

# **“Tinkering With Dynamic Digital Models of Greek Alphabet’s Letters”**

**A case of implementation of workshop activities in the classroom**



# Technology - Engineering - Arts - Mathematics

## Scenario

Construction of letter (ex. N, Z, M)

Debugging of letter model

Creation and presentation of a dynamic poster / video

(students worked in groups with the digital tool “MaLT2”)

1

Students: Constructionism & Social Constructionism:  
Learning through tinkering models → Public

2

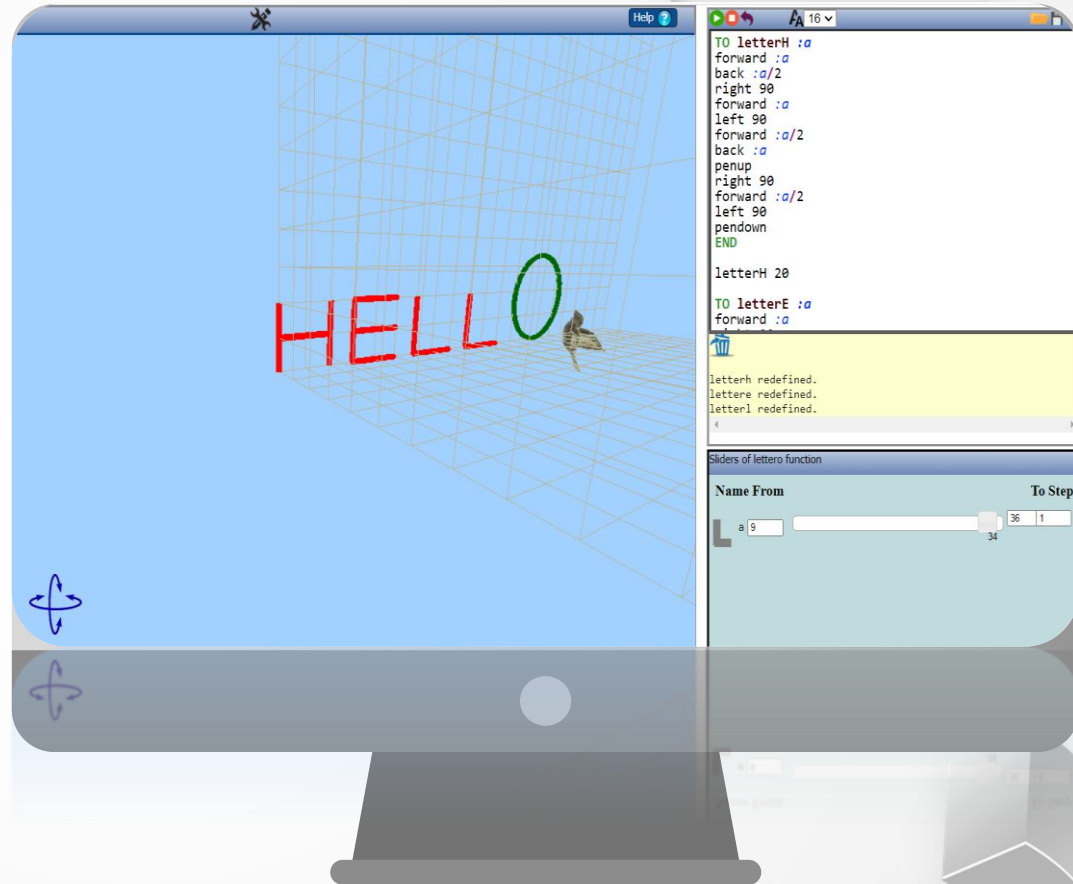
Teachers – designers: Mathematics through Programming:  
a. Embedding mathematical concepts in a program  
b. Inserting bugs in a model

3

Students → designers using technology to construct and modify artifacts

# “MaLT2”

- ✓ Web-based tool
- ✓ Freely available
- ✓ Based on **Hummingbird Geometry (HuGe)** & Logo language
- ✓ Dynamic manipulation of variable procedure values
- ✓ 3D stage & 3D camera



# Steps of STEAM PBL

## 5th Step

Evaluation of the generalized model based on the result and comparison with the first one constructed by the students.

## 1st Step

Task: A. Creation of Models of Letters by the students.  
B. Students were given a “**half-baked**” letter model.

## 2nd Step

Using of the graphical representation and the dynamic manipulation offered by the tool to explore the faulty model.

## 4th Step

Design – Construction – Debugging of the letter model through testing of ideas in the tool.

## 3rd Step

Exploring the mathematical properties that are embedded in the model.

