

## NeoTrieVR: new teaching tool for geometry lessons

### Lesson 1: Polygons (11 years old)

**Date:** Tuesday, 13. 03. 2018 r.

**Number of pupils:** 24

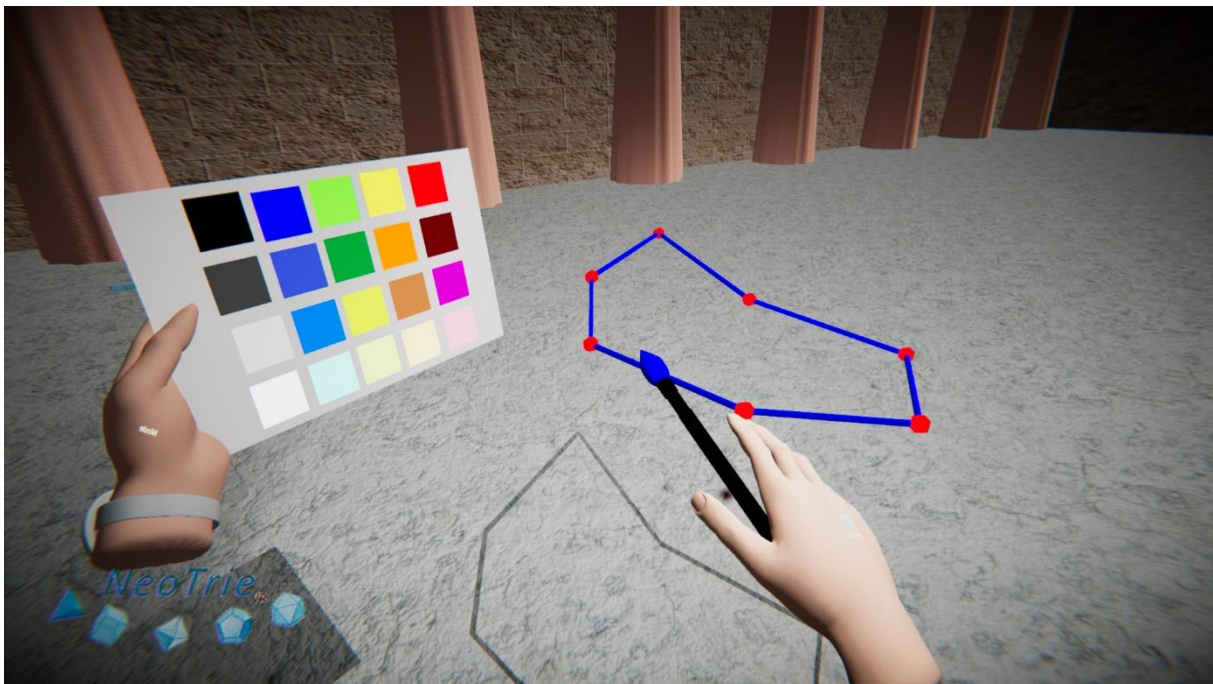
**Age of pupils:** 11 years old

**Activities in Neotrie VR:**

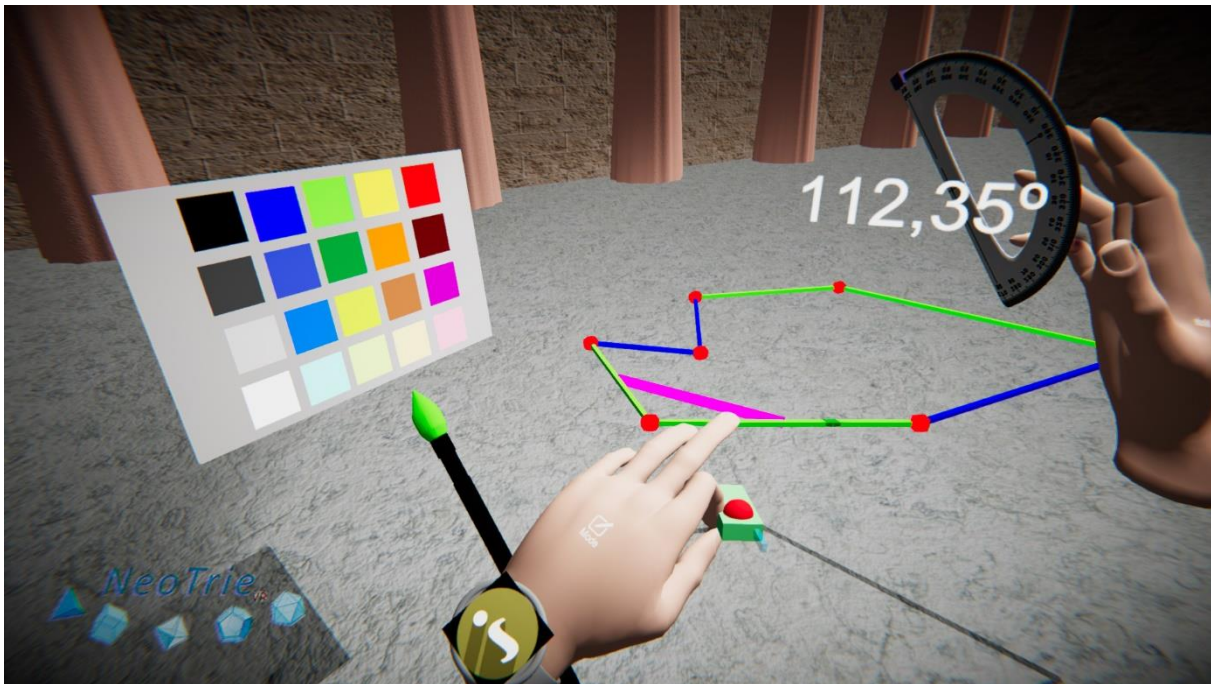
**Tools available:** brush, protractor



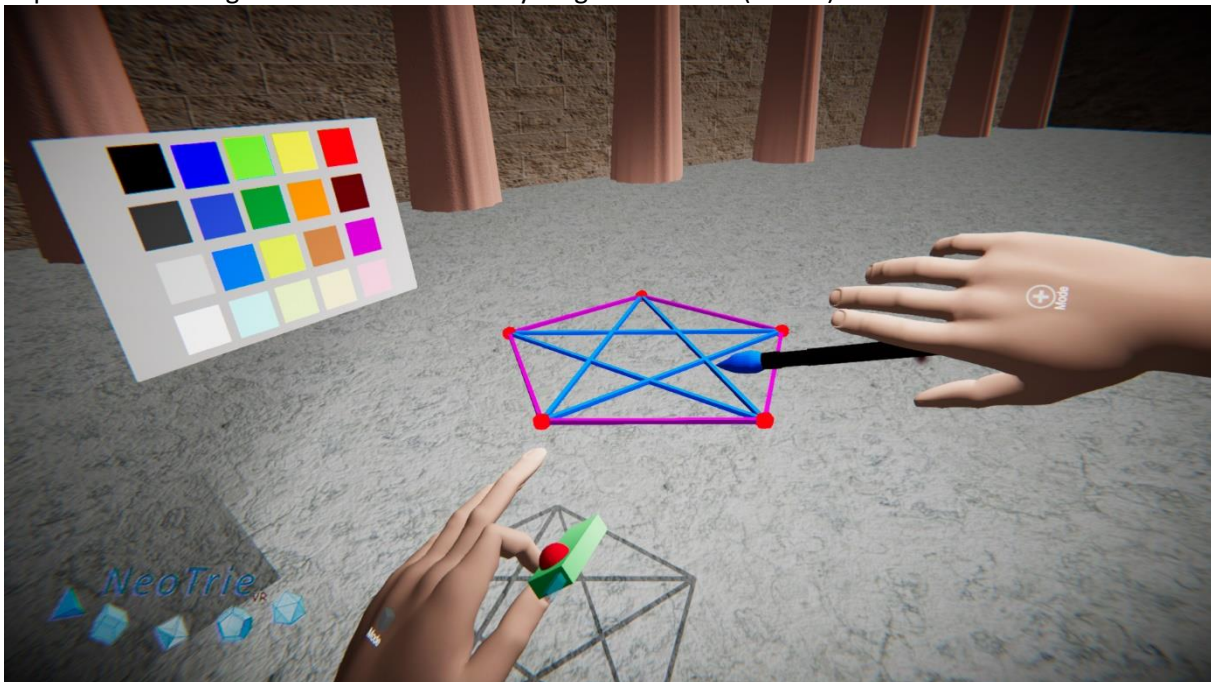
1. Draw a closed polygonal chain consisting of 7 segments and paint them blue, name their vertices: A, B, C, D, E, F, G, edges: AB, BC, CD, DE, EF, FG, GA and angles: ABC, BCD, CDE, DEF, EFG, FGA, GAB. Name the polygon (pupils draw in their notebooks, the teacher draws with the use of Neotrie) (time 15').



2. Draw a polygon with at least 2 obtuse angles. Paint the sides in green. How many sides, angles and edges has it? Name the polygon (time 8')

