

Regular Polygons: From Scratch to Construit!

School: Ralleia Experimental Primary Schools

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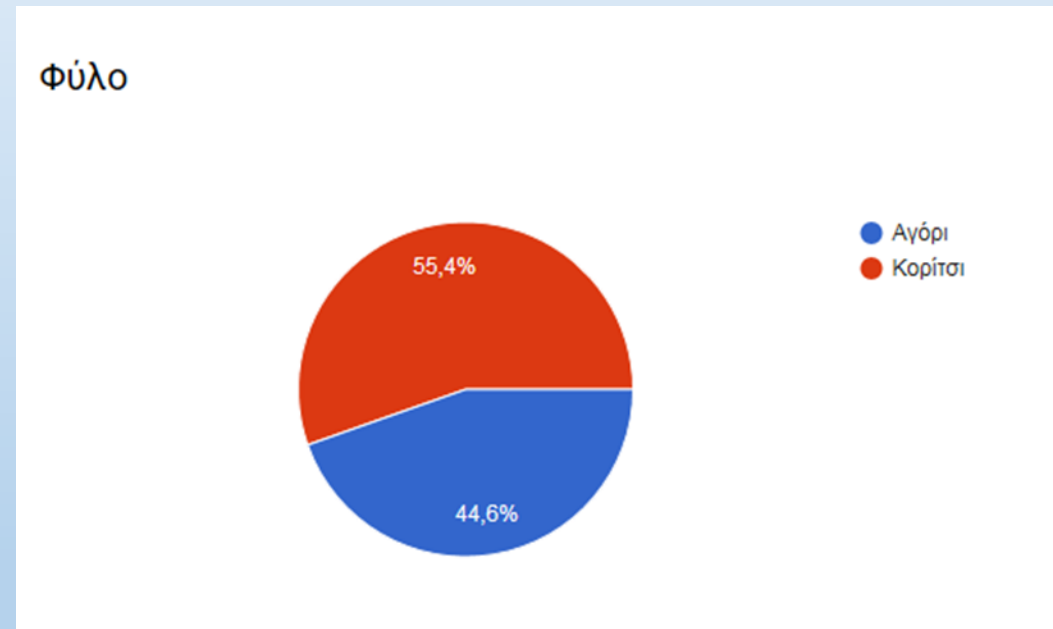
May-June, 2017

Sample

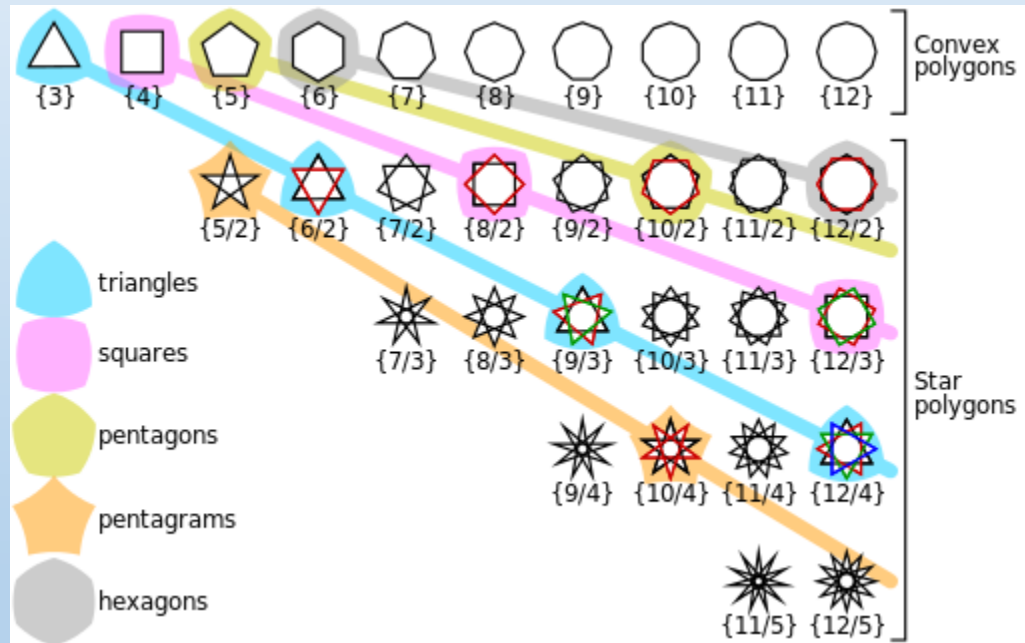


- 3 Classes 72 pupils
- 44,6 Male/55,4 Female
- A mixed 5th & 6th grade Class(20 pupils)
- A 5th grade Class (26 pupils)
- A 6th grade Class (26 pupils)

Sex

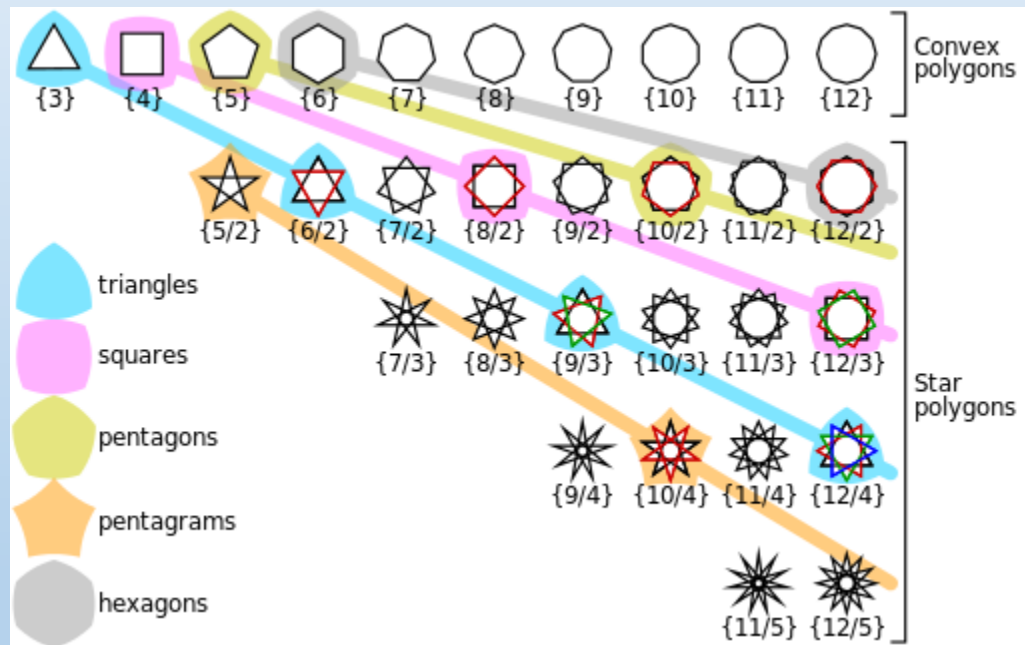


The problem: Convexing Regular Polygons



- Convexing Regular Polygons
- Logo like use of Scratch for polygon drawing-construction.
- 3-45' lessons.
- Parameterization of polygon construction giving the:
 - Starting point,
 - Number of sides,
 - Size of sides.

