Explain what you do when you do not use the formula

Πρέπει να προσέξεις τα λάθη του πολλαπλασιασμού

Try to avoid the multiplication errors.

2. Πιστεύεις ότι οι δράσεις αξιολόγησης γραπτών άλλων μαθητών βοήθησαν τη μάθησή σου;

Με βοήθησε πολύ και η διαδικασία της διόρθωσης ενός διαφορετικού ανθρώπου με βοήθησε και στο να καταλάβω πως να διορθώνω μικρά αλλά σημαντικά λάθη

2. Do you think that the assessment of other students' worksheets helped your learning?

The process of correcting another person's worksheet helped me a lot to figure out how to correct small but important mistakes.

- ➢ Students like the assessment of other students' work, the fact that their mistakes are made by classmates too and the opportunity to offer feedback.

HIGHLIGHTS OF THE ACTIVITY

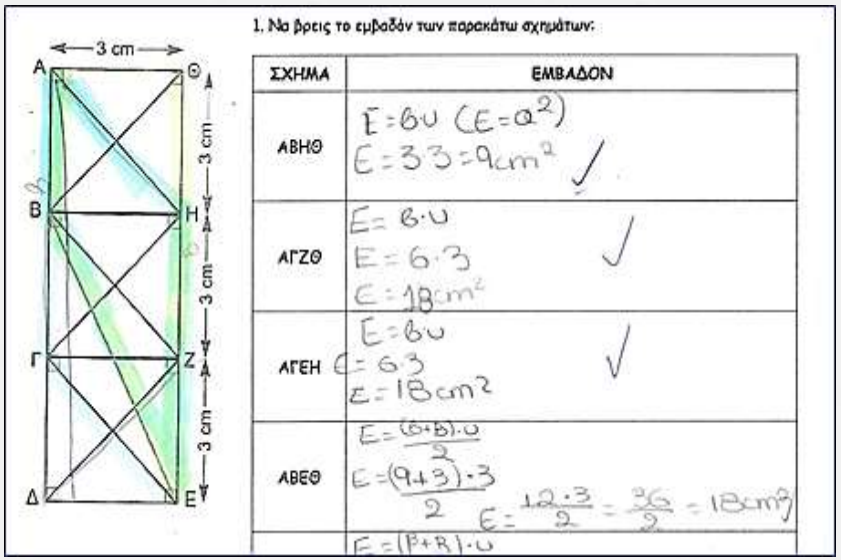
- ✓ The teacher's suggestion to color each shape (“following” the vertices) to see it clearly.

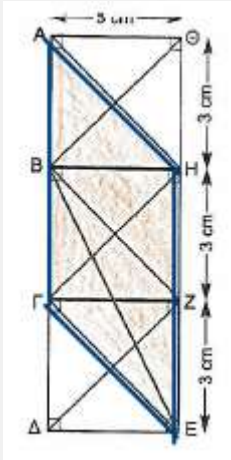
1. Ποια βοήθεια, από αυτές που σου δόθηκαν, σού ήταν πιο χρήσιμη:

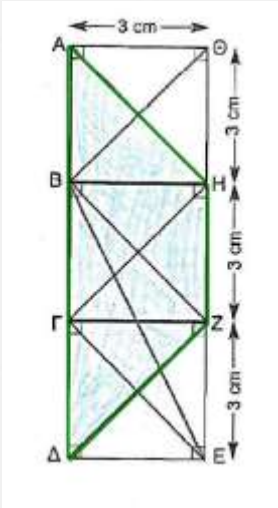
~~εαυτόν~~ με τα χρωματιστά σχήματα, ώστε να μπορώ ~~να βρω~~ το σχήμα για να υπολογίσω την βάση το ύψος.

1. Which help, from these given to you, was most useful to you?

The one with the colored shapes so that I can find in order to calculate the base, the height