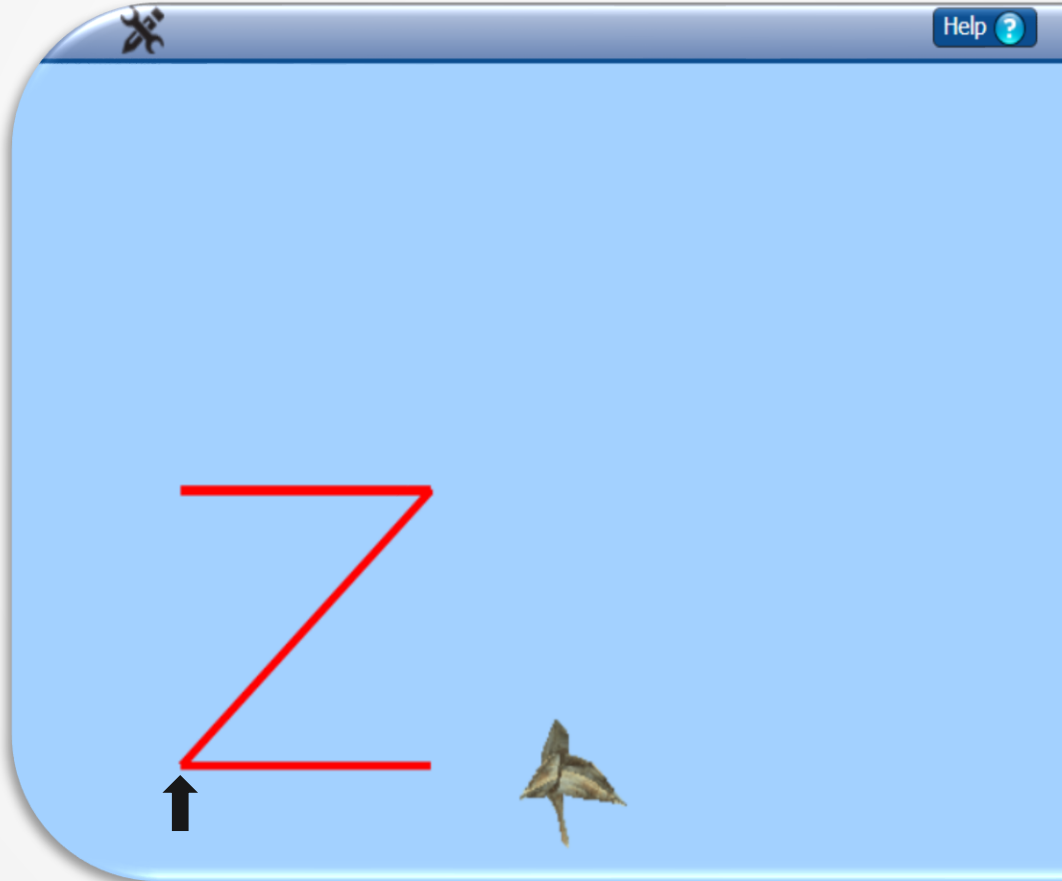
# The Letter 'Z' Model – Task Analysis

Parallel lines

Angle as a  
“turn”

Equal interior  
angles

Notional right  
triangle →  
Pythagorean  
Theorem



```
TO letterZ :x
right 90
forward :x
back :x
left 45
forward sqrt(:x*:x + :x*:x)
left 135
forward :x
END

letterZ 60

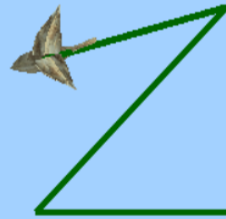
|

letterz defined.
```

# The “Half-Baked” ‘Z’ Model - Task Analysis

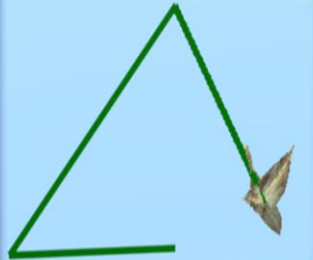
**Bug:** Removal of the property of equal angles

Insert of a variable



```
TO letterZ :x :w
right 90
forward :x
back :x
left 45
forward sqrt(:x*:x + :x*:x)
left :w
forward :x
END

letterZ 60 150
```



Sliders of letterz function

Name From

x	<input type="text" value="30"/>	<input type="range" value="60"/>	<input type="text" value="120"/>
w	<input type="text" value="75"/>	<input type="range" value="150"/>	<input type="text" value="300"/>