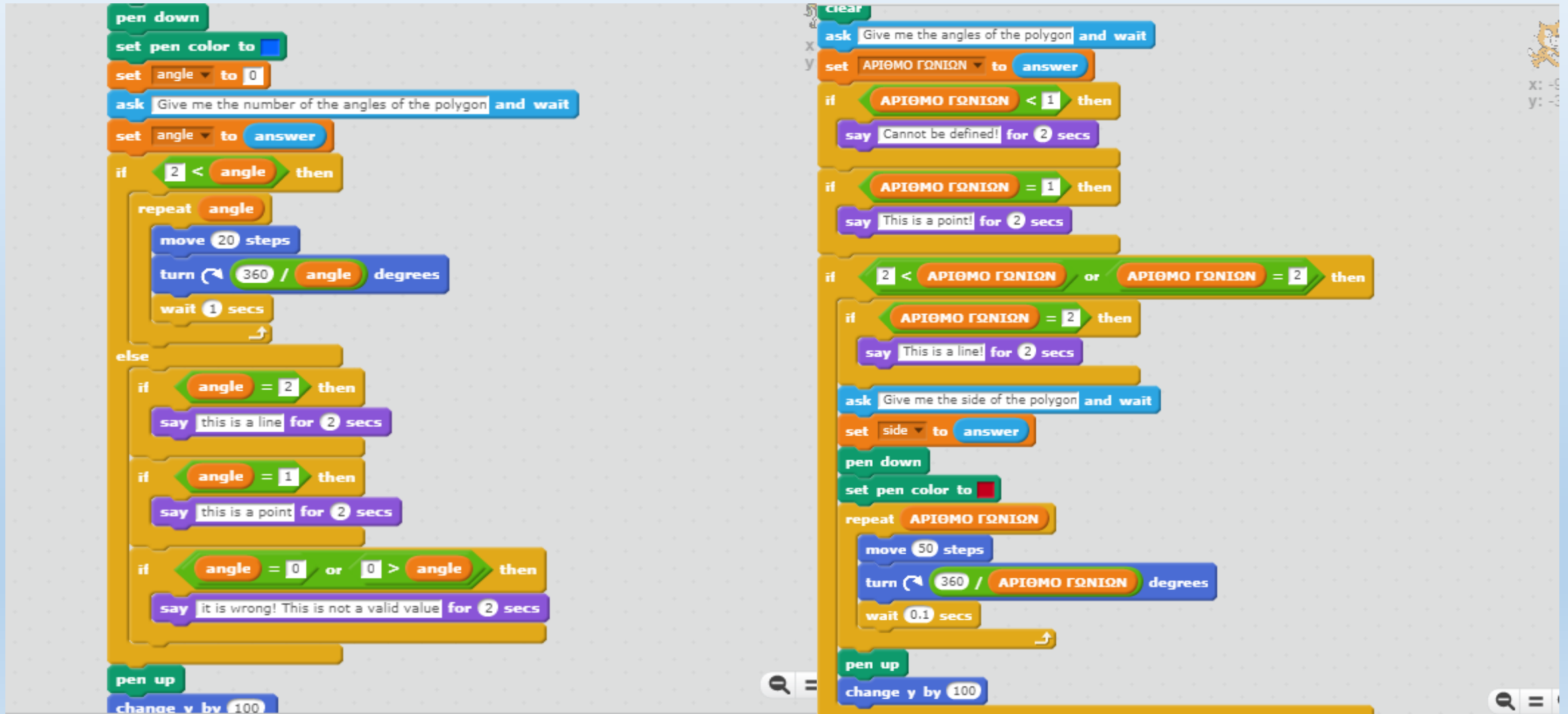
Previous Knowledge on Maths



- Drawing with Scratch.
- Circle: Radius-Diameter-Perimeter.
- Line starting from certain point.
- Direction of a line.
- Turning of sprite certain number of angles.

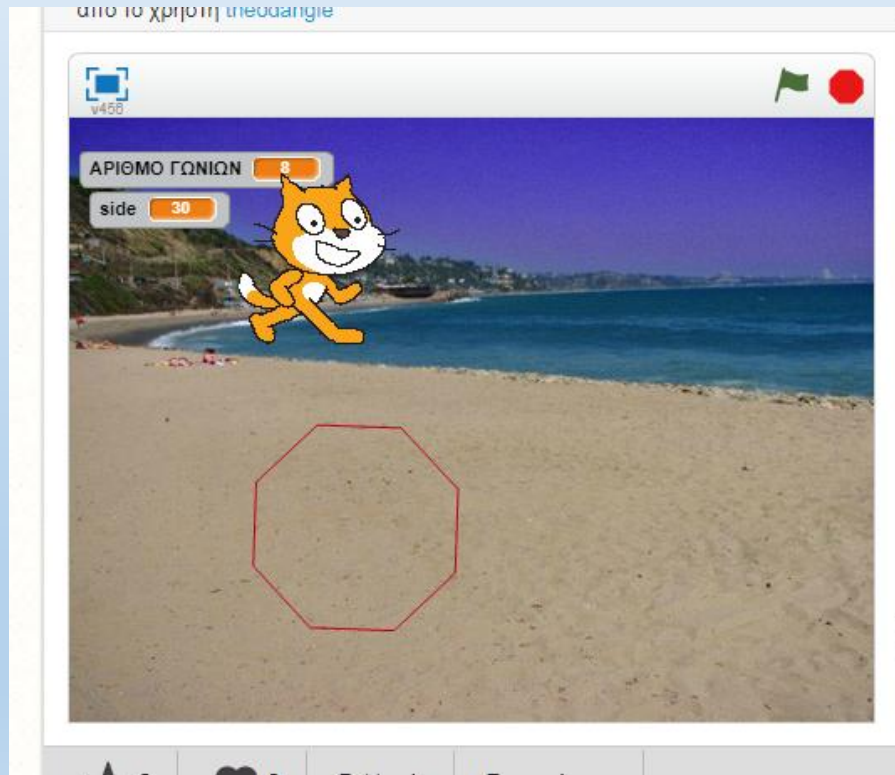
Regular Polygons Drawing: Same Problem different Solutions.

