EARLY Teaching Scenario

Topic: Teaching physics with mBot

Aim(s): Students learn how:

- Changes in speed affect distance travelled
- Speed affects the time it takes to travel a particular distance
- To use tables and/or graphs to record, analyse and compare speed versus time versus distance

Skills pupils develop during the scenario: connect to curriculum →

The National Curriculum for Polish primary schools (Physics) states that by the end of class 8, students should be able to:

- Extract phenomena from the context, name them, and indicate factors relevant and irrelevant to their occurence
- Carry out selected observations, measurements and experiments using their descriptions
- Distinguish between the concepts of track and distance
- Convert time units (second, minute, hour)
- Use the concept of speed to describe rectilinear motion
- Calculate its value and convert its units
- Use the relationship between speed, distance and the time it was travelled in the calculations

The course components that are trained in this learning scenario are as follows:

- Measuring time, distance and speed with standard tools
- Conducting experiments to find out the relationship between them
- Using a robot for this purpose
- Problem solving
- Collaboration

Target group: pupils in primary school (grades 3 - 4)

Age of students: 9 - 10 years old

Number of pupils: maximum of 10 in a class subgroup

Duration (estimated time/number of lessons): 3 x 45 minutes

Prerequisites (necessary materials and online resources):

- mBOT/s
- Mobile devices with mBlock App installed
- Meter sticks or tapes
- Stopwatches
- Markers for marking distances on the floor
- This video tutorial will be also useful: https://youtu.be/wH7f4gSme9U

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

This scenario provides a set of hands-on activities where students can learn the relationship between speed, distance, and time and conduct experiments with a small vehicle-robot (mBOT) to validate their knowledge.

Before the program begins (preparatory work for teacher)

- Make sure that students have downloaded and launched mBlock App on their mobile phones
- They should know how to connect it with the mBot to be used in the following lessons
- Let them play with the app so that they are familiar with the robot controller (very intuitive and easy to use interface)

The main part of the scenario (3 lessons)

Lesson one: how to measure distance, time and speed

- Demonstrate the use of a meter stick or tape on the classroom whiteboard.
- Divide the class into smaller groups and let them measure various distances in the classroom. Explain that distance units change from smaller (e.g. cm/m) to larger (e.g. km) when we measure longer distances. Also the measuring tools change.
- Demonstrate the use of a stopwatch. In smaller groups students measure the time a ball rolls from one corner of the classroom to another. Explain that time units change from smaller (e.g. seconds) to larger (e.g. minutes or hours) when we measure longer periods of time.
- Introduce the idea of speed as distance/time. The ball exercise can provide good examples for the students to grasp the concept. Use the same measurement units as in the forthcoming experiments with mBOT.
- As a result of these introductory activities students should be able to compare different speeds at which an object travels across the classroom floor.

Lesson two: experiment with different speed and the same time

- In smaller groups students set different speeds of the mBOT on their mobile devices. There are only three default speed values (slow, fast, fastest) but they can be adjusted with the ‘calculator’ on the app. They should be able to compare the values, now in a digital version. This is a good basic math exercise.
- Now it’s time to activate the robot so that it can execute the defined commands. Depending on the size of the class and the number of robots available this can be done in a row or simultaneously in smaller groups.
- Students try different speeds keeping always the same time and check how distance changes.
- They start at a slow speed and increase it to larger speeds. In each case they measure the distance travelled and mark it on the floor for comparison.
- At a certain point the distance travelled by the robot remains the same as compared with the previous lower speed. This is the clue of the experiment for the students to resolve: why is the distance shorter than expected?
- As a conclusion of the experiment process, each group should discover the maximum speed of the robot which impacts on the maximum distance it can travel in a given time.

Lesson three: experiment with the same speed and different time

- In this lesson students set the robot speed to ‘slow’ and increase the time it travels on the floor (1, 2, 3, 4, 5, 10 seconds).
- In each case, they mark and measure the distance travelled by the mBOT.
- Depending on the class level the students analyze and compare the data from the two experiments.
- One pupil in the group could film the experiments and later on the group in Class could document and repeat what they have learned using a Google presentation, a Keynote-presentation or another similar tool.
- The results from the experiments can be recorded in a table provided by the teacher or depicted in a graph (more advanced level)

Learning outcomes
Students will be able to:

- Measure distance, time and speed with basic tools
- Activate and navigate a simple robot
- Grasp the relationship between distance, time and speed through experiments with the robot’s movements
- Record and analyze the data from the experiments