# The “Half-Baked” ‘M’ Model – Task Analysis

The screenshot shows a Logo environment with a blue background. On the left, a green letter 'M' is drawn. A red arrow points from the 'M' to the code window on the right. The code window contains the following text:

```
TO letterM :x :y
forward :x
right 135
forward :y
left 90
forward 60
right 135
forward :x
END

letterM 80 100
```

A green arrow points to the 'forward 60' line in the code. Below the code window is a yellow console area with the text:

```
letterm defined.
letterm redefined.
letterm redefined.
```

At the bottom, there is a 'Sliders of letterm function' window with two sliders:

Name	From	To	Step
x	40	160	1
y	50	200	1

**Bug:** Removal of the property of equal slanted sides → the one changes & the other has a stable number

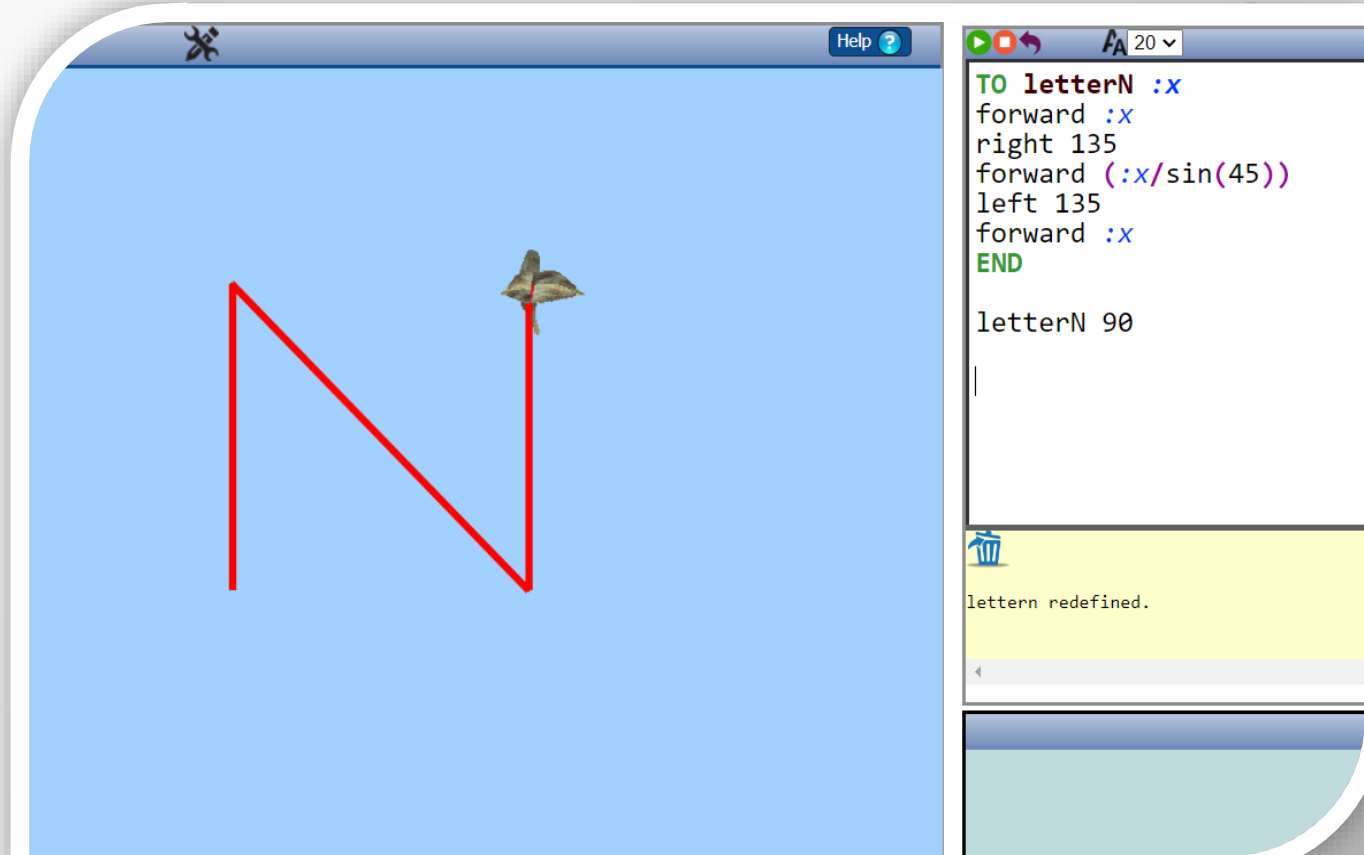
Students' ways of **debugging:**

- Proportional relationship
- Pythagorean Theorem
- Trigonometric functions

# Construction of 'N' Model - Task Analysis

Trigonometric  
function  $\rightarrow$  sine

*Student: "The bird  
turns 135 and I look  
to the side that is  
opposite that angle.  
So, sine! I can use  
sine cause I have got  
a right triangle.  
That's the way we  
will find the length of  
the hypotenuse!"*