More at: <https://scratch.mit.edu/studios/4179144/>

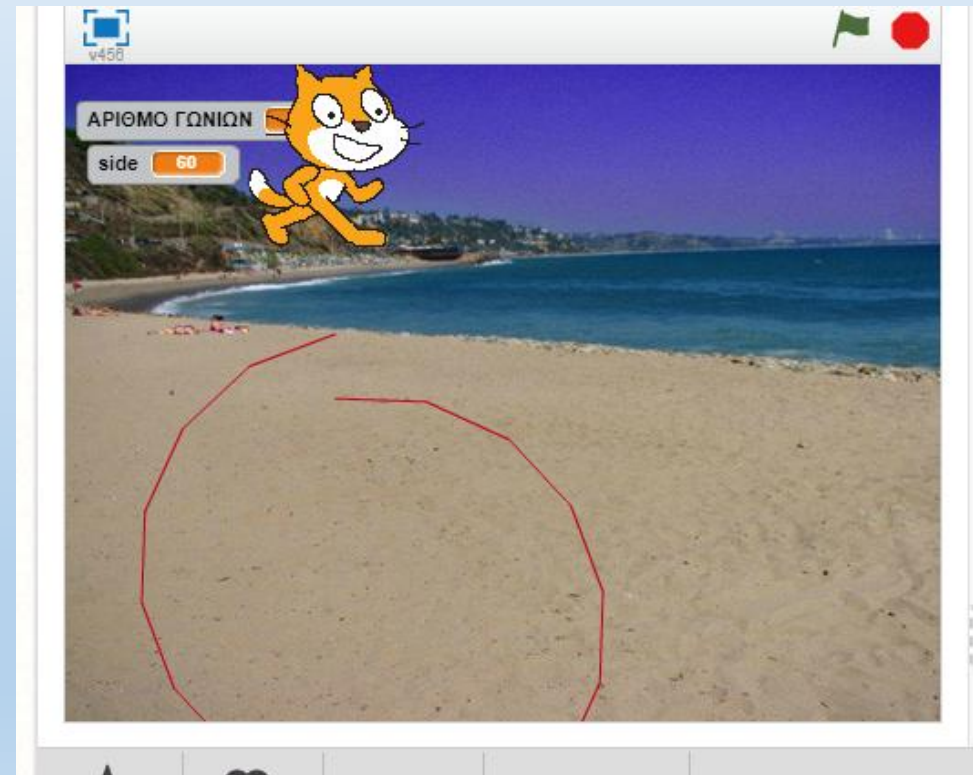


Accuracy...floating point numbers

8 side-30 pixels



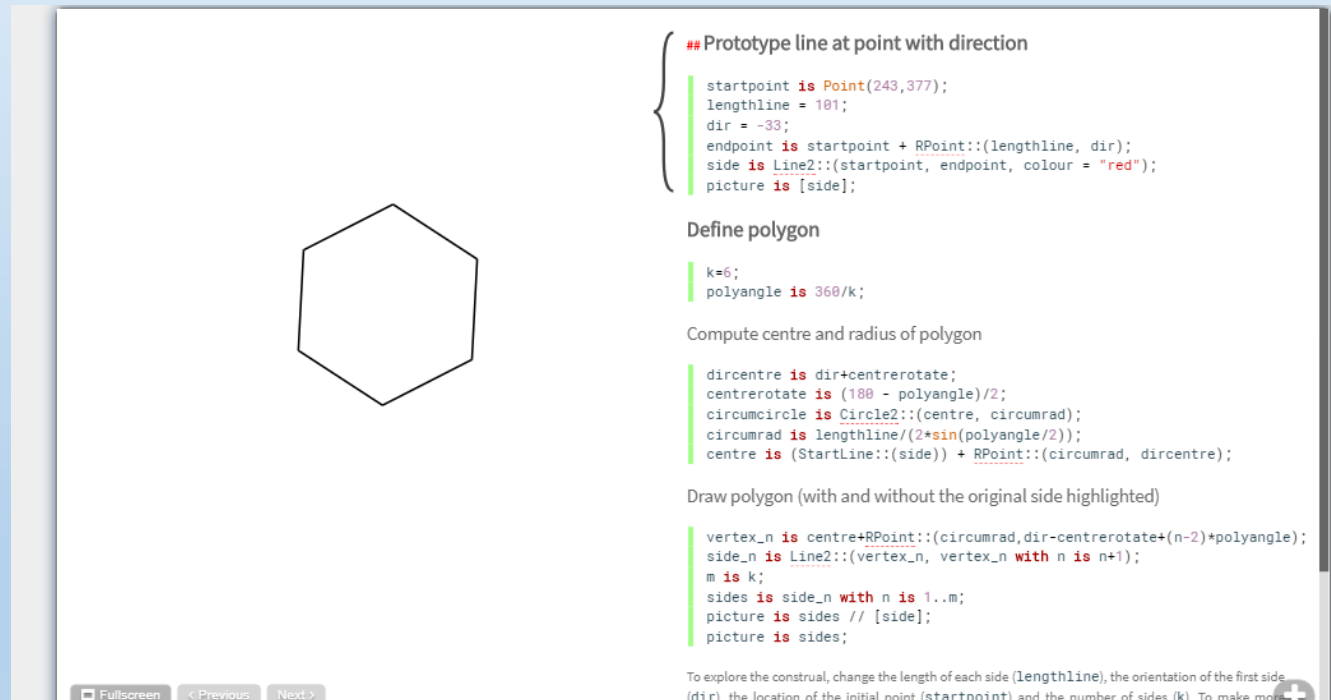
12 side – 50 pixels



JS-Eden: Regular Polygon Construal

More at: jseden.dcs.warwick.ac.uk/construit/?load=210

jseden.dcs.warwick.ac.uk/construit/?load=210



```
## Prototype line at point with direction
startpoint is Point(243,377);
lengthline = 101;
dir = -33;
endpoint is startpoint + RPoint::(lengthline, dir);
side is Line2::(startpoint, endpoint, colour = "red");
picture is [side];

Define polygon
k=6;
polyangle is 360/k;

Compute centre and radius of polygon
dircentre is dir+centrerotate;
centrerotate is (180 - polyangle)/2;
circumcircle is Circle2::(centre, circumrad);
circumrad is lengthline/(2*sin(polyangle/2));
centre is (StartLine::(side)) + RPoint::(circumrad, dircentre);

Draw polygon (with and without the original side highlighted)
vertex_n is centre+RPoint::(circumrad,dir-centrerotate+(n-2)*polyangle);
side_n is Line2::(vertex_n, vertex_n with n is n+1);
m is k;
sides is side_n with n is 1..m;
picture is sides // [side];
picture is sides;
```

To explore the construal, change the length of each side (lengthline), the orientation of the first side (dir), the location of the initial point (startpoint) and the number of sides (k). To make more

A Regular Polygon Construal was given to pupils to experiment themselves on the construction of regular polygon for a 45' lesson.

Questionnaires

Self-Evaluation/JS-Eden Evaluation

Κατάλαβα πως μπορώ να αλλάξω το μέγεθος της πλευράς του πολυγώνου Change the size of reg. Polygons side

- 1. Καθόλου /Not at all
- 2 Λίγο/Little
- 3 Αρκετά/ Enough
- 4 Πολύ Καλά/ Very well
- 5. Άριστα/ Excellent

Κατάλαβα πως μπορώ να αλλάξω το πλήθος των γωνιών του πολυγώνου I understand how to change the num of angles of the reg. Polygon

- 1. Καθόλου /Not at all
- 2 Λίγο/Little
- 3 Αρκετά/ Enough
- 4 Πολύ Καλά/ Very well
- 5. Άριστα/ Excellent

Κατάλαβα πως μπορώ να μετακινήσω το πολύγωνο στο χώρο/ I understand how to move the polygon on the canvas.

- 1. Καθόλου /Not at all

Learning Outcome Evaluation: Multiple-Choice Test

Οι γωνίες ενός κανονικού πολυγώνου είναι μεταξύ τους:/The angles of a regular polygon are:

- 1. Όλες διαφορετικές/All different
- 2. Όλες 90 μοιρών/ All 90 degrees
- 3 Όλες ίσες μεταξύ τους/ All equal

Οι πλευρές ενός κανονικού πολυγώνου είναι μεταξύ τους:/The sides of a regular polygon are:

- 1. Όλες διαφορετικές/All different
- 2. Όλες 90 εκατοστών / All 90 cm
- 3 Όλες ίσες μεταξύ τους/ All equal

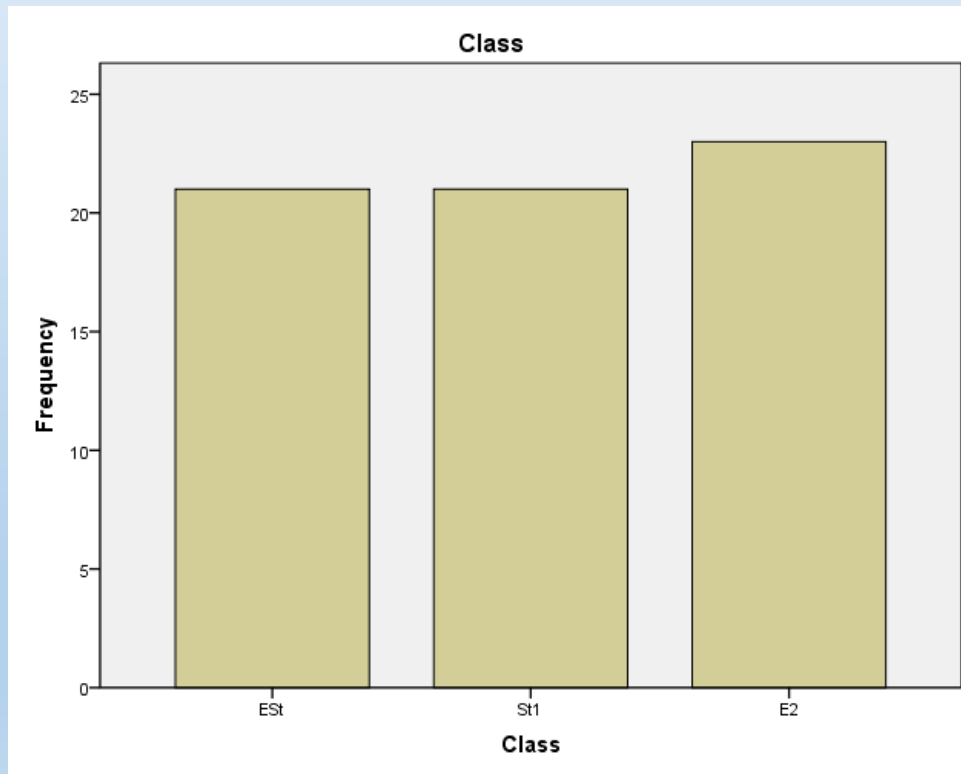
Σε ένα κανονικό τρίγωνο οι μοίρες των γωνιών του είναι:/On a regular triangle the degrees of each angle are

- 90
- 120
- 60
- 100

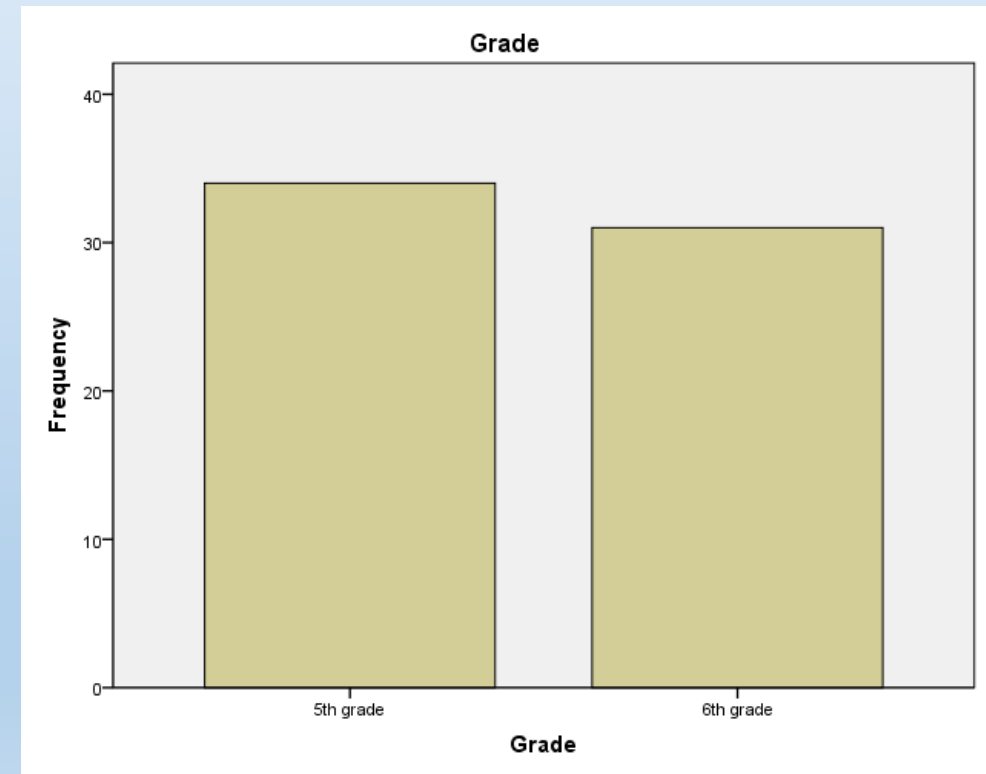
Πόσες μοίρες χρειάζεται να στρίψει ο γατούλης του Scratch για να σχηματίσει ένα ισόπλευρο τρίγωνο/How many degrees has the Cat sprite of Scratch to turn in order to make a equal

