INSTITUTE OF MATHEMATICS AND INFORMATICS – BULGARIAN ACADEMY OF SCIENCES

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LEARNING MATH WITH ROBOTS

Daniela Leone
Istituto Comprensivo 21 Bologna

https://www.istitutocomprensivo21bologna.edu.it/

Istituto Comprensivo 21 is a public institute including primary and lower secondary schools in Bologna, Italy.

Besides curricular activities, the school also organizes:
optional labs of coding, making and ICT for students
training for undergraduate students in Mathematical Education.

These classroom activities have been designed with Dr.s Lorenza Prencipe for her dissertation in Mathematics Education at University of Bologna, on march 25, 2022: https://amslaurea.unibo.it/25604/

The activities are for students in the 3rd year of lower secondary school (age 13).
The aim is to encourage cooperative learning of mathematics curriculum contents:

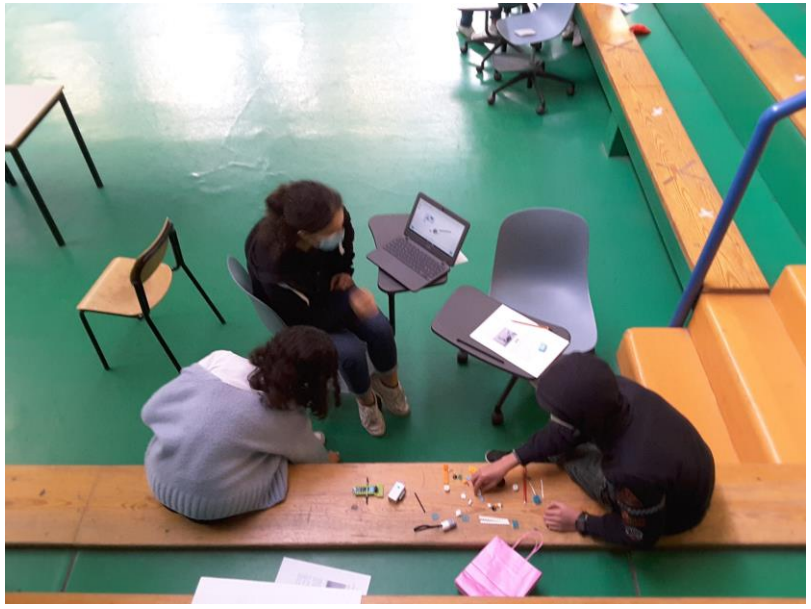
1. Circumference and circle area
2. Linear and circular motion

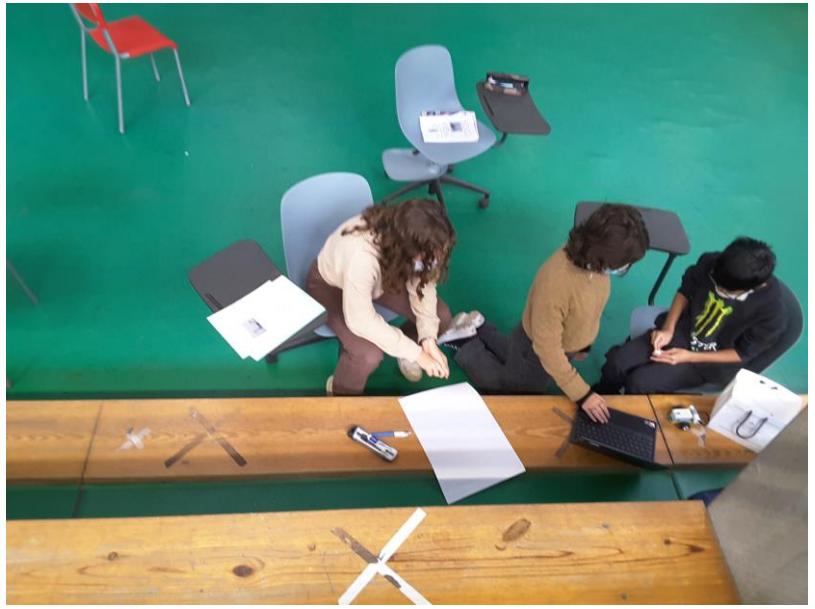
Tools used for the activities:

- educational robots Lego WeDo2.0©
- chromebooks with the Lego Education© app to program the robots
- worksheets with questions to report observations, data and conclusions
- millimeter paper and other measurement tools (ruler, chronometer, goniometer)
- instruction slides shared in Google Classrom

Students worked in groups of 3; each group member had a specific task:

1. building the robot,
2. programming the robot,
3. measuring data.

