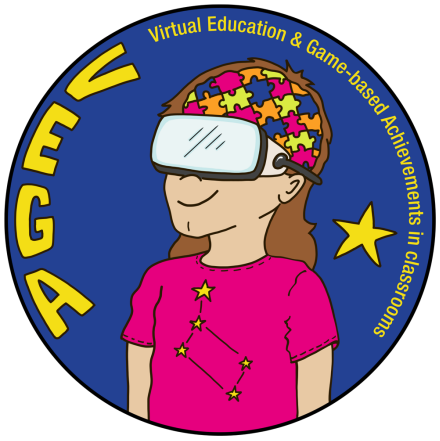
Erasmus+



Coordinate Plane – VEGA Teaching Scenario

Topic: The topic of the following course will be the Cartesian coordinate system. The Cartesian coordinate system is defined as a coordinate system drawing location points on a plane using two numbers, the x and y-coordinates. The Cartesian coordinate system is often cited as the foundation to solving geometric problems using algebra as well as providing visual prompts to conceptualizing algebraic relationships that are often quite abstract. By combining a topic that is usually considered quite challenging for young students with programming, the theoretical material is more digestible and teaches wider skills that are essential for learners in the 21st century. These skills include digital competence, critical thinking as applied to varied scenarios, problem solving, resilience, processing, and creativity. Students also practice applying the theoretical principles in a practical manner in real-life scenarios.

Subjects: Maths, English

Age / Grade: 11-12 years old (6th-year Primary School)

Short description of the Interactive Game in this scenario:

Scratch is a free-to-use graphical programming platform that has been designed to facilitate and develop technological readiness and competence. It was developed to provide ”tinkerability” for child programmers to construct, deconstruct and reconstruct coding building blocks and do so in the scope of their imagination. The blocks can be taken apart and reassembled as users logically strive to script their desired effects and movements. Furthermore, Scratch’s interface has been designed in a way to appeal to younger audiences, making it appropriate for users of all ages. In regards to Maths, from the onset, students using Scratch are engaging and exploring mathematical concepts, starting with the cartesian coordinates to direct their sprites across the screen.

(Source: https://www.thinglink.com/scene/467173600525287424)

Introduction to the scenario:

This course aims to introduce students to the foundations of cartesian coordinates on both a theoretical and game-based practice approach. This includes understanding the x and y-axis, how points are written in the (x, y) format, and oriented across the axes. By approaching these often challenging concepts through gameplay, students will be better equipped to engage with the ideas presented in their math course and less likely to feel intimidated by abstract problems and complicated rules.

Learning outcomes:

The students will:

- become familiar with the x and y-axis and learn how to write points in the (x, y) format
- use a range of mathematical strategies to orient across the axes
- explain how a coordinate system represents location and plot points in the first quadrant of a Cartesian coordinate plane
- construct polygons using a variety of tools, given angles and side measurements
- describe their mathematical thinking orally and/or in writing with their peers and during whole-classroom discussions

A selection of learning outcomes from the Cypriot Curriculum:

- Appreciation of the value and usefulness of mathematics in all fields of human activity
- Development of students' self-esteem in knowing they are capable of "doing" mathematics and perceiving it as a creative activity

- Development of attitudes, knowledge, and skills, and comprehension of concepts that will facilitate students in using mathematics in their daily life and future work
- Capacity development to solve problems in multiple ways, as well as to think and take decisions creatively and logically
- Cultivation of knowledge as required in contemporary society based on information

Formative assessment

Number of students: 20-25 students (4-5 students per group)

Duration: 5 lessons of 40-45 min each

Prerequisites:

1. Computers/laptops with a strong internet connection to access the web-based platform Scratch (preferably one computer per student or at least one per group)
2. Notebooks and pens/pencils
3. Interactive Whiteboard (if the teacher does not have access to a whiteboard, they may substitute this option by sharing the content on their laptop screen)
4. Plain whiteboard
5. Help Resources for Scratch can be found on the links below to best assist their students during the hands-on activities
6. Resources/Printouts for students as described in Part One and Two below

Before the program begins (preparatory work for teacher):