Sample Classes and Grade

No of pupils/Class

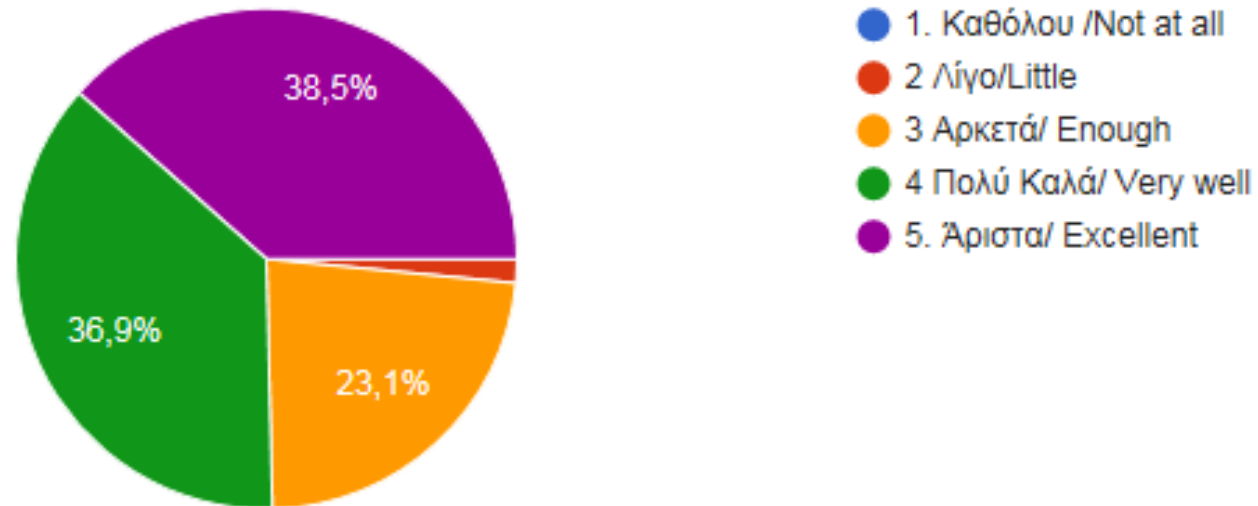


No of pupils/Grade



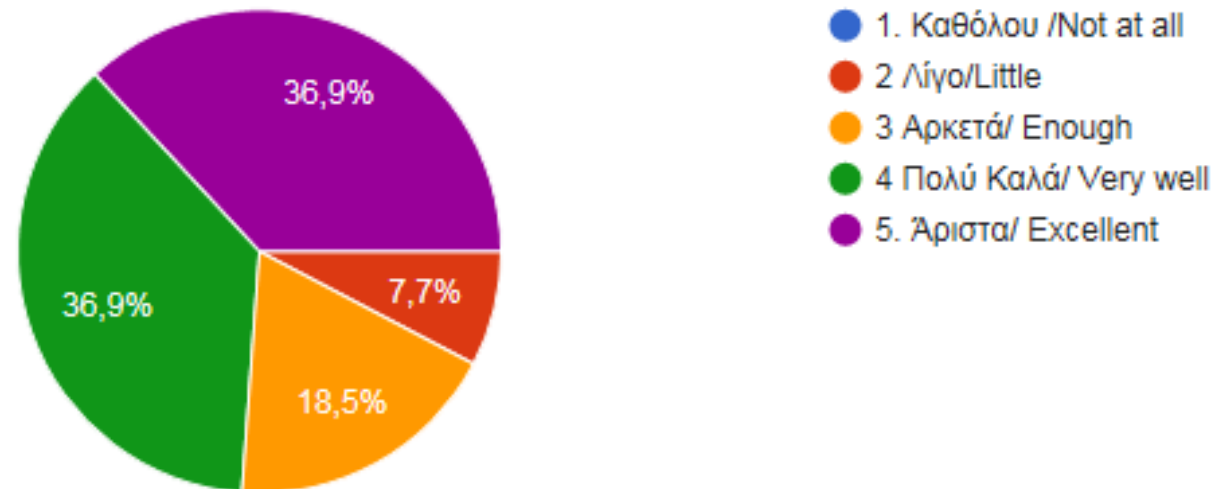
Self Evaluation: “I Understand how to change the size of reg. Polygon Side on JS Eden” 75,4% answered from Very Well to Excellent.

Κατάλαβα πως μπορώ να αλλάξω το μέγεθος της πλευράς του πολυγώνου
Change the size of reg. Polygons side



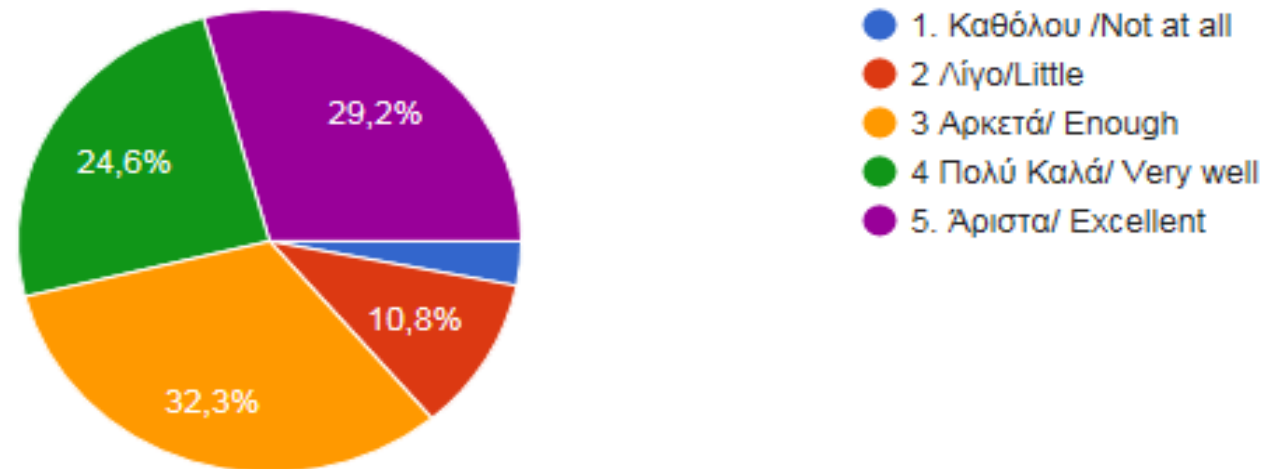
Self Evaluation: “I Understand how to change the number of angles of reg. Polygon on JS Eden” 73,8% answered were from Very Well to Excellent.

Κατάλαβα πως μπορώ να αλλάξω το πλήθος των γωνιών του πολυγώνου I understand how to change the num of angles of the reg. Polygon



Self Evaluation: “Understand how to move the regular Polygon on the Canvas” 86,1% answers were from Enough to Excellent.

