LEARNING SCENARIO Students and robots can solve real-word problems

Educational level: Primary Education | **Age:** 8 to 10 years old

Author: Neuza Pedro, Hugo Roxo, João Graça, Sérgio Pinto, IEULisboa

LEARNING OBJECTIVES/ ASPIRATIONS

This scenario is developed in primary schools, involving students from 3rd or 4th grade. A real-world challenge is presented to them: to find a solution for an environmental crisis, the Ocean Plastics Pollution, with the help of their new classmate: Sphero, the robot.

Learning objectives:

1. Develop computational thinking and programming skills (logical reasoning, algorithmic thinking, decomposition, abstraction, generalization and evaluation skills).
2. Explore concepts related to mathematics and geometry (situating objects in space, Decimal representation of natural numbers, recognizing geometric properties, measuring lengths and times) as well as physics (conducting experiments with light, performing experiments with mechanics)
3. Development of oral communication skills (learn to listening and build knowledge; producing speeches for different purposes, considering the situation and the interlocutor) and writing skills (Writing narrative texts; relating the text to previous knowledge, elaborating and deepening ideas and knowledge)
4. Development digital literacy skills and apps-related knowledge.
5. Promote awareness of environmental problems, namely associated with pollution
6. Promoting 21st-century skills (4C - Critical thinking, Creativity, Collaboration, Communication).

NARRATIVE OVERVIEW

Presently students are becoming more and more familiar with technology and even in primary schools computational thinking and educational robotics is being introduced. Using this technology to engage students in addressing curricular content in an applicable way and make them think about how they can solve real-world problems can be an effective strategy to motivate students. In this scenario, robots and students work together to reduce environmental pollution. Robot Sphero is presented as a new student in the class. He is a robot, and he has great superpowers. He and all the students have been asked to accept a mission: to solve one of today's' major environmental problems, the high level of plastic in the ocean.

The mission consists of crossing one of the most polluted oceans and identify “islands of garbage”, areas contaminated by pollution and plastic waste, and therefore Sphero, the robot will collect this garbage and will put in recycling bins saving the ocean from this terrible environmental catastrophe. To prepare students for this mission, three training activities are planned for the development of navigation and programming skills because although Sphero has a lot of superpowers, he needs the students to help him activate each of his superpowers.

Students will work in groups of 4, assuming different responsibilities inside the group. Students will take full advantage of indoor and outdoor learning spaces.

APPROACH TO TEACHING AND LEARNING

Collaborative learning: students work in groups to develop a collaborative project;

Challenge based learning.

ASSESSMENT:

Students are evaluated by

- the progress made during each of the learning activities (teacher feedback),
- by the final version of the code developed,
- the eportfolio created by the group based on the photos and videos collected in each activity as well as by the reflective annotation taken about the observations made. A rubric for assessing the eportfolio is made available to the students for supporting their self-assessment and supports teachers and parents final grading.

ROLES

LEARNERS: Students are asked to work collaboratively in groups of 4, in which each of them assumes a different role: programmers/ drivers, photographers, directors and annotators. In each activity, each element must alternate in the roles provided.

TEACHERS: All the teachers act as guides through all the activities. The teacher has the role of presenting the mission and involving every student in it. He explains each of the activities to the students, according to the narrative and guiding them in the process of implementing the learning scenario. Teacher assesses students' group performance.

OTHERS: Parents that are invited to attend the final presentation of the e-portfolios by accessing a web conference System. They are asked to grade each of the e-portfolios of the groups where they son/daughter is not one of the members.

Students and robots can solve real-word problems

LEARNING ENVIRONMENT

This scenario involves using different learning spaces, indoor and outdoor. The teacher **interacts** with the students: he/she presents the challenge: 'The Plastic Pollution in the Ocean'. Then the group of students **researches** and finds more deeply information about this environmental issue (causes and possible solutions). Each group **develops** a presentation of their main finding to the peers and the teacher by using an app for Interactive presentation. Each group **presents** their solutions. The process of developing the program happens in all the spaces available as groups need to discuss ideas and try out the robot's performance without disturbing the other groups' work.

Students go out of the classroom to place the robots into water and try out the fitness of the code developed. The annotations, the videoclips and the photos collected throughout all the activities by each group are used to **create** an e-portfolio of how they solve this challenge - by using the tablets as well as the software available for this purpose. At the end each group **presents** their e-portfolio to the whole class as well as to the parents that are online, through an Online Conferencing system.

POSSIBLE CHALLENGES

- Access to the required equipment.
- Presently letting students go outside of the classrooms can be difficult and authorization is required.
- Having access to a lake or a big recipient of water where the robots can more freely.

RESOURCES

- Tablets
- Robots (e.g. Sphero SPRK+ (1 per group) plus Apps Sphero EDU (Javascript text programs),
- Video-camera and video editing software
- Protractor 360 degrees, adhesive tape, tape measure, scissors, liquid yogurt packages, polystyrene plates
- Lake (or a 50 L of water recipient)
- Web Conferencing system

LITERATURE TO SUPPORT

Videos: "what is plastic pollution?", Sphero SPRK+ User Manual, Challenge Based Learning, Rubric for portfolio-based assessment

LEARNING SCENARIO VIDEO

https://www.youtube.com/watch?v=9nuWZ-maSb8

LEARNING ACTIVITIES

This scenario starts with a research activity where all students conduct online searches about Plastic pollution of the oceans. After this, students start exploring basic concept on robot programming (relate time, speed and distances) with the help of teacher. Students are asked to create a program with only one block that allows the Robot to move at a constant speed (30) over a given period of time (2 seconds). Then students will change only the time variable (4s, 6s, ...) and record the distances covered. After this, students create a program with two blocks that allows the Robot to travel a certain distance and then return to the starting point. Records are made of the distance traveled through photography, short-video clips and annotations. The following activities are then presented to the students:

Activity - Against Waste Pins
Students are asked to create and optimize a trial-and-error program using one of the motion programming blocks ("roll") that allows the Robot to drop the largest number of plastic packages. Students explore the importance of positioning and orienting objects in space when executing a program. Records are made about the progresses in this activity through photography, short-video clips and annotations.

Activity - Painting angles and shapes with light
By trial-and-error, students are asked to discover and optimize an algorithm that allows the Robot to execute a previously defined distance (edge of a square), identify the angles that, geometrically, define a square. Then students create and execute a program with four blocks that allows the Robot to make a square from the original block (edge). Students add a code block that activates the light sensor during the execution of the square in a low light environment. Records are made about the progresses in this activity through photography, short-video clips and annotations.

Activity - Save the 'islands of garbage'
Students are asked to create a program with the code blocks in the Robot Edu app that allows the Robot to execute the complete circuit in the water aiming to get into the 'islands of garbage' (represented at the base by a geometric shape). Students then run the program in the school lake or on a water recipient, moving learning to outside the classroom. Records are made about the progresses in this activity through photography, short-video clips and annotations. After this, they reflect on the differences in the robot behavior when executing the program on a smooth (solid) surface and in an aquatic medium (liquid). Students identify external factors that can interfere with the performance of the robot movement (wind, swell and swell direction, floating vegetation) and then optimize the program for the Robot to move effectively in water. Students then try out the adequacy of the improved program by putting the Robot on the lack again. The number of attempts will be made until the robot capture all the garbage on the ocean.

After all these activities students work in groups to develop a presentation of their work in a video format and present the outcome to their peers and to the parents.

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