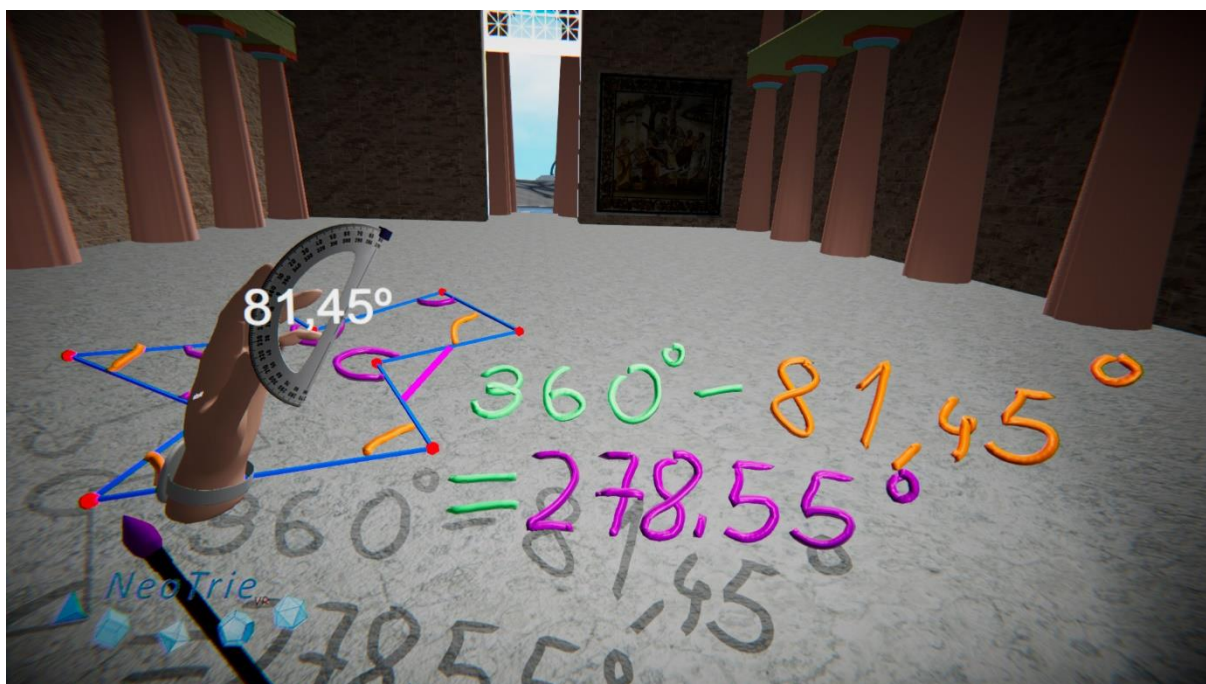


3. Create a pentagon and plot its diagonals. Use the SRS to instantiate the pentagon. Paint the sides in pink and the diagonals in blue. How many diagonals has it? (time 8')



4. Draw any polygon and indicate the acute and obtuse angles. Use the free drawing and paint them in purple (bigger than  $180^\circ$ ) and orange (smaller than  $180^\circ$ ). Check the angles by measuring them with a protractor. You can edit the vertices to change the angles if you like (time 10').

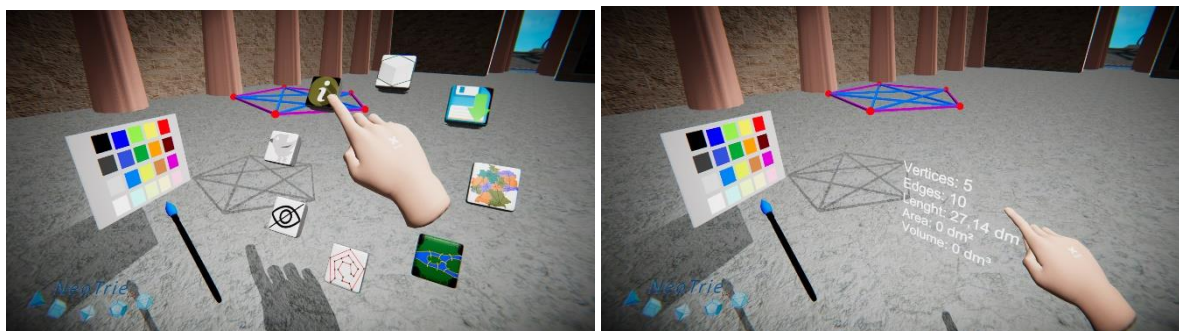




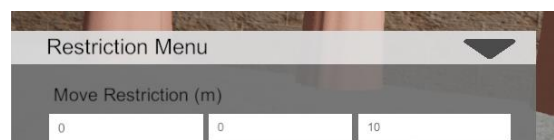
The protractor gives always an angle  $< 180^\circ$ , so for angles bigger than  $180^\circ$  one has to make the difference to  $360^\circ$ .

**Advantage:** The teacher does not have to use the board, the pupils are concentrated and interested a lot. They are very happy to perform the tasks. Earlier, however, you have to divide the class into small groups so that everyone knows when it will be his turn.

**When you press the Menu button you can use:** Figure info and get the list of some figure properties, like number of vertices, edges and length of all edges!



**Grid:** Segments drawn in 3-space don't need to be flat. If teachers are interested in flat polygons, one can fix a "blackboard" as follows: In the Restriction Menu accessible in the screen of the computer, fix:  $Z=10$ . This forces points to be at the plane  $Z=0$  (as the grid is of 10 meters in Z-axis). You can chose other planes.



## Lesson 3: Prisms (14 years old)

**Date:** Friday, 16. 03. 2018 r.

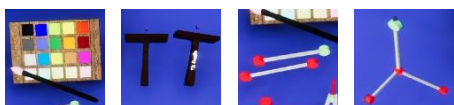
**Number of pupils:** 18

**Age of pupils:** 14 years old

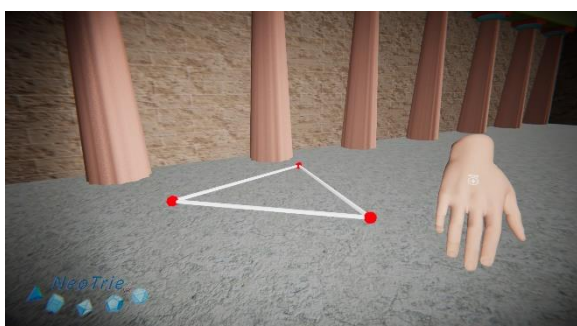
**Activities in Neotrie VR:**


Division of the class into 3 groups performing the NeoTrie activities one by one.