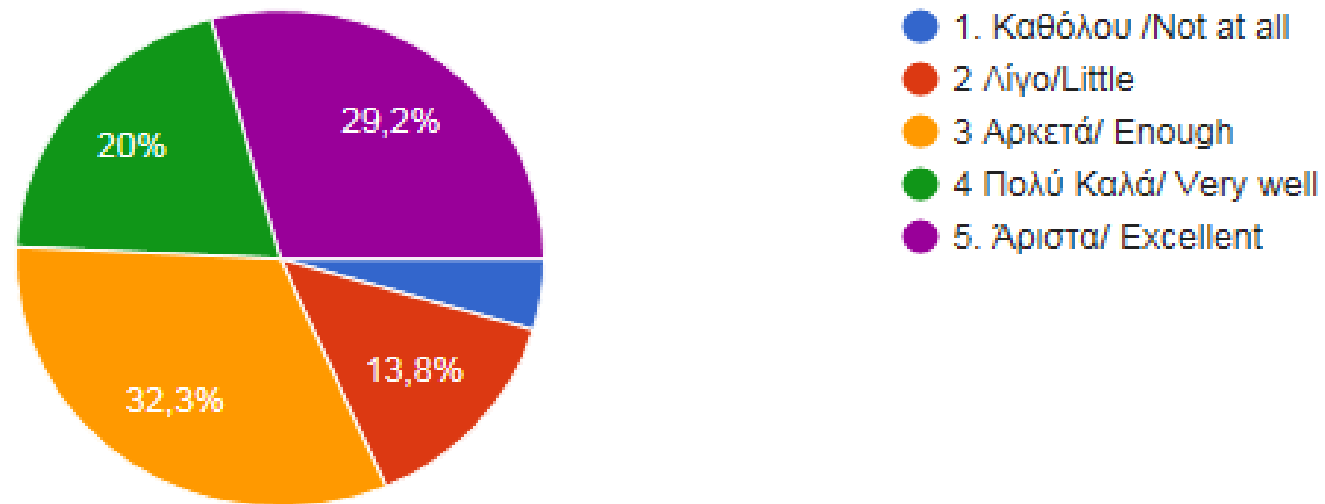
Κατάλαβα πως μπορώ να μετακινήσω το πολύγωνο στο χώρο/ I understand how to move the polygon on the canvas.



Self Evaluation:

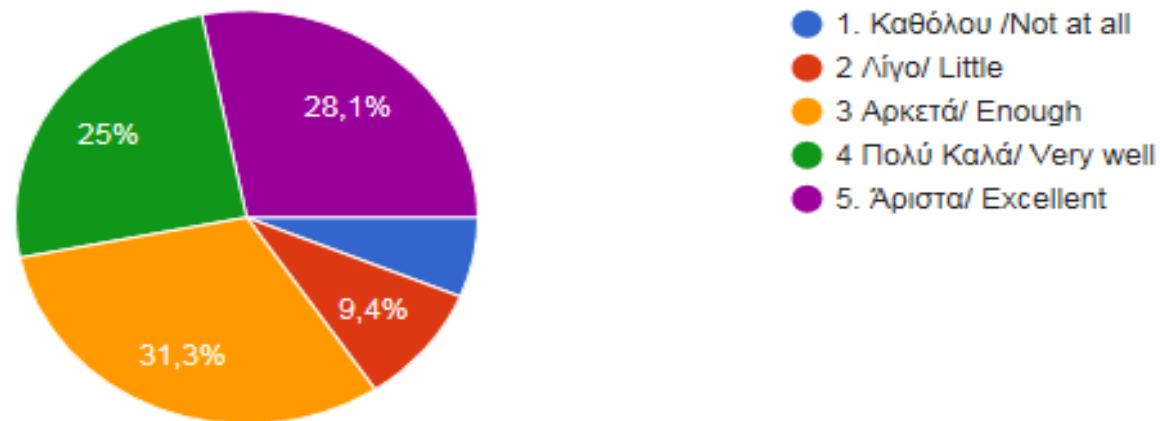
“I Understand how to move the starting point of the polygon.” 81,5% answers were from Enough to Excellent.

Κατάλαβα πως μπορώ να ξεκινήσω από διαφορετικό σημείο στο χώρο το πολύγωνο./ I understand how to move the starting point of the polygon.



Self Evaluation: “I Understand how to move the direction of the initial side of the polygon.” 84,4% answered from Enough to Excellent.

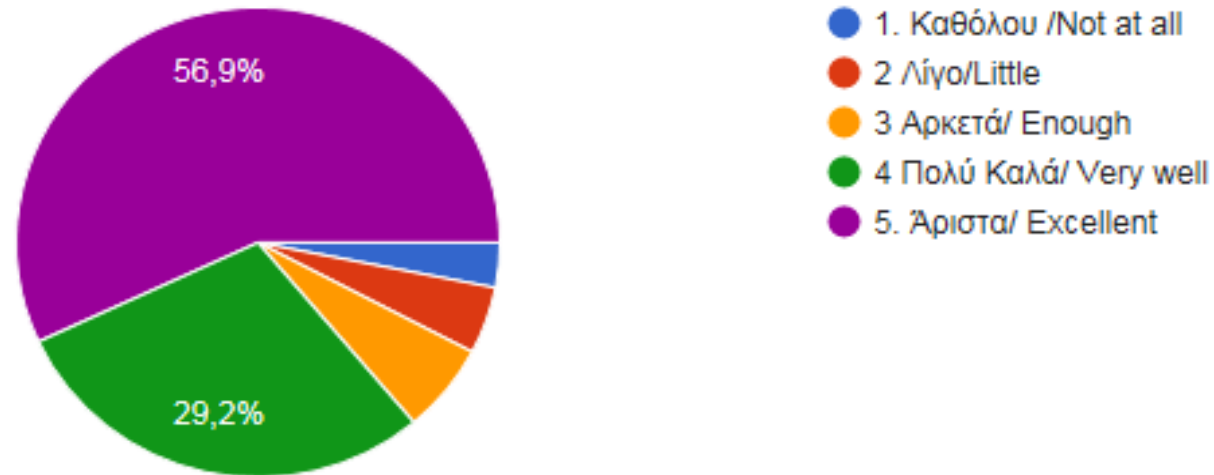
Κατάλαβα πως αλλάζει η κατεύθυνση της αρχικής πλευράς του πολυγώνου./ I understand how to change the direction of the initial side of the polygon



JS-Eden Evaluation:

“I Understand when I delete something by mistake.” 86,1% answered from Very Well to Excellent

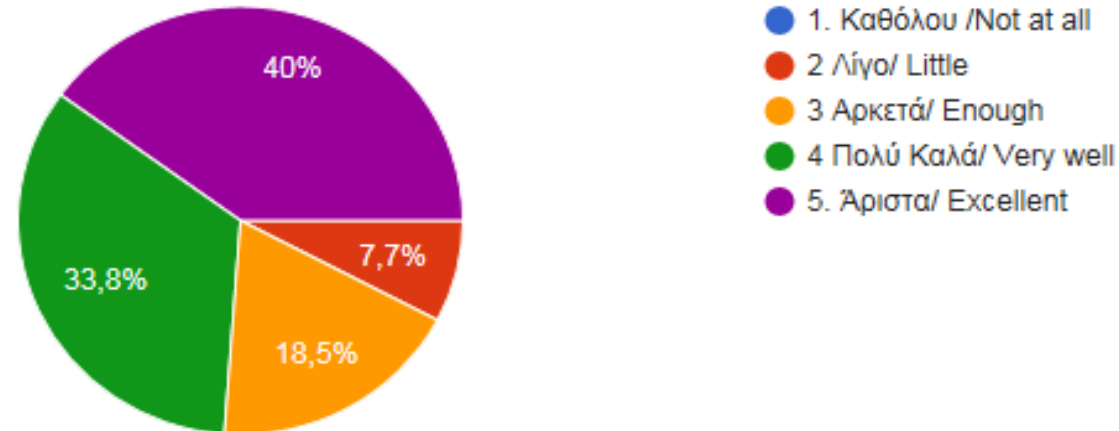
Αν σβήσω κατά λάθος κάτι καταλαβαίνω ότι έσβησα κάτι που δεν έπρεπε/
When by mistake I delete something I understand that I shouldn't have deleted that



JS-Eden Evaluation:

“I’m able to correct the code that I deleted by mistake.” 73,3% answered from Very Well to Excellent.

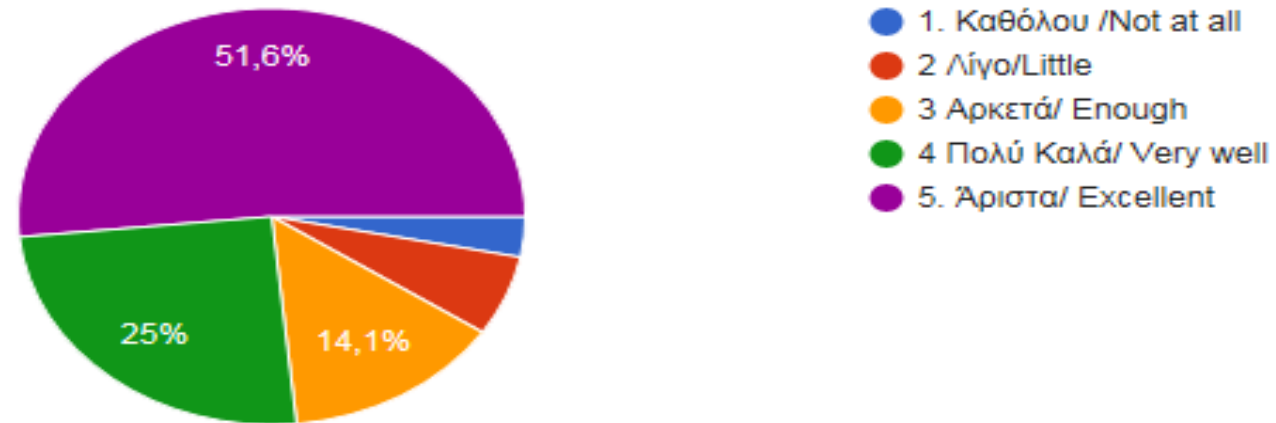
Αν σβήσω κατά λάθος κάτι μπορώ να κάποιες φορές να το ξανασυμπληρώσω σωστά σε εκείνο το σημείο./ If by mistake I delete something sometimes I can retype it correctly at the right place.