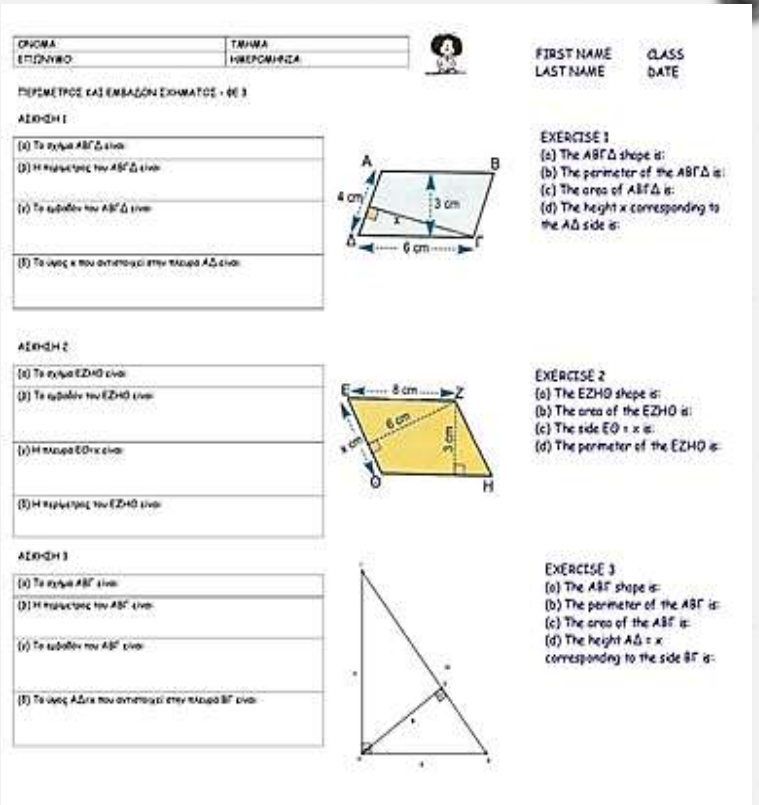


3rd ACTIVITY
OF FORMATIVE ASSESSMENT

Self-assessment

ACTIVITY

Students are given an individual worksheet containing three exercises (designed by the teacher after taking in consideration the two previous activities).



In each exercise students have to

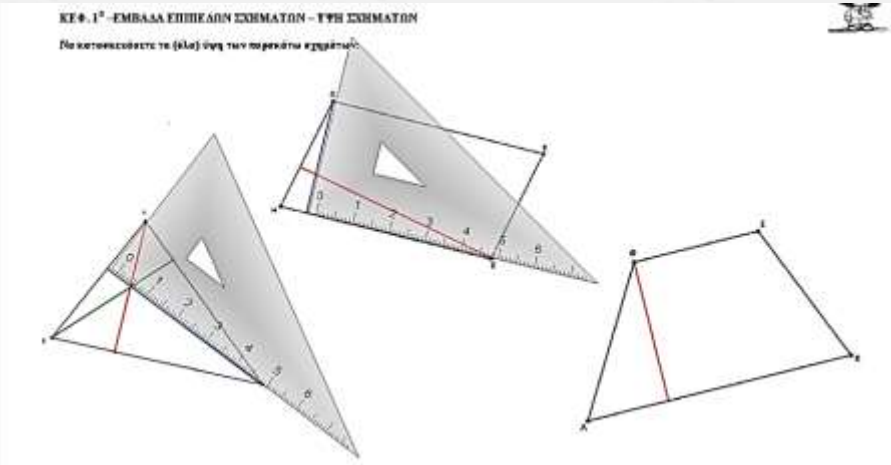
- calculate the perimeter and the area of a 2D-shape and/or a (corresponding) height/base,
- replace the correct elements in the formula (corresponding base/ height),
- perform arithmetic operations and verify the results,
- develop criteria to assess their work and decide on the next learning steps.

Students work individually at their own pace with minimum help.

- The teacher adjusts the time, the instructions and the activities accordingly.
- It takes more time to work in that way.

HIGHLIGHTS OF THE ACTIVITY

- ✓ Some students continue to confuse the shorter side of a parallelogram with the distance between its parallel sides (height).



The teacher adjusts the activities so that those students practice by constructing altitudes.

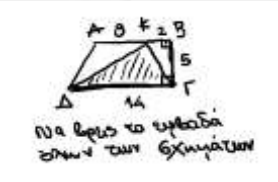
- ➢ For further implementation:

An interactive application is needed for the students to test if a height correspond to a particular side, in order to achieve understanding.

HIGHLIGHTS OF THE ACTIVITY

Students

- ✓ estimate how well they did,
- ✓ assess their own work and create assessment criteria,
- ✓ reflect on the work's strong and weak points, write down the difficulties they encountered,
- ✓ make their learning plan,
- ✓ gain confidence.



ADJUSTING ACTIVITY

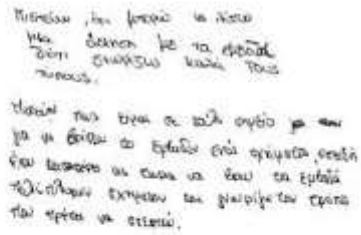
The teacher asks the students to create their own problem involving shape area (with at least two different shapes).

- ➢ Students deepen their understanding of the subject and tighten their learning.

I know the formulas.
I confuse heights-sides.
I have to practice.

I have to understand that a shape has at least two heights and two bases.

Yes I can assess the work I have done.
At first I check the formula (if it is the wright one)
Then the operations
The way I have written (presented) them.
I try the same exercise again, until I figure it out and solve it correctly



I think I can solve an exercise about (calculating) areas because I know the formulas well.
I believe I am in a certain point where I can calculate the area of a shape, because I have managed to calculate areas of complex shapes and I know the way (how) to do it.

THE END

THANK YOU!

ΕΥΧΑΡΙΣΤΩ!