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

A case of implementation of workshop activities in the classroom

STEAMTeach

Science | Technology | Engineering | Arts | Mathematics

Technology - Engineering - Arts - Mathematics

Scenario

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

Debugging of letter model

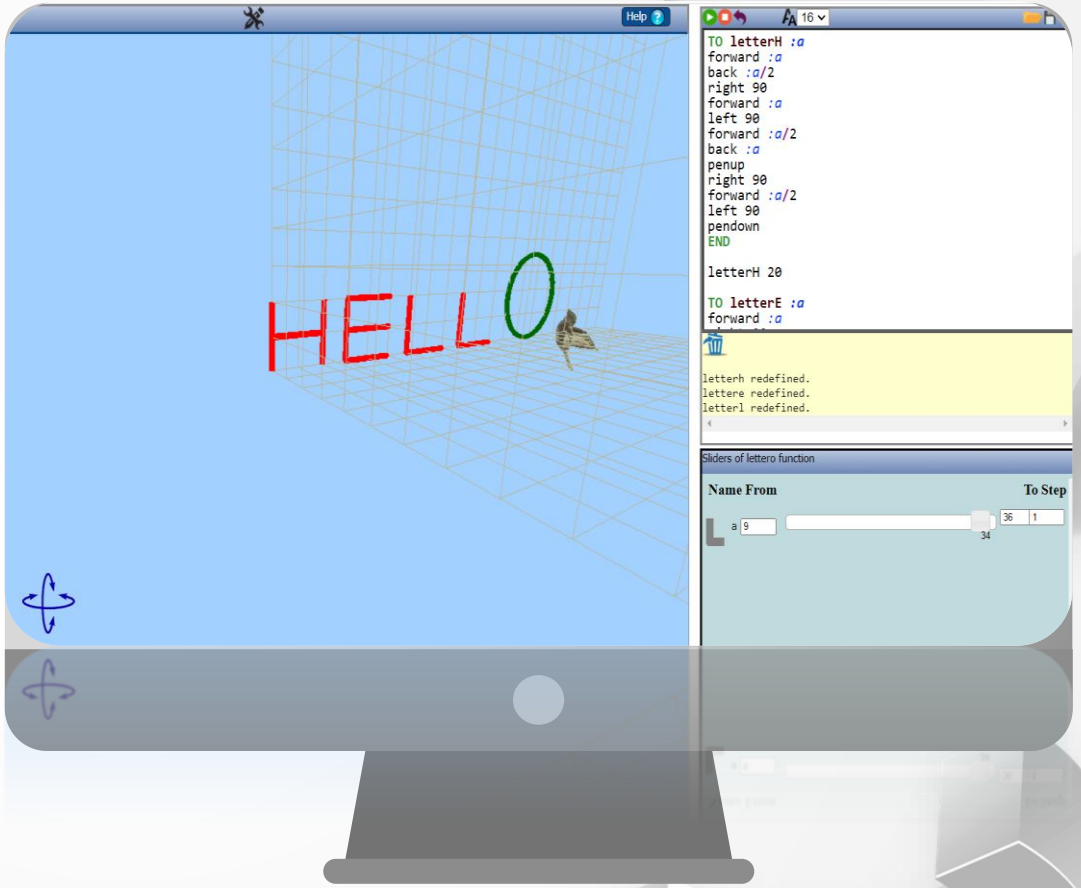
Creation and presentation of a dynamic poster / video

(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



http://etl.ppp.uoa.gr/malt2/

Steps of STEAM PBL

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.

3rd Step
Exploring the mathematical properties that are embedded in the model.

4th Step
Design – Construction – Debugging of the letter model through testing of ideas in the tool.

5th Step
Evaluation of the generalized model based on the result and comparison with the first one constructed by the students.