JS-Eden Evaluation:

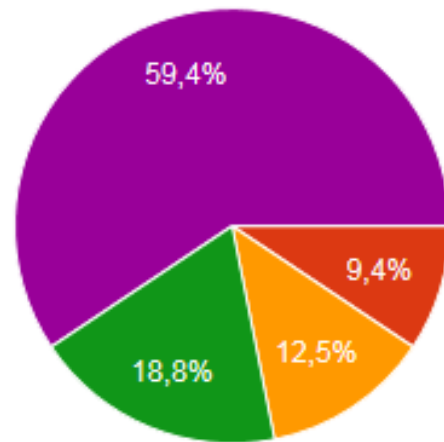
“I liked this Environment” 76,6% answered from Very Well to Excellent

Το περιβάλλον αυτό μου άρεσε/I liked this environment



JS-Eden Evaluation: The statement that it was fun changing things on JS-eden environment Polygon Construal expressed the opinion of the 78% of the sample from very well to Excellent

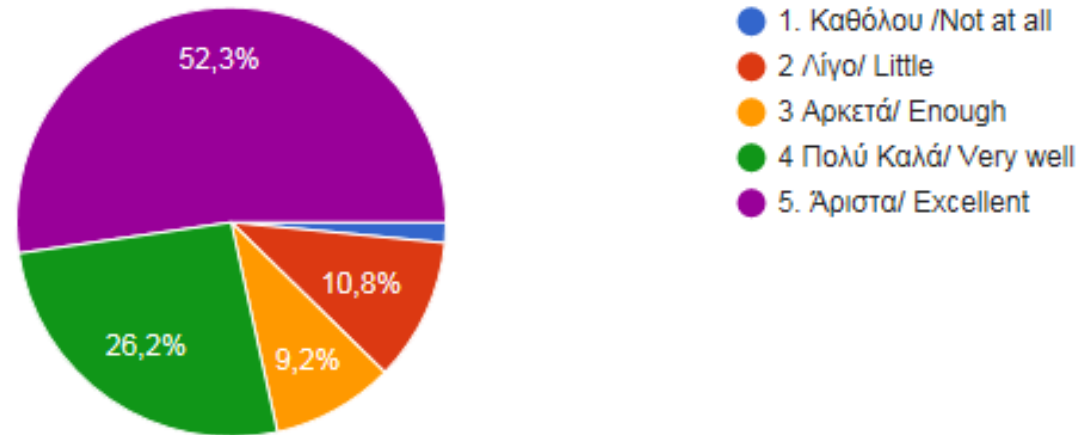
Το βρήκα διασκεδαστικό να αλλάζω πράγματα σε αυτή τη σελίδα/ It was fun to change things on that page.



- 1. Καθόλου /Not at all
- 2. Λίγο/ Little
- 3. Αρκετά/ Enough
- 4. Πολύ Καλά/ Very well
- 5. Άριστα/ Excellent

JS-Eden Evaluation: The statement that it was interesting to see coding on JS-eden environment Polygon Construal expressed the opinion of the 78, 5% of the sample from very well to Excellent.

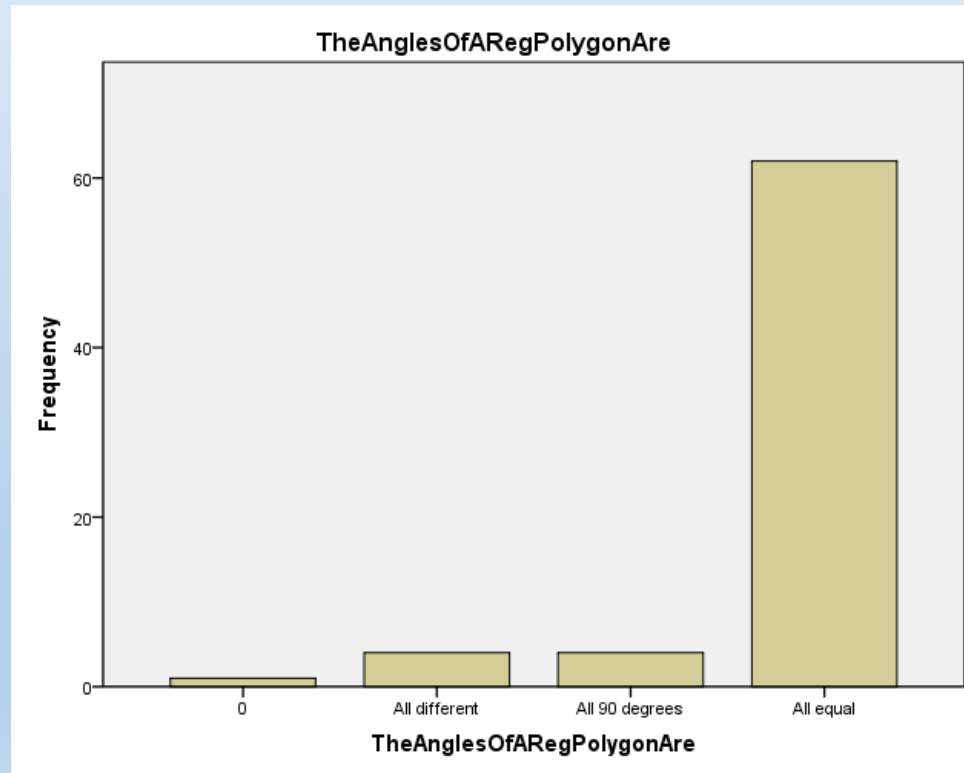
Ήταν ενδιαφέρον να μάθω τι πως είναι ο κώδικας πίσω από τα κουμπάκια του Scratch./It was something interesting to findout what is behind the tiles of Scratch.



Learning Outcome Evaluation: Multiple Choice Test

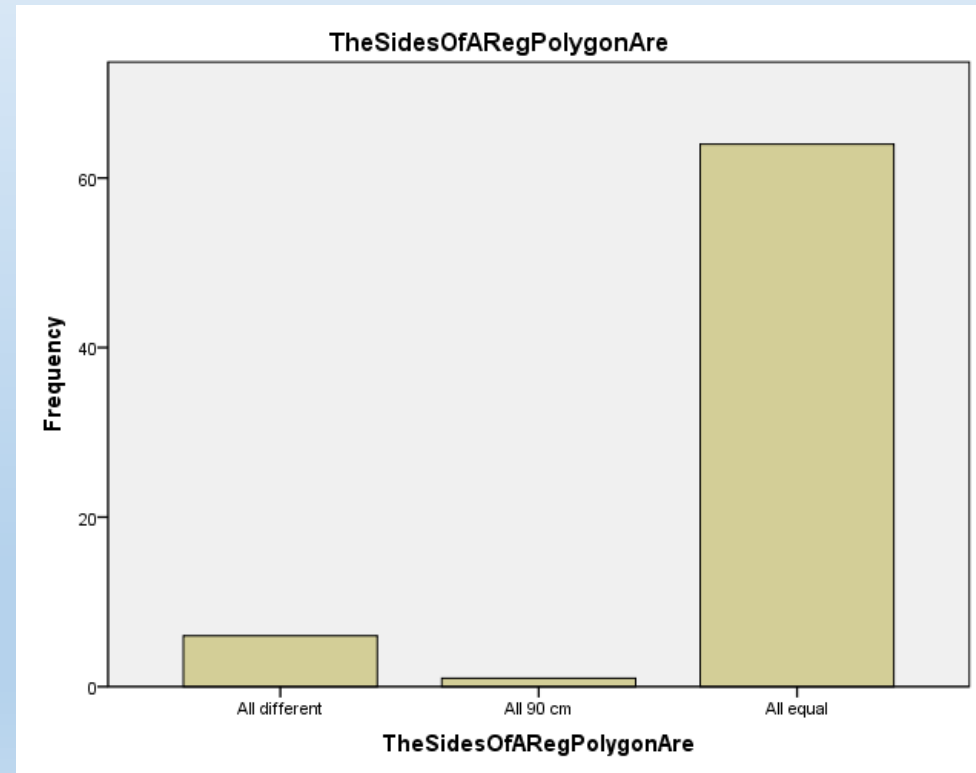
The angles of a regular polygon are:

87,3% All angles of Reg Polygon are Equal



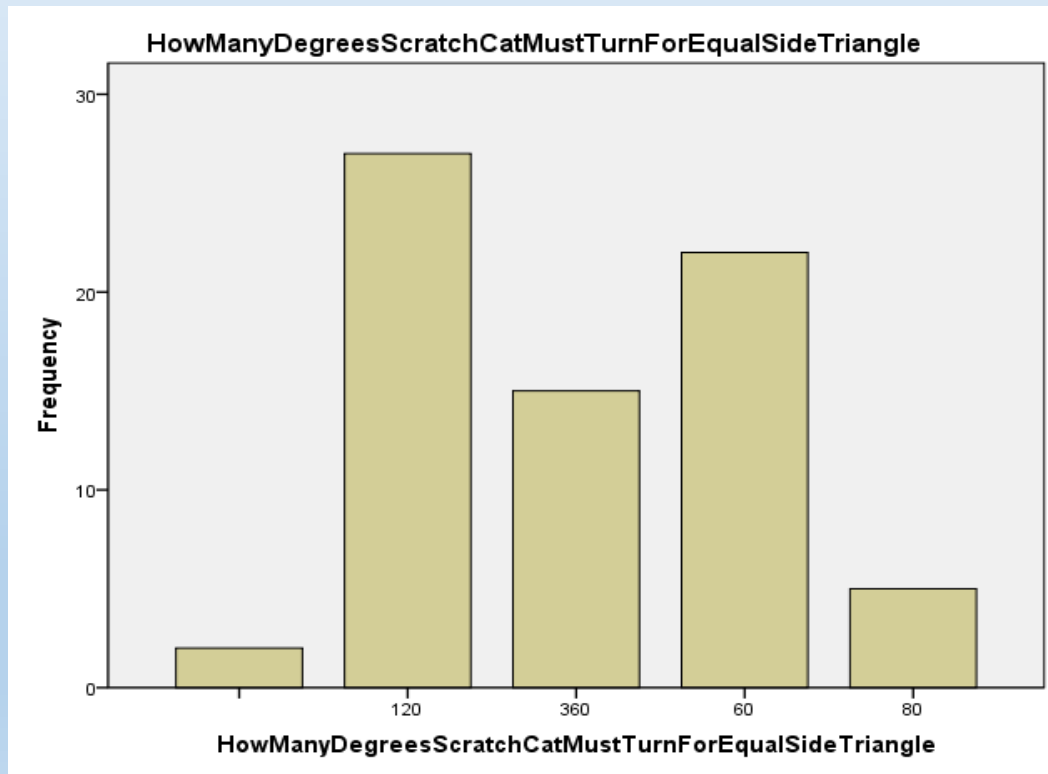
The sides of a regular polygon are:

90,1% All sides of Reg Polygon are Equal



Teaching needs depth of time

3 Classes Sample



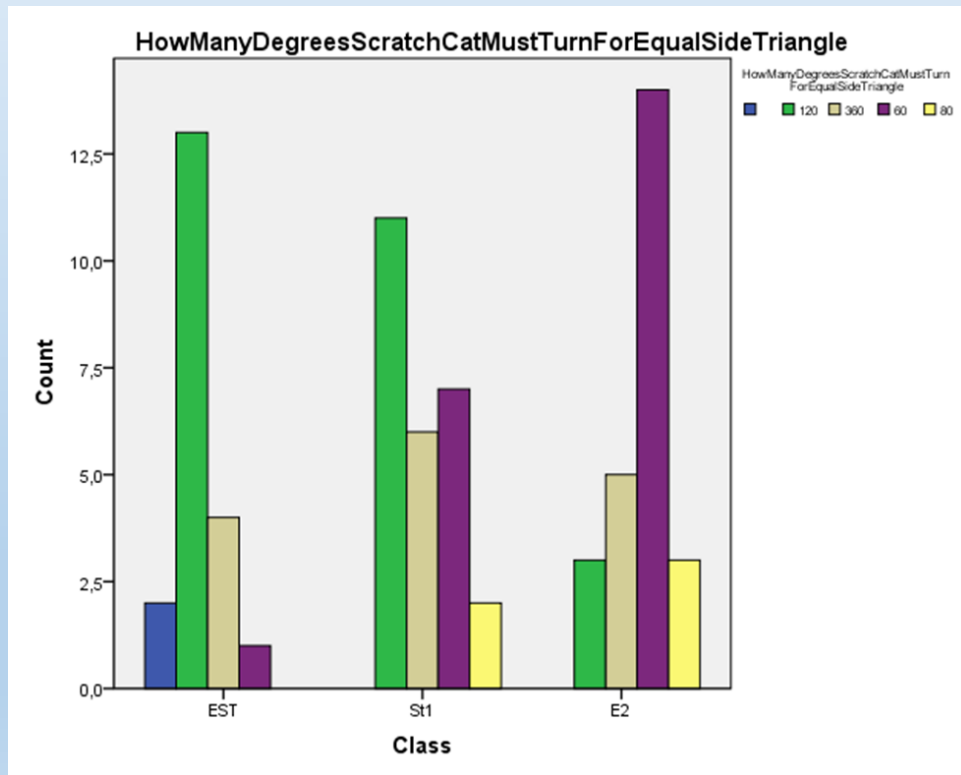
How many degrees the Scratch Sprite must turn in order to draw a Regular Triangle

- 35% answered correctly 120.
- 28% answered 60.
- 20% answered 360...

Looking closely...

Answers/Class

CrossTabs a=0.001

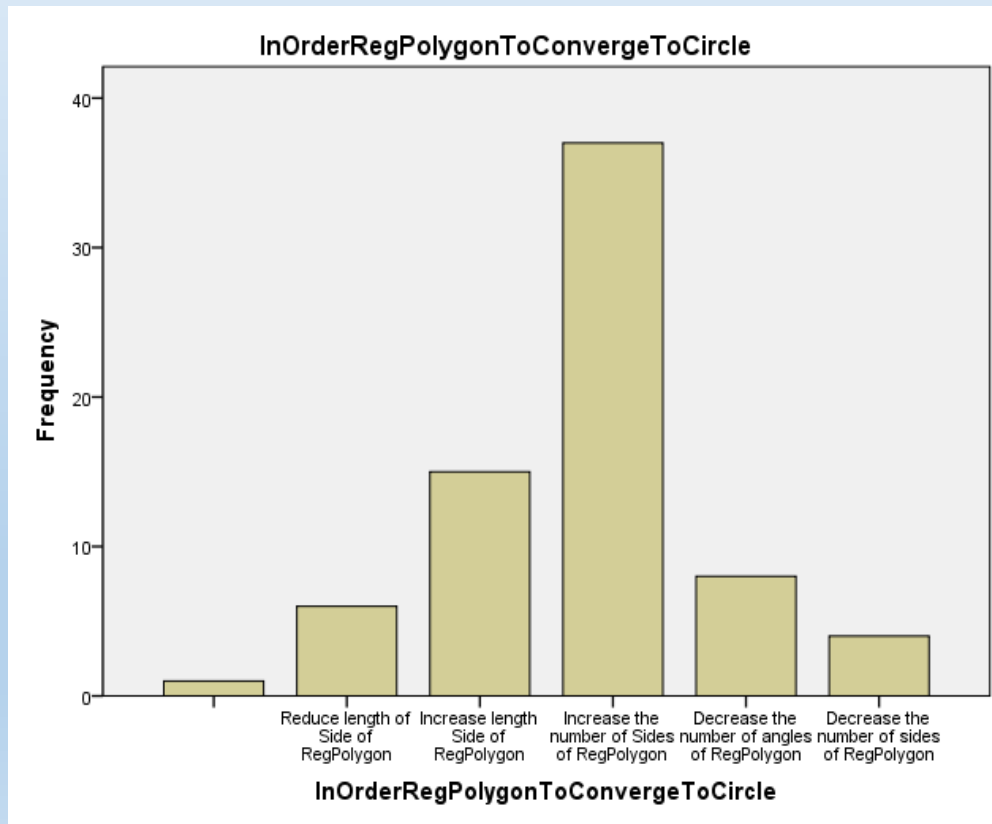


What was different?

- Means of math grades were equal in all three classes.
- 3-45' lessons took place in all three classes.
- Same ICT teacher.
- Same Lesson Plan.
- Duration of project:
 - EST: One month.
 - E2: 10 days.
 - St1: 10 days

Teaching needs depth of time...