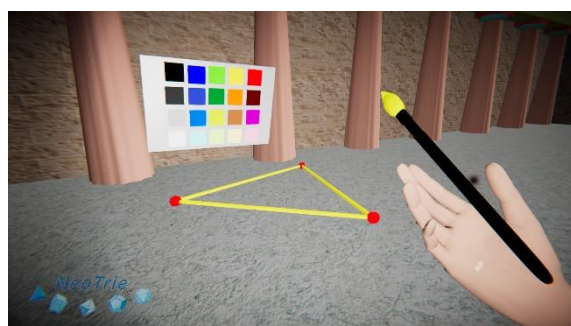
**Tools:** brush, copy seal, perpendicular and parallel tools



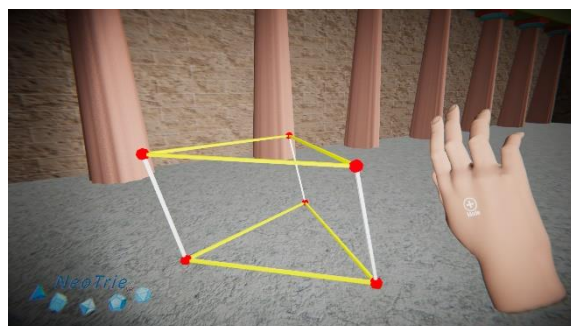
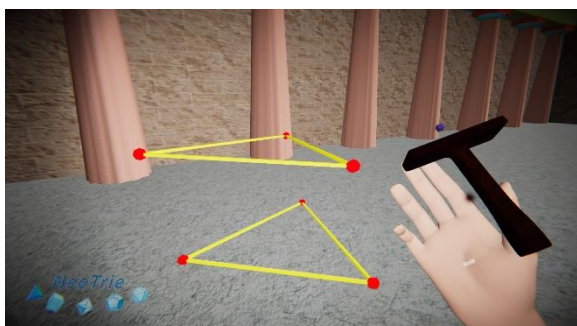
1. Draw a triangle, copy it and try build prism (go to activity 5 if you like to build perfect prisms). What do you have to do? How can you name this prism? How many faces does your triangular prism have? How many of these faces are formed by a rectangular? Paint one of the faces. How many other faces are parallel to it? How many edges does your prism have? Paint an edge. How many other edges are parallel to it? How many vertices does your triangular prism have? Paint the faces, enlarge it and go inside, write its name. (1 group)





Use  to create a triangle.

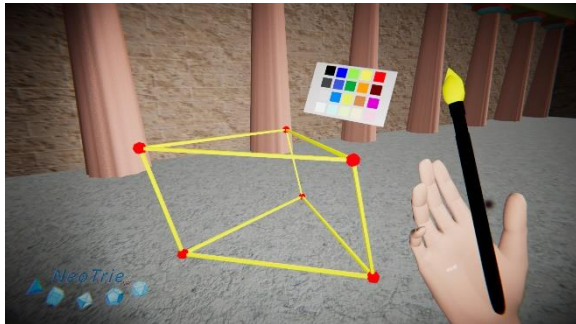


Paint them in yellow.

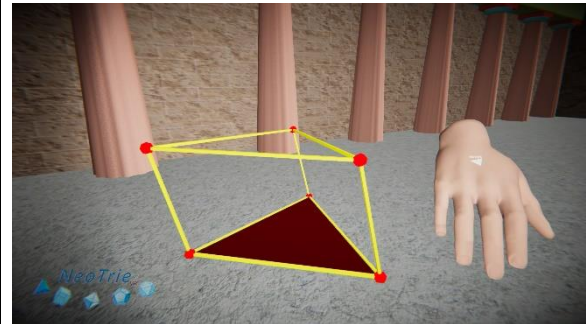


Use the copy seal  to make an exact copy of the triangle.

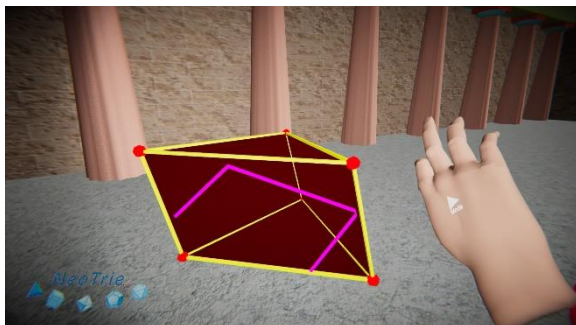
Move the new triangle with  if necessary, to put it over the first triangle. And add the rest of the edges.



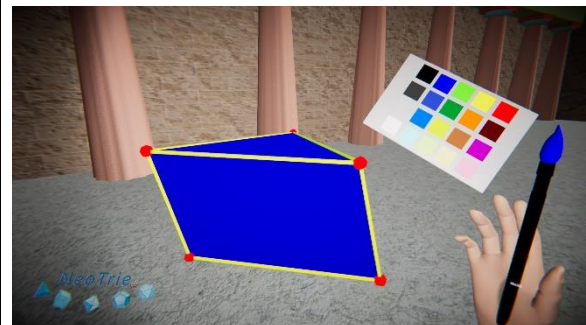
Paint all the edges in yellow. There are 9 edges.



Make the faces with . Start with the first triangle.



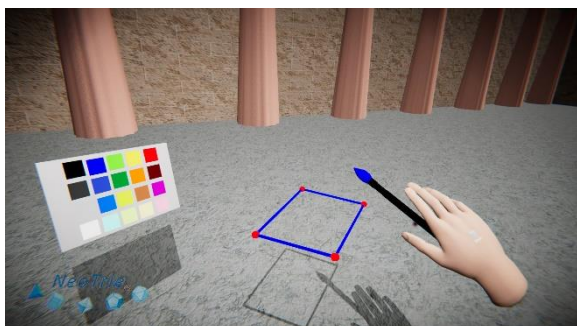
Make all the faces with .