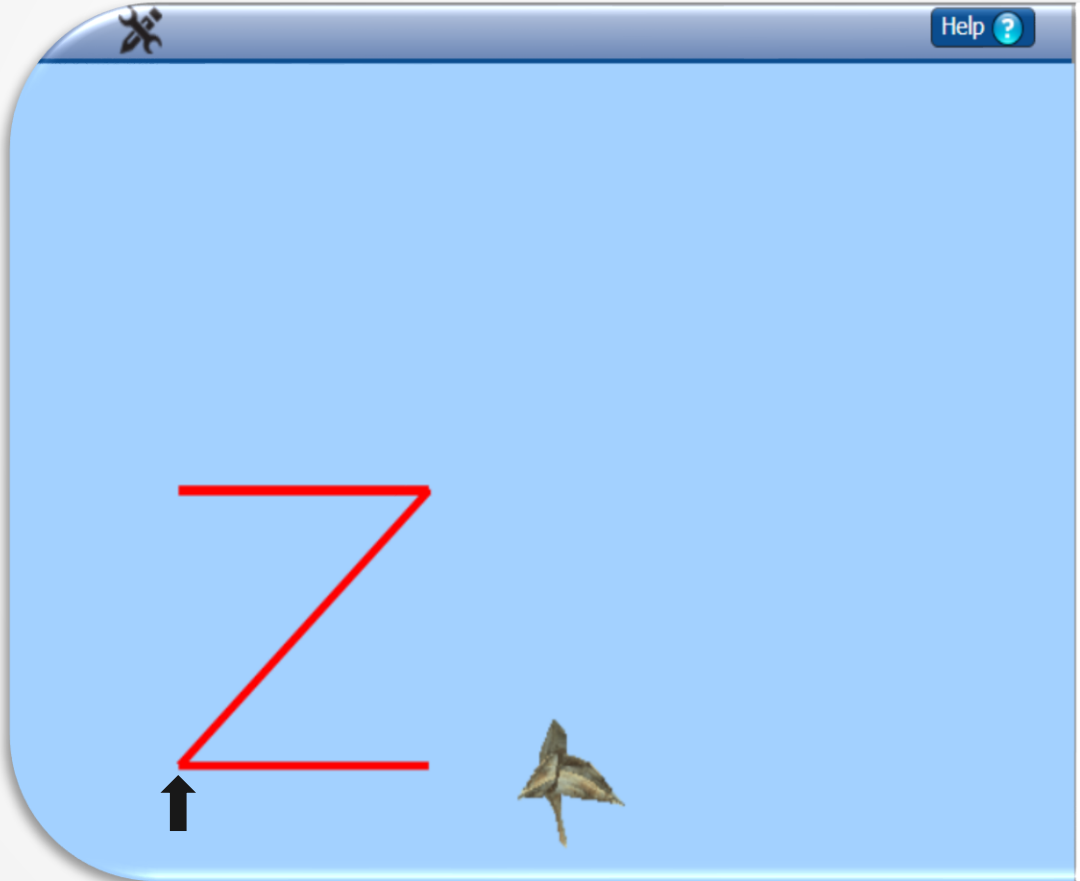
The Letter ‘Z’ Model – Task Analysis

Parallel lines

Angle as a “turn”

Equal interior angles

Notional right triangle → Pythagorean Theorem



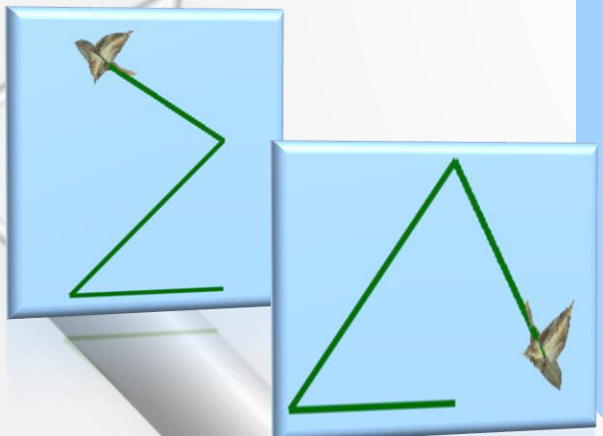

```
TO letterZ :x
right 90
forward :x
back :x
left 45
forward sqrt(:x*:x + :x*:x)
left 135
forward :x
END

letterZ 60
```

