EARLY Teaching Scenario

Topic: **Equations of motion**

Learning outcome:

- mathematical skills. Body position is given by position and change in time.
- must find appropriate technical parts for the experiment
- make a program for Lego EV3
- make a robot for the experiment
- test robot and programme
- read graph
- Acquire practical experience by working in pairs.

Skills pupils develop during the scenario (connect to curriculum →)

- Abstract thinking and practical spatial reasoning in relation to the position of the robot.
- New words, steady speed, accelerated movement, distance, time.
- Technical equipment: control module, sensor, position measurement with an ultrasonic sensor.
- Working together, sharing ideas.
- Develop something new, extend ideas to the next level. Comprehension and expertise wherein all movements can be described by formulas.

Estonian model of digital competences based on The Digital Competence Framework 2.0 of EU (https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework) states that by the end of 6th class students should be able to:

- find information from different digital sources;
- uses digital information for constructing new knowledge;
- uses different digital technology with the help of the teacher;
- uses and connects different devices for importing and exporting digital information.
- uses digital technology safely in order to protect devices, content, personal data and privacy in digital environments.

Target group: 8-9 class

Age of students: 15-16

Number of pupils: In pairs (up to 12 pairs)

Duration (estimated time/number of lessons): 45-90 min

Prerequisites (necessary materials and online resources):

- Lego EV3 Mindstorm kit, ultrasonic sensor.
- computer for programming
- Enough room for driving robots 1,5 meters.

Introduction to the scenario *(incl. possible applications, alternatives and risks)***:**

- In this lesson, the topics involved are mathematical knowledge about line function and physics knowledge about equations of motion integrated into one practical exercise
- It is vital that the teacher ensures the students fully comprehends the explanation in moments where it's needed.

Before the program begins (preparatory work for teacher):

- Before beginning, students should know the straight line function and curved line function from math class
- Before beginning, students should know what type of body speeds can be (steady speed and accelerated movement).
- Before beginning, students should think about simple body movement and what data is needed to determine body position in different time moments?
- What shape of graphs corresponds to different movements.

The main part of the scenario:

- Open discussion about different body movement possibilities.
- Watch the video - https://youtu.be/NbImxk4ZJmQ
- What kind of graph corresponds to different movements. Steady movement- straight graph line and accelerated movement- curved graph line.
- How does the function look from a mathematical perspective to describe straight graph line and curved line? x=ax+b, y=ax2+bx+c
- To look at the graph and describe/define steady movement and accelerated movement?
- How to collect data for body positions?
- Put together a robot that can move and collect data about its position in the real time. Lego EV3 robot with the ultrasonic sensor.
- Create a program that makes the robot drive at different steady speeds.
- Create a program that makes the robot drive at an accelerated speed.
- Connect Lego EV3 with computer via Bluetooth.
- Start the programme and drive the robot at different speeds and observe from the submenu the graph representation and how the equation of movement is represented.

Learning outcomes:

- Student's integrate knowledge from math and physics lessons.
- Students experience data collecting problems and solutions during the experiment.
- Learn how to connect Lego EV3 with the computer.
- Learn programming skills. Inputs vs outputs.
- Comprehend the purpose of math and physics equations and experiments.