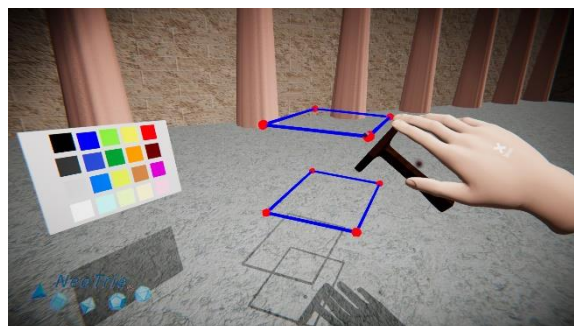
Paint the faces with blue..


2. Draw a rectangular prism ABCDEFGH and colour the edges in blue and the faces in green (or black). Describe it. How many vertices does your prism have? How many faces does your prism have? How many edges does your prism have? (2 group)

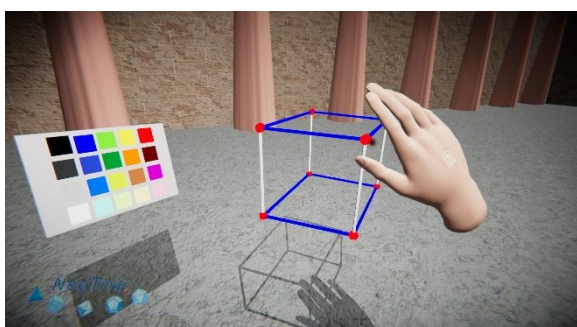





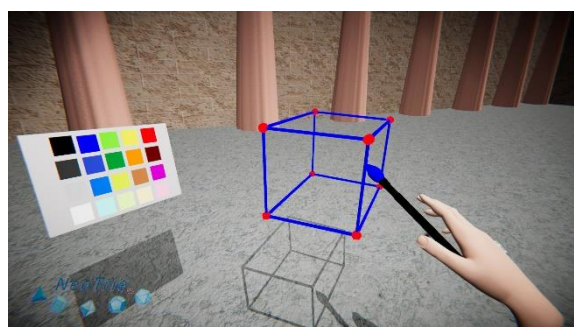
Use  to create a rectangle. Paint them in blue.



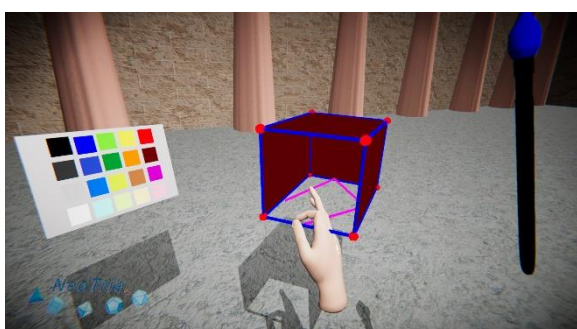
Use the copy seal  to make an exact copy of the rectangle.




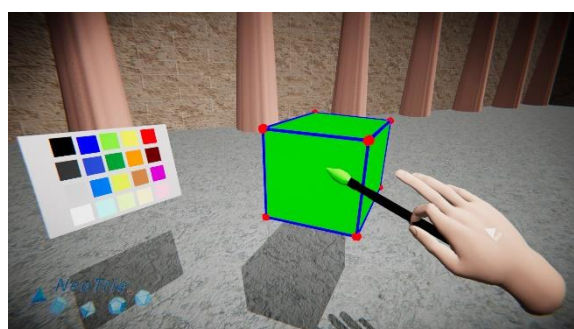
Move the new rectangle with  if necessary, to put it over the first rectangle. And add the rest of the edges.



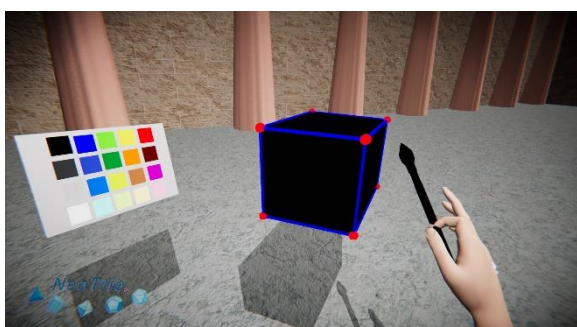
Paint all the edges in blue. There are 12 edges.



Make the faces with .



Paint the faces with green.

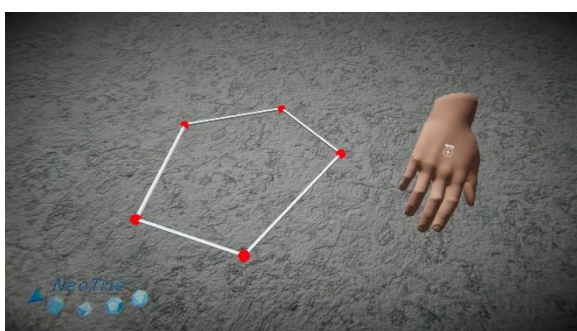



or black...

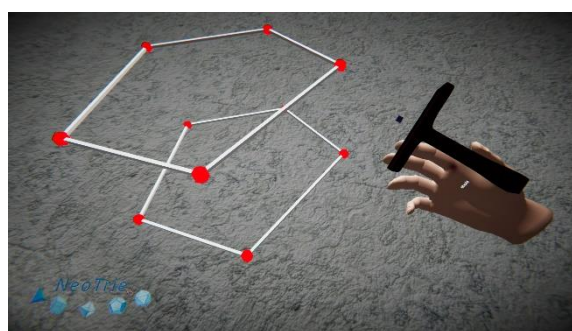



Active the info button from the menu to show number of vertices and edges.