- Troubleshoot the internet connection before the beginning of the lesson
- Make sure the computers the students will be using are working and have access to the internet
- Review the mathematical theory of the lesson
- Create a Teacher Account on Scratch and add your students (use the resource below for a step-by-step guide): https://www.youtube.com/watch?v=PPHcvbHZtLg
- Print out the login credentials for students to access Scratch
- Study and practice using the Scratch platform (use the resource below for a step-by-step guide): https://youtu.be/mUN4S6wZTP0
- Print Handout for class use (one for each student): https://docs.google.com/document/d/1MQ2AhjvmB_QPkNmdac_UYQXIKd_Bk7hZFAK0tdFVDLU/edit
- Print Worksheet for students (one for each student): https://docs.google.com/document/d/1HVRhzeKnmFct9Fzs-PiivOe2DNFHS4HWZ6q5BTvXs_8/edit
- Print Homework Assignment (one for each student)

The main part of the scenario:

Part One (3 lessons of 40-45 minutes)

Lesson 1-3:

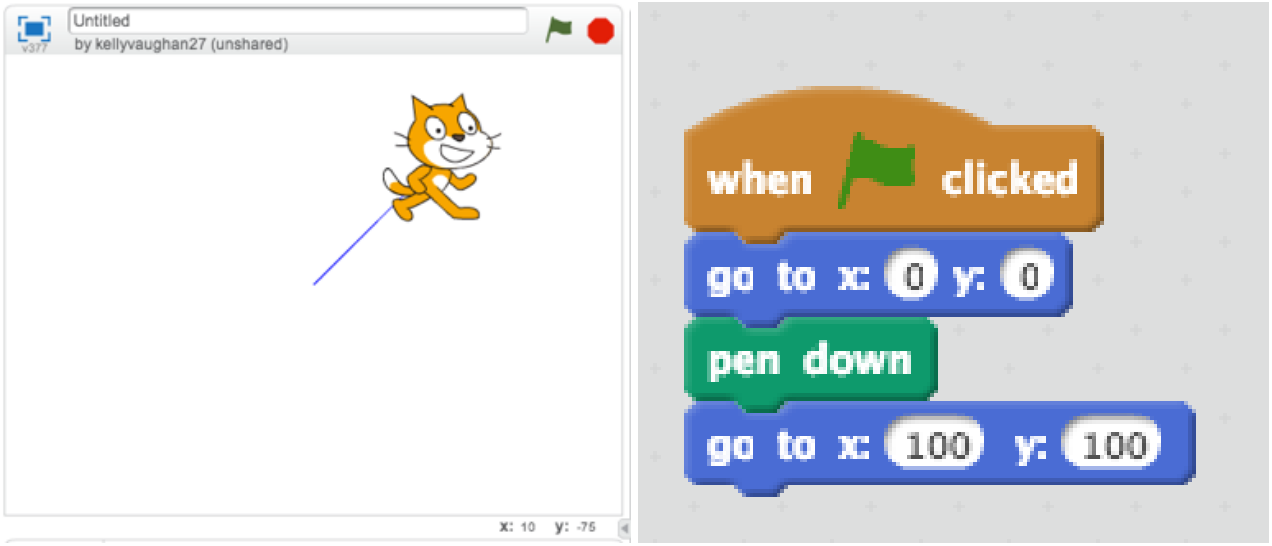
Preparations:

- Troubleshoot the internet connection before the beginning of the lesson
- Make sure the computers the students will be using are in order and have access to the internet
- Print out the login credentials for students to access Scratch
- A display poster displaying the x and y-axis
- Printed cards with x and y-axis for students
- Review the mathematical theory of the lesson
- Create a Teacher Account on Scratch and add your students (use the resource below for a step-by-step guide): https://www.youtube.com/watch?v=PPHcvbHZtLg
- Study and practice using the Scratch platform (use the resource below for a step-by-step guide): https://youtu.be/mUN4S6wZTP0
- Print Handout for class use (one for each student): https://docs.google.com/document/d/1MQ2AhjvmB_QPkNmdac_UYQXlKd_Bk7hZFAK0tdFVDLU/edit
- Print Worksheet for students (one for each student): https://docs.google.com/document/d/1HVRhzeKnmFct9Fzs-PiivOe2DNFHS4HWZ6q5BTvXs_8/edit
- Print Homework Assignment (one for each student)