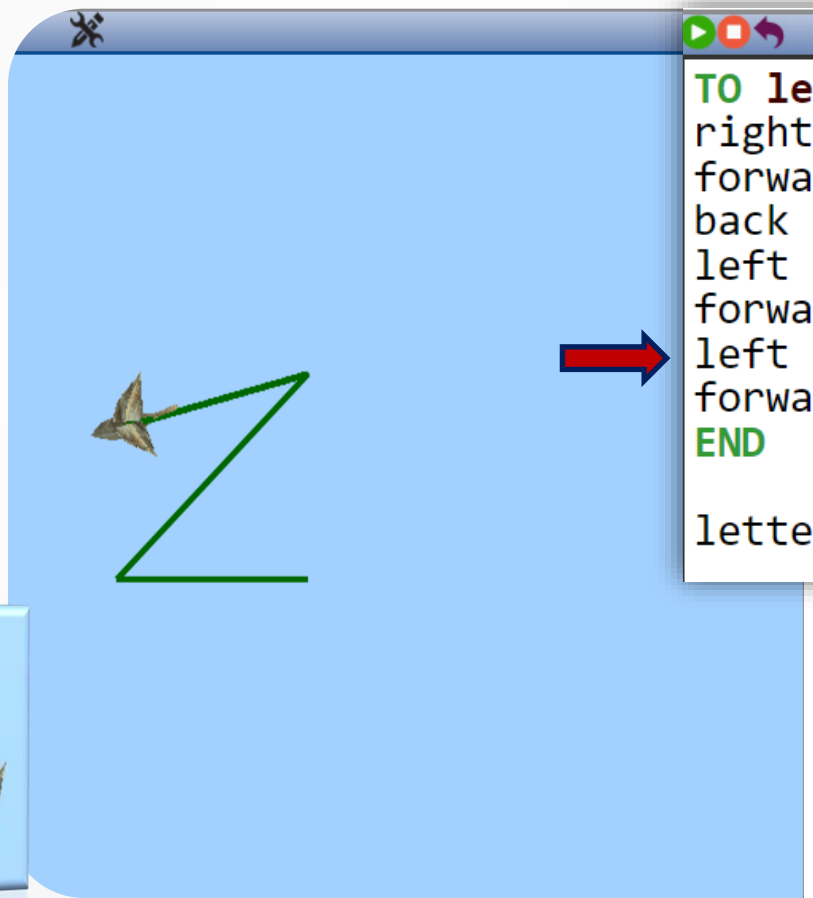
```
letterz defined.
```

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

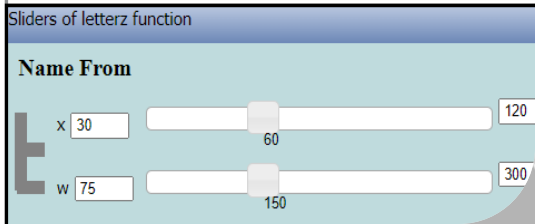
Bug: Removal of the property of equal angles