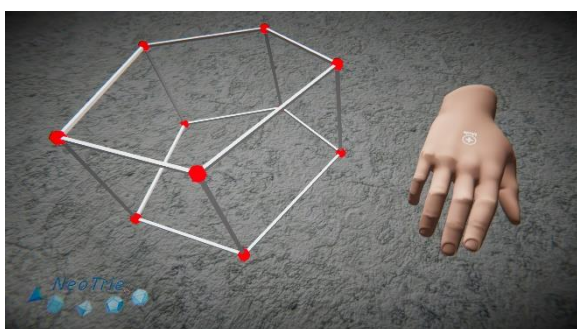
3. Draw a pentagonal prism. How do you think, which segment is height of this prism? (3 group)




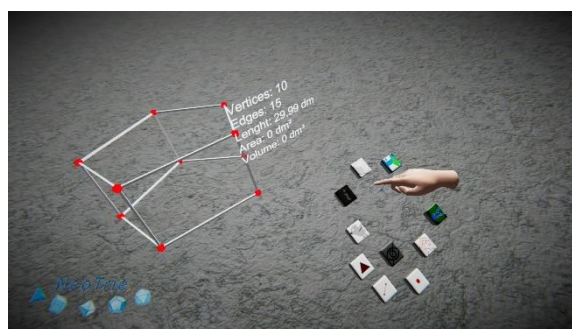
Use  to create a pentagon.



Use the copy seal  to make an exact copy of the pentagon.



Move the new pentagon with  if necessary, to put it over the first pentagon. And add the rest of the edges.

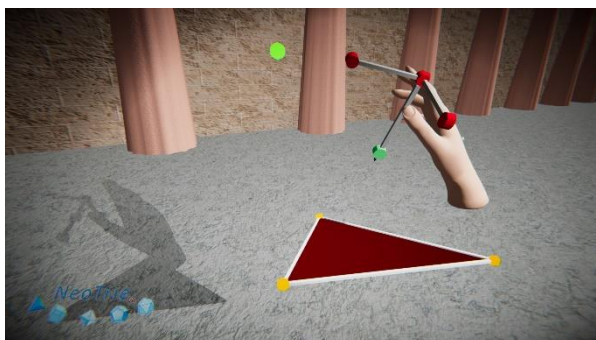


Active the info button  from the menu to show number of vertices and edges.

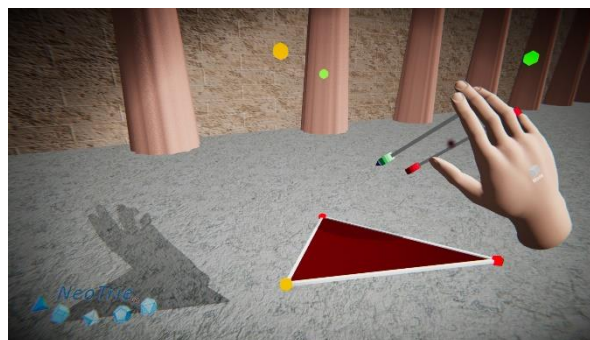
4. Draw a prism and describe it. Try to name it. (3 group)

5. Extra activity: Use the perpendicular and parallel tools to build a perfect and dynamical triangular prism.

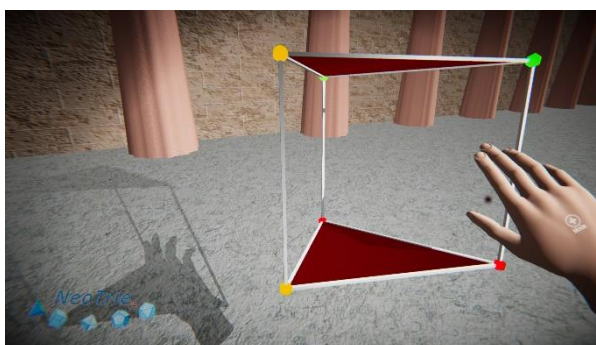




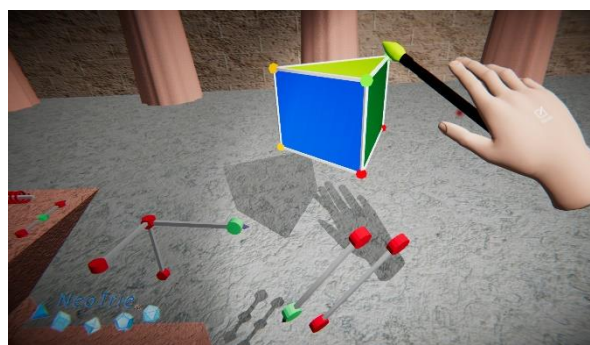
Step 1: Draw any triangle ABC, and then use the perpendicular tool, touching the vertices A, B, C to find a point D, such that BD is perpendicular to BA and BC.



Step 2: Use the parallel tool to find parallels to segment BD



Step 3: joint the vertices and add the faces



Step 4: You can play with it, paint it, make it bigger, measure angles, distances, etc.