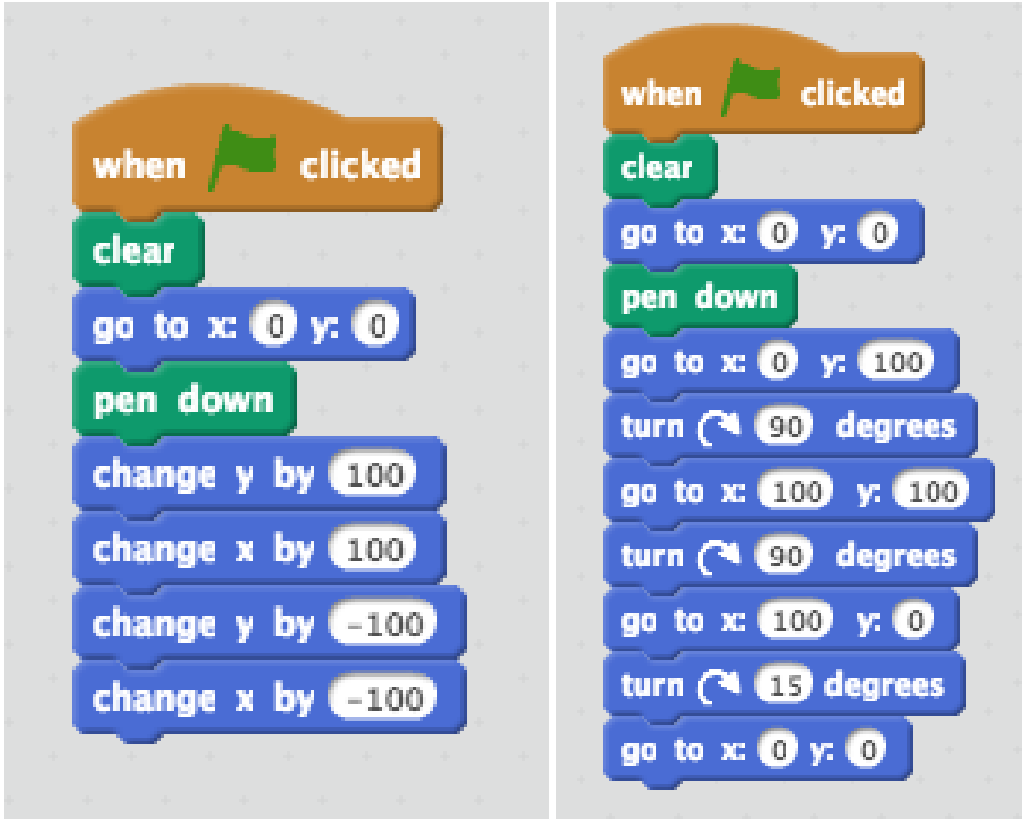
Learning sessions:

- The educator introduces students to Scratch. The educator will explain to the students that the game will give them the ability to move their sprites exactly where they want them on the stage. Every point on their stage has a specific address, and it is this address that directs the sprites where they want them to go. The address also tells them where the sprite is located at any given time. A good comparison would be to compare (x,y) coordinates to street addresses i.e. street numbers and street names. In the same way, the Scratch address has an x-component and a y-component. Educators can use this video with the audio on or muted to begin the theoretical concepts of the lesson: https://youtu.be/iX8oqTBzki4 or https://scratch.mit.edu/projects/2903229/ The following topics should be covered: (x, y) coordinate pairs, the origin (0, 0), how to find a point in Quadrant I (pos, pos) [the educator does not need to use the language of quadrants in this lesson], how to find a point in the other.
- The educator then provides the students with a worksheet to test their understanding. For instance: https://docs.google.com/document/d/1HVRhzeKnmFct9Fzs-PiivOe2DNFHS4HWZ6q5BTvXs_8/edit
- The educator shows the students the x and y-axis poster and it is recommended to leave the poster on display throughout the course as reference material.
- The educator distributes the x and y-axis cards to each student to keep on hand as a reference during the course.
- The educator projects the following game using the Interactive Whiteboard and has students volunteer to move the sprite to the correct position on the graph: https://scratch.mit.edu/projects/27166090/
- The educator spends 10-15 minutes introducing the class to scratch using the Interactive Whiteboard. The educator may use this video to explain the basics of Scratch to students: https://youtu.be/ptvSaVv_oLU.
- The educator distributes the Handout to each student. Ask the students to log in to the accounts that you have already created for them: https://docs.google.com/document/d/1MQ2AhjvmB_QPkNmdac_UYQXIKd_Bk7hZFAK0tdFVDLU/edit