The screenshot shows a Scratch environment. On the left, a red 'N' shape is drawn on a light blue background. A small bird icon is positioned at the top of the rightmost vertical stroke of the 'N'. On the right, the code editor is visible, showing the following code:

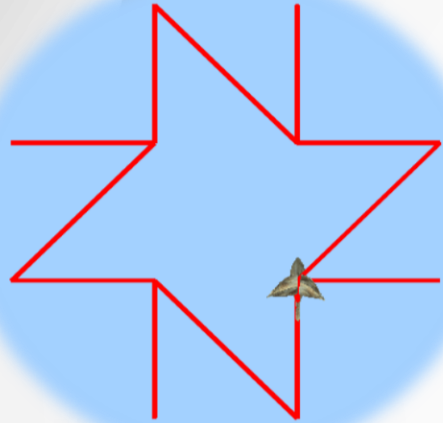
```
TO letterN :x
forward :x
right 135
forward (:x/sin(45))
left 135
forward :x
END

letterN 90
```

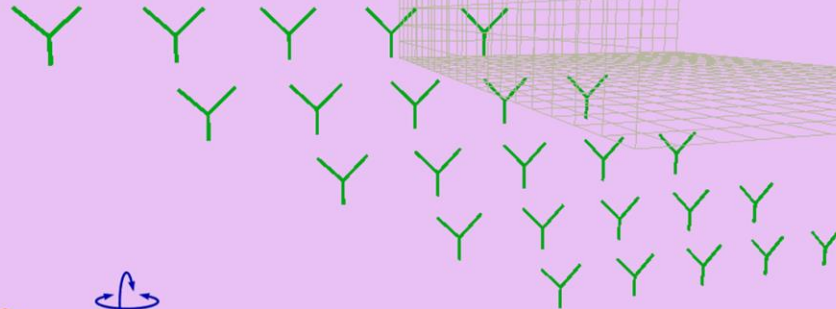
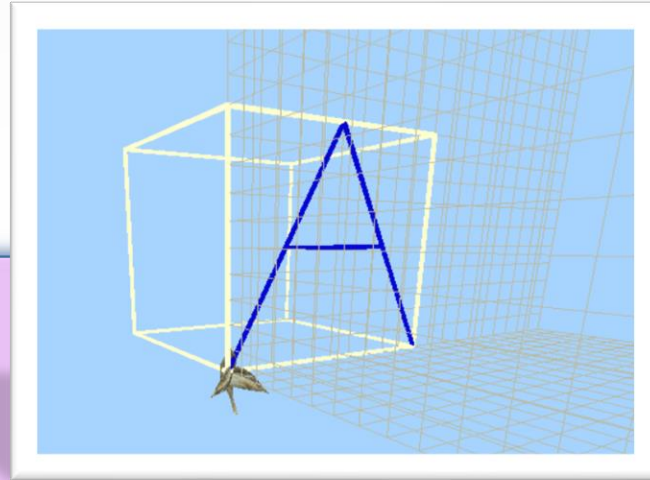
Below the code editor, a yellow message box displays the text: "lettern redefined."



# Free Constructions with the Models



Using letter  
model as a unit  
to create a  
more complex  
artifact.



```
ΓΙΑ ύψιλον :α
συλοπάνω
δεξιά 90
μπροστά :α/2
αριστερά 90
συλοκάτω
μπροστά :α/2
αριστερά 45
μπροστά (:α/2 * ρίζα 2)
πίσω (:α/2 * ρίζα 2)
δεξιά 90
μπροστά (:α/2 * ρίζα 2)
συλοπάνω
α 45 π :α δ 90 μ :α/2 α 90
συλοκάτω
ΤΕΛΟΣ
```

```
ΓΙΑ μετ :α :δ
οπ
```



```
νι defined.
ήτα defined.
σίγμα defined.
<
```



# Added Value of **TEAM** Implementation

- ✓ Knowledge is actively constructed by students based on their ideas and their experiences with the tool through exploration and experimentation of the graphical representations and the code.
- ✓ Fill the gap between abstract knowledge and application.
- ✓ Motivation & Engagement of the students.
- ✓ Identifying the problem – Generating ideas – Evaluating the model – Refining the model – Presenting the project → Reflection, Argumentation, Exploration.
- ✓ 21st century skills: Computational Thinking – Creativity - Critical Thinking – Collaboration.

**Thank you**