**Advantage:** Many pupils at this stage of education have a problem with space imagination. That's why spatial geometry is difficult for them. NeoTrie allows them to create, construct and interact with 3D geometrical object. Pupils can touch faces, vertices and edges. They can paint, enlarge and even go to inside solids. Class division into groups allows for cooperation and mutual help and allow all children to participate in the lesson. All activities are carried out by the pupils themselves. The children are active and they formulate conclusions.

**Optional restriction on grid:** One can fix a grid in the restriction menu:  $X=0,1$ ,  $Y=0,1$ ,  $Z=0,1$ . This forces coordinates of points to be separated by 10cm in every axis. Hence, can draw perfect prisms.

**Complementary activity:** At the beginning of the lesson each pupil creates a given prism with 3D polyfelt (you can use straws or models of prism), describes it and names it. Then they complete the table:



Names of prism	Number of vertices	Number of edges	Number of faces	$V - E + F$
Triangular prism				
Square prism				
Pentagonal prism				
Hexagonal prism				
Octagonal prism				
Decagonal prism				

The pupils find a relation between vertices, faces and edges.

$$V - E + F = 2$$

The Teacher talks briefly about Leonhard Euler and his discovery.

## Lesson 8: Pyramids (12 years old)

**Date:** Monday, 24. 04. 2018 r.

**Number of pupils:** 21

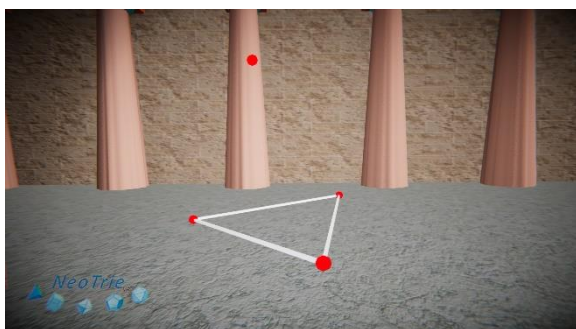
**Age of pupils:** 12 years old


**Tools:** brush

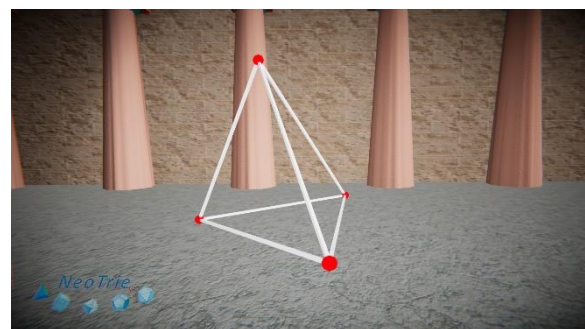



### Activities in Neotrie VR:

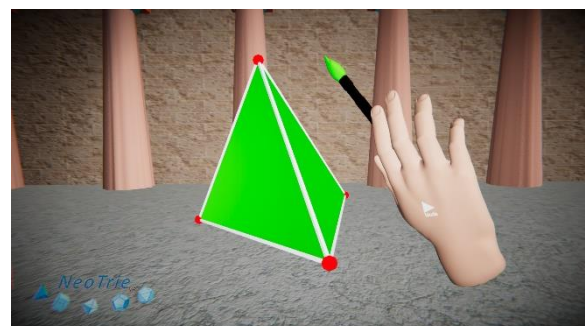
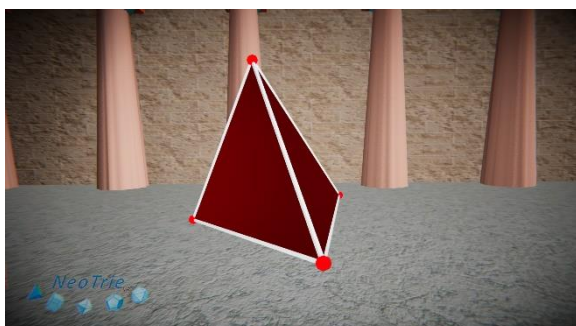
1. Create a pyramid with the smallest number of vertices. How many vertices do you have to use? How can you name this pyramid? How many faces does your triangular pyramid have? What polygons are the side faces and its base? How many edges does your pyramid have? Paint the faces, enlarge it and go inside, write its name.



Use  to create a pyramid with the smallest number of vertices.



Use  to add the rest of edges.



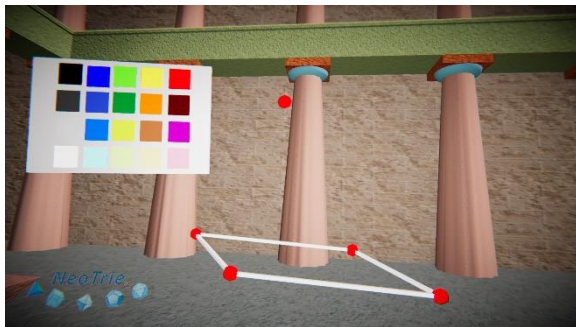



Make the faces with

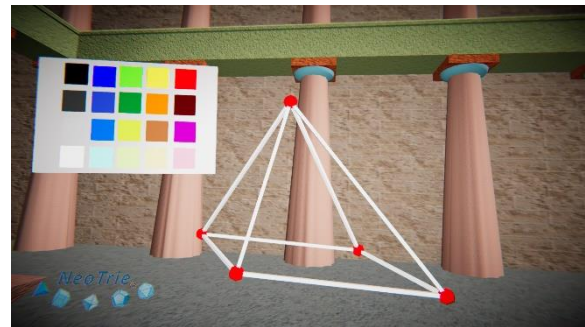



Paint all faces in green.