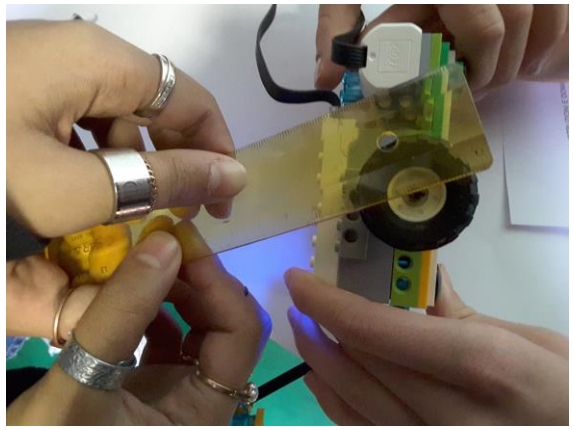


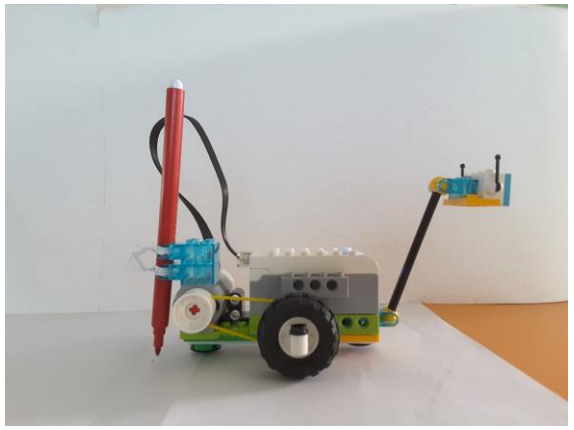


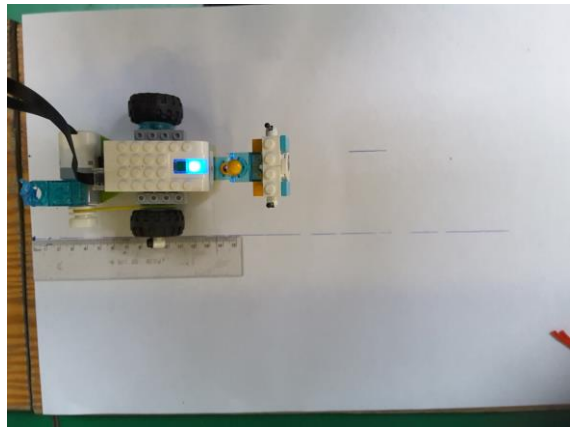
1. Circumference measurement

Students prepared the rover model with a pen and a reference mark on a wheel, and programmed its motion to draw a line as long as a wheel circumference.

They measured the line length C and the wheel diameter d and calculated the rounded value of π with the ratio C : d.



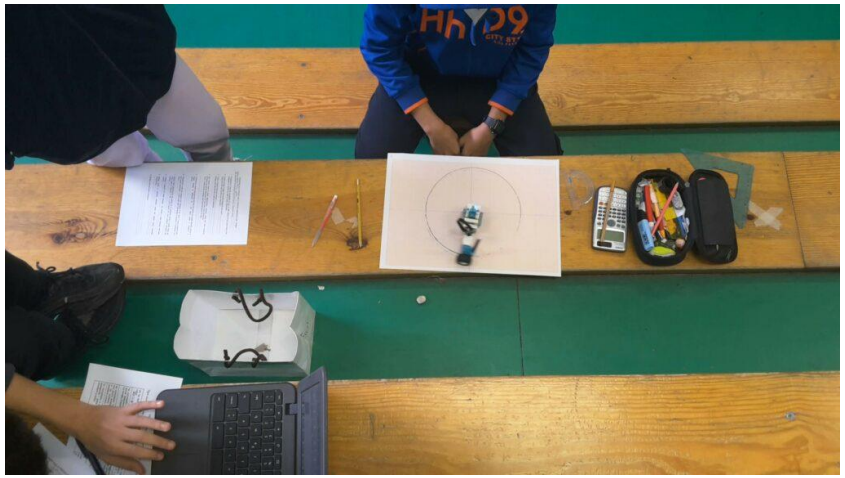