Insert of a variable

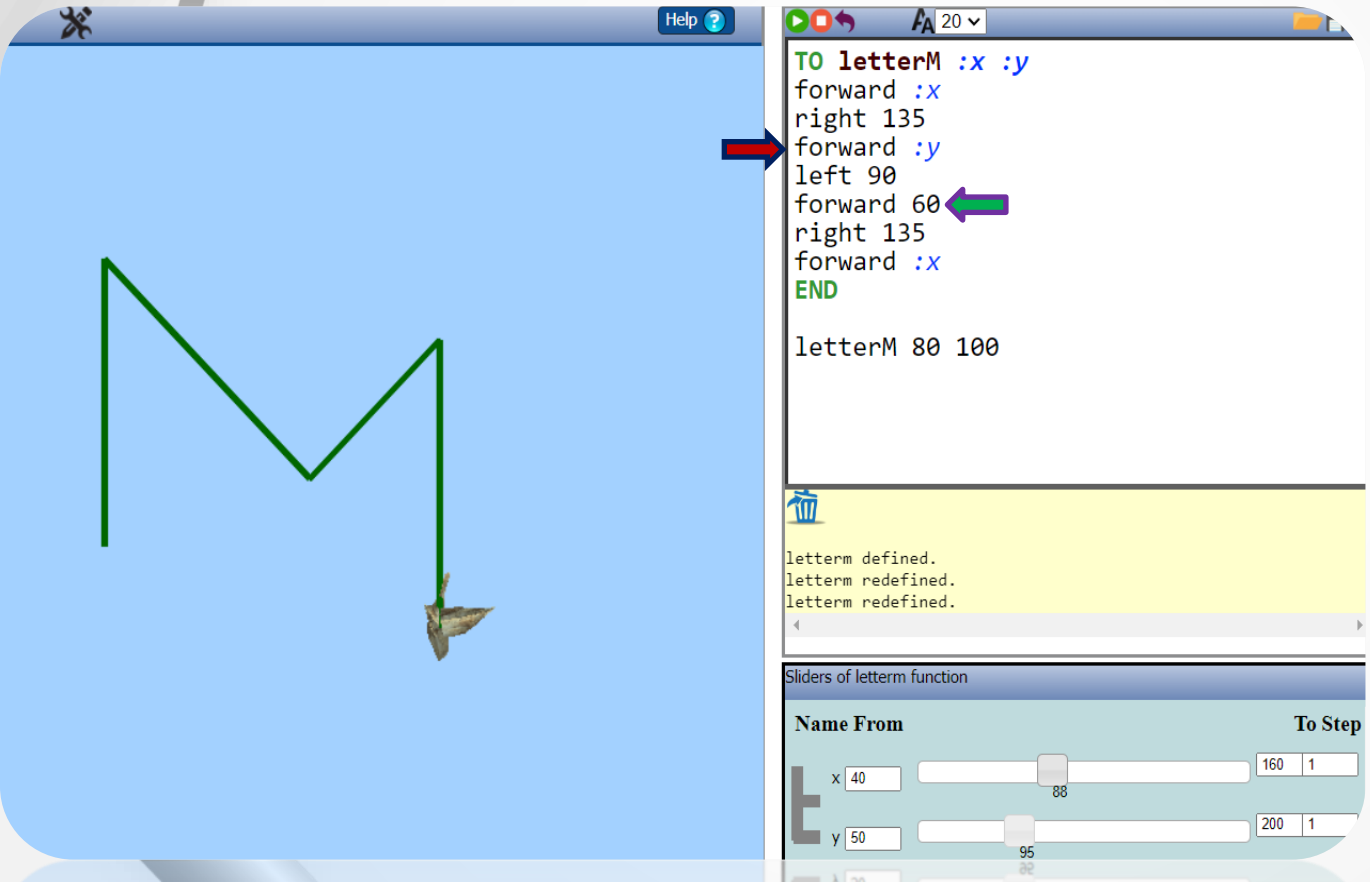




```
TO letterZ :x :w
right 90
forward :x
back :x
left 45
forward sqrt(:x*:x + :x*:x)
left :w
forward :x
END

letterZ 60 150
```



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



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

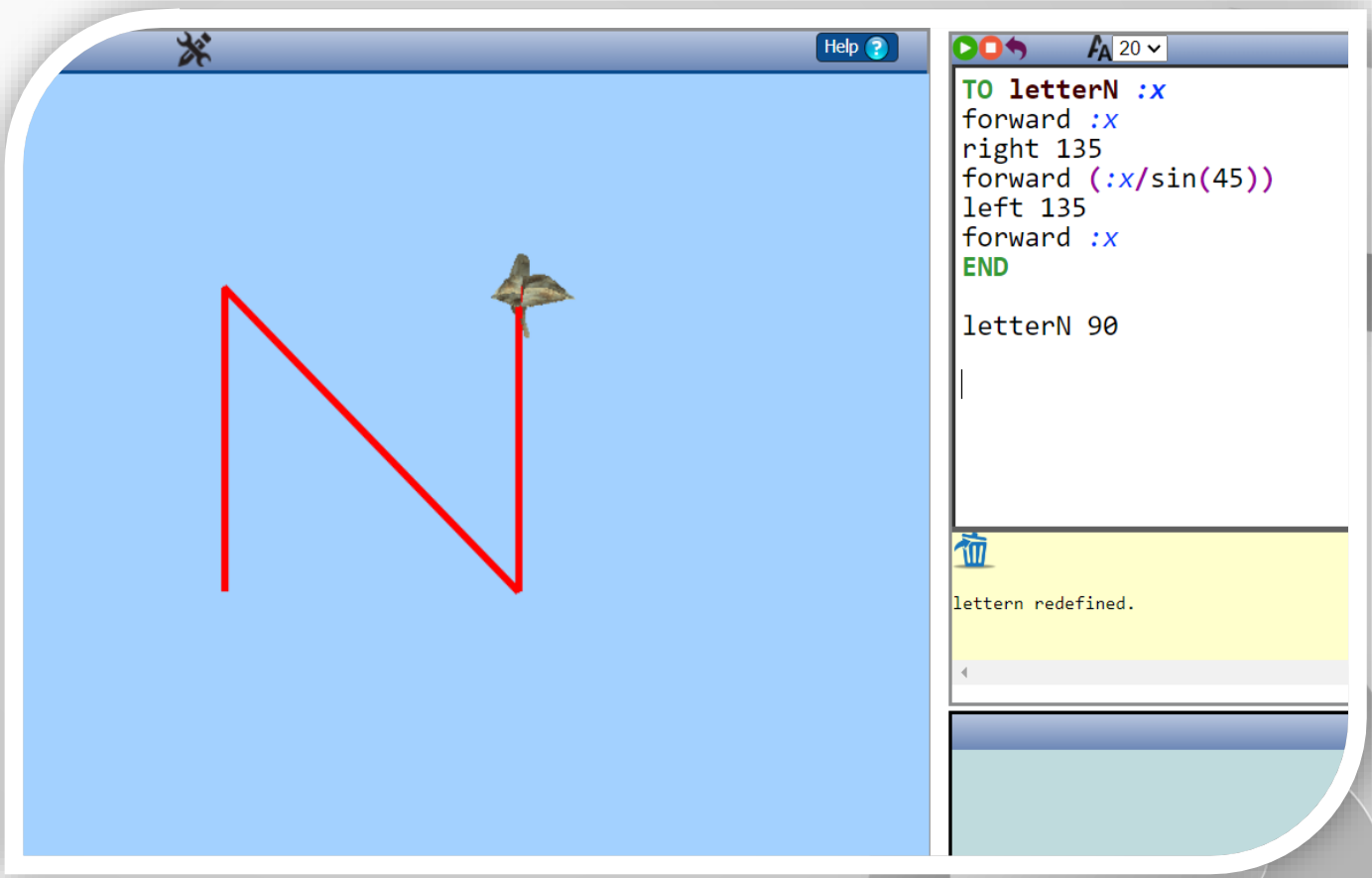
Students’ ways of **debugging**:

- Proportional relationship
- Pythagorean Theorem
- Trigonometric functions

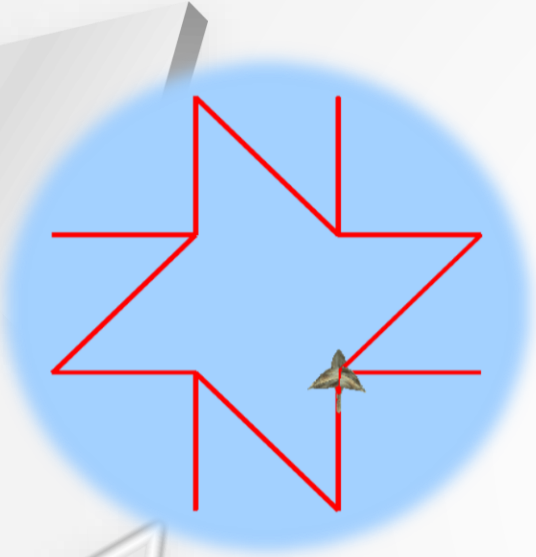
Construction of ‘N’ Model - Task Analysis

Trigonometric function → sine

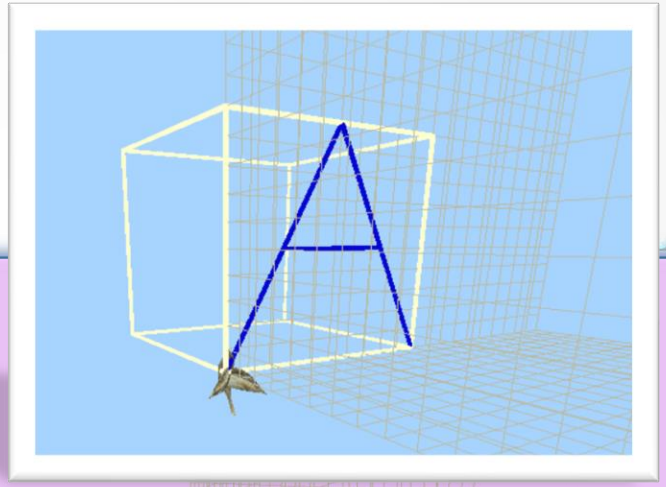
Student: “The bird turns 135 and I look to the side that is opposite that angle. So, sine! I can use sine cause I have got a right triangle. That’s the way we will find the length of the hypotenuse!”



Free Constructions with the Models



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




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

ΓΙΑ μετ :α :δ
σπ
```

```
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