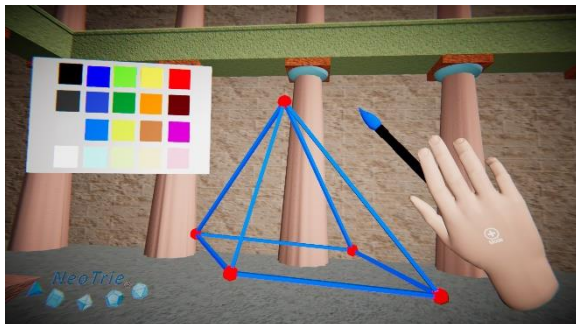
2. Create a pyramid consisting of 5 vertices and colour the faces in pink, the edges in blue. Describe it. How many faces does your pyramid have? How many edges does it have? Enlarge it and go inside, write its name.



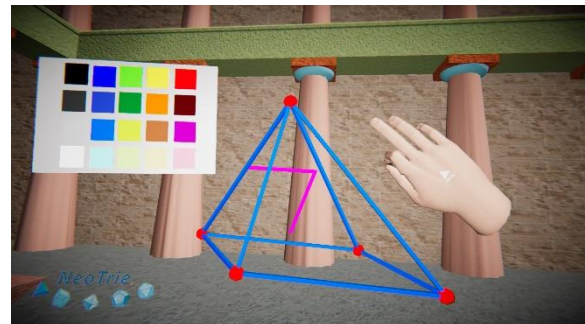
Use  to create a pyramid consisting of 5 vertices.



Use  to add the rest of edges.

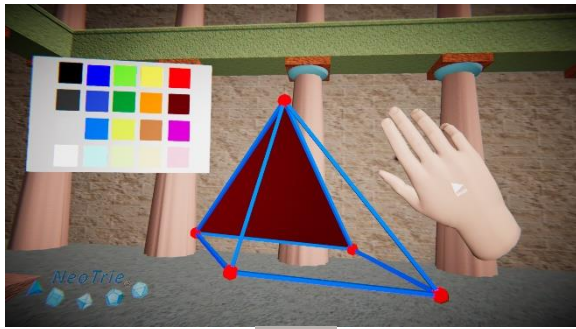


Paint all edges in blue.

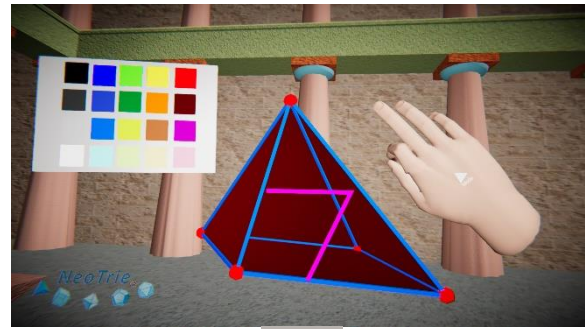


Make the faces with

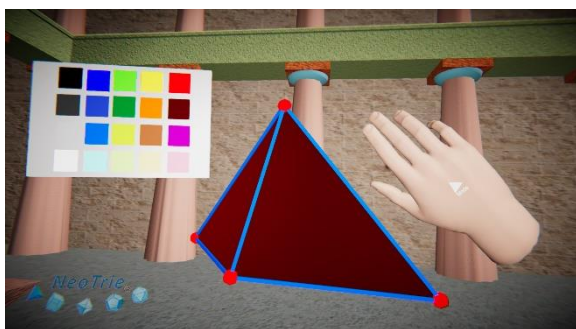




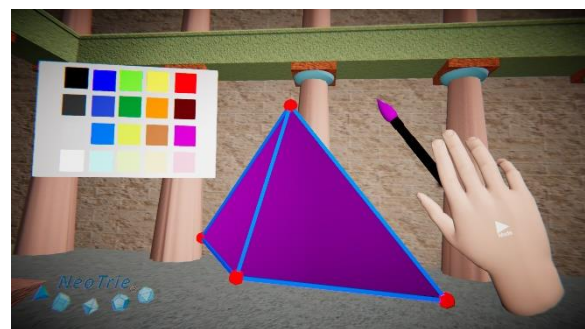
Make the faces with



Make the faces with



Make the faces with



Paint all faces in pink.

3. Create a pentagonal pyramid. Describe it. How many faces does your pyramid have? How many edges does it have? How do you think, which segment is the height of this pyramid? What do you have to do?

4. Create a pyramid and describe it. Try to name it. Take a photo of all the pyramids!

**Advantage:** NeoTrie allows the pupils to create, construct and interact with 3D geometrical object. Pupils can touch faces, vertices and edges. They can paint, enlarge and even go to inside solids. They can take a photo their solids.

**Hint:** At the beginning of the lesson each pupil creates pyramids with 3D polyfelts (you can use straws or models of pyramids), describes it and names it.



## Web References

Scientix page: <http://www.scientix.eu/projects/project-detail?articleId=689498>

Official page of NeoTrie VR: <http://virtualdor.com/es/NeoTrie-VR/>

Video tutorials: First steps in NeoTrie

VR <https://www.youtube.com/channel/UCdLPDDusXOjAa16odHRkTsw/playlists>

The project on Facebook: <https://www.facebook.com/neotrie/>

Tags: [mathematics](#), [Neotrie](#), [virtual reality](#), [VR](#)