- The educator models how to explore canvas coordinates. The students label the drawing on the Handout. [x-axis goes from -240 to 240, y-axis goes from -180 to 180]
- The educator shows students how to create event scripts in Scratch. The script draws a line between two points, (0, 0) and (100, 100). This can be seen on the screenshot below:



- The educator asks students how they could draw a line representing the x-axis:
  - starting at (-240, 0) and drawing the line to (240, 0)
- The students should then repeat the process for the y-axis.
  - starting at (0, 180) and drawing the line to (0, -180)
- The educator asks students how they would draw a square starting from (0, 0) with sides of length 100?
  - Two ways can be seen shown below. Other solutions are possible.



- The educator models how to calculate the distance between two points (problem 6 in the Handout).
- **Challenges (Handout):** When the students are ready, the educator will set them to complete the Challenges section from the Handout.
- The educator will circulate & assist students during this time. The educator will allow 20 minutes for students to complete this activity individually or in groups (depending on the availability of devices).

- After the students have completed the challenges, the educator will assign groups of 4-5 students (if working in groups previously, the educator should change the make-up of the groups here so students can work with different classmates in this activity) where students can discuss their answers in their group.
- Following group discussions, the educator will go through the questions and ask a few students to show how they solved each challenge. The educator can use the Interactive Whiteboard for this. The educator can answer students' work through their Teacher Account.
- The educator reviews the theoretical math concepts of the lessons.
- The educator assigns homework to test students' understanding of the mathematical concepts.

Debriefing:

- How did you find Scratch?
- What did you enjoy most about using Scratch?
- What challenges did you face and how did you overcome them?
- How did you find discussing your game in your group and with the whole class?

Home assignment

- The teacher should prepare a Home Assignment to revise the material of these lessons.

Part two/ Polygons (2 lessons of 40-45 minutes):

Lessons 4 & 5:

Preparations:

- Troubleshoot the internet connection before the beginning of the lesson
- Make sure the computers the students will be using are in order and have access to the internet
- Print out the login credentials for students to access Scratch
- Review the mathematical theory of the lesson
- Print Summative Assignment (one for each student)

Learning sessions:

- The educator reviews the various angles and polygons students have covered in the past.
- Using the Interactive Whiteboard, the educator draws the various polygons that have been covered in previous classes and labels each.
- The educator informs the students that they will be using Scratch to draw the following angles and polygons: rectangle, right-angle triangle, acute triangle, square, and a parallelogram (the educator can circle each of these shapes for a visual aid on the Whiteboard).
- The educator explain to the students that the challenge is the following: each polygon must have one side that is 60 units long; one of the polygons needs to be placed in the first quadrant.

- Students have 25-30 minutes to complete the assignment. They may complete it individually or in groups depending on the availability of computers.
- The educator asks students to add notes to their project to explain how they know they have completed each challenge.
- Once the task has been completed, the educator divides the class into groups of 4-5 students (if working in groups previously, the educator should change the make-up of the groups here so students can work with different classmates in this activity). The educator encourages each student to present their answers in the group and explain their reasoning.
- The educator asks students to volunteer to present their answers to the whole class (the educator can access their answers through their Teacher account). Students should explain how they overcame each challenge and the steps they took to draw each polygon and angle.
- Math theory: The educator reviews the Math theory of all 5 lessons.

Debriefing:

- How do you feel about using Scratch? Is there anything you are unsure about/find difficult?
- How did you feel discussing your projects/answers with your group? What did you learn from this sharing experience?
- Would you like to continue using Scratch in your Maths classes?