All Sample



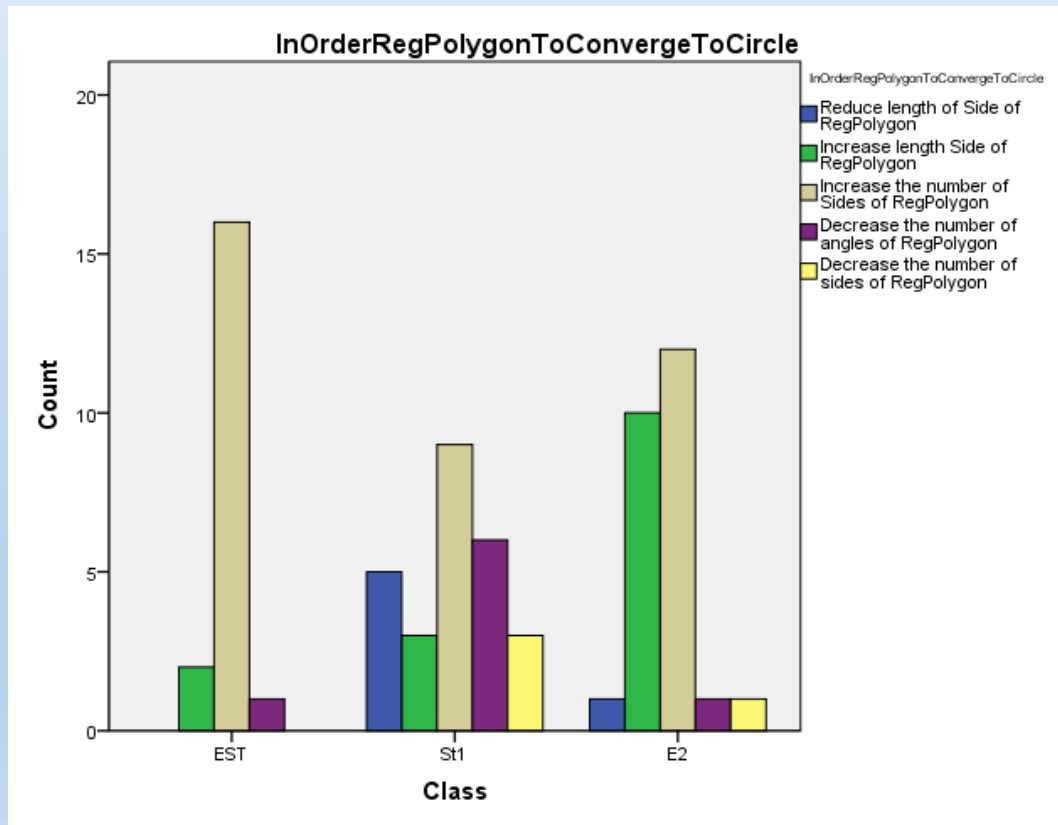
In order a polygon to converge to a circle:

- 50% Increase the number of sides
- 21% Increase the length of the sides
- 13% Decrease the number of angles

Looking closely..

Answers/Class

CrossTabs a=0.002



What was different?

- Means of math grades were equal in all three classes.
- 3-45' lessons took place in all three classes.
- Same ICT teacher.
- Same Lesson Plan.
- Duration of project:
 - EST: One month.
 - E2: 10 days.
 - St1: 10 days

Conclusions



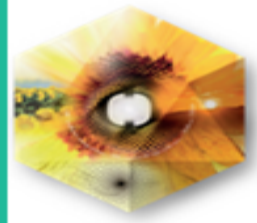
- Pupils are usually confused on the degrees of interior angle of the Regular Polygon and degrees that the Scratch Sprite has to turn (supplementary).
- Pupils could spot what was deleted from the construal.
- Sometimes they could actually correct it-retype it.
- Pupils of 6th grade point the fact that in order the center for the Regular Polygon to be defined, the number of degrees should not be under 360.
- Few pupils observed the fact that the center could still be defined on the canvas if the degrees were above 360 depending on the number of angles of the polygon (if they were divisor of the degrees)
- In some cases they actually moved the Regular Polygon around the canvas not by changing the starting point but by changing the type of the calculation of the center as they had unlimited permission to change whatever they liked..
- Research is to be continued.

Acknowledgement

I would like to express my thanks to Prof. Steve Russ, Nicolas Pope, Elisabeth Hudnott and all the members of Construit! Team who worked and help this research to be implemented. Last but not least, I would like to thank prof. Meurig Beynon who introduced me to Empirical Modeling and who implemented the Regular Polygon Construal for this project.

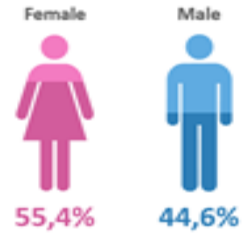
REGULAR POLYGONS CONSTRUAL

FROM SCRATCH TO CODING WITH JS-EDEN

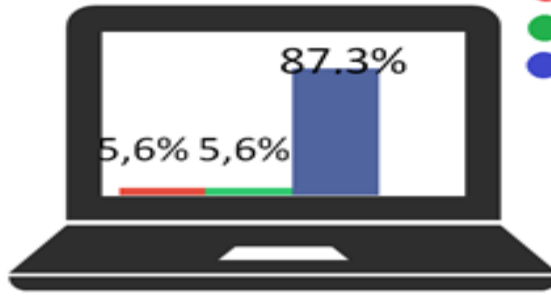


Test on Regular Polygons Construal

3 Classes 5th & 6th grade

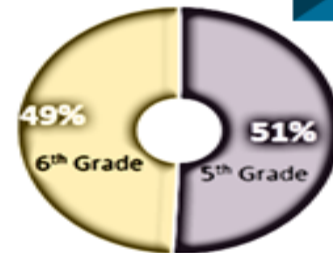
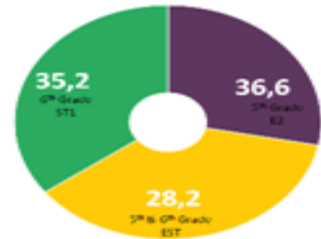
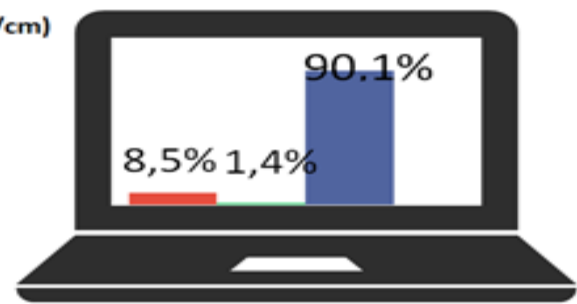


Angles are:



- All Different
- All 90 (degrees/cm)
- All Equal

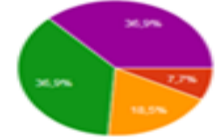
Sides are:



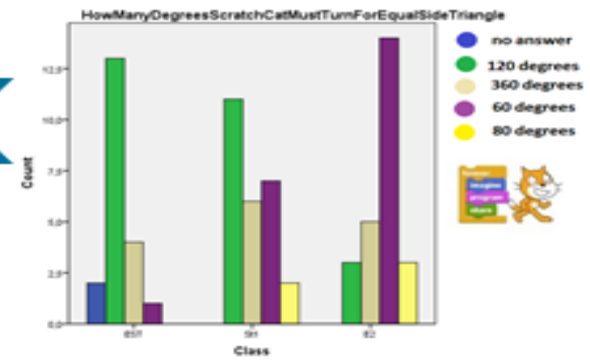
JS-Eden Evaluation: 78% Interesting & fun!

Self-Evaluation on Regular Polygons Construal

I understand how to change the number of angles



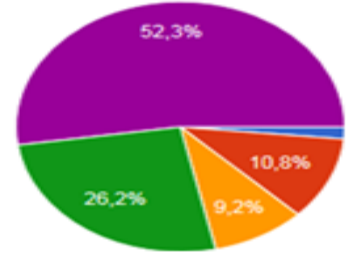
- Excellent
- Very Well
- Enough
- Little
- Not at all



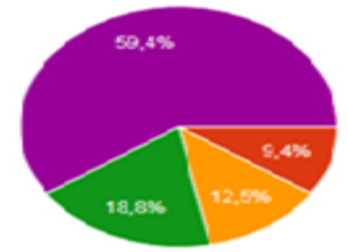
From **Very Well** to **Excellent**

It was interesting to change things on that page

It was fun to change things on that page



- Excellent
- Very Well
- Enough
- Little
- Not at all



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- https://ralleiapliroforiki.blogspot.gr/2017/05/blog-post_17.html
- <http://jseden.dcs.warwick.ac.uk/construit/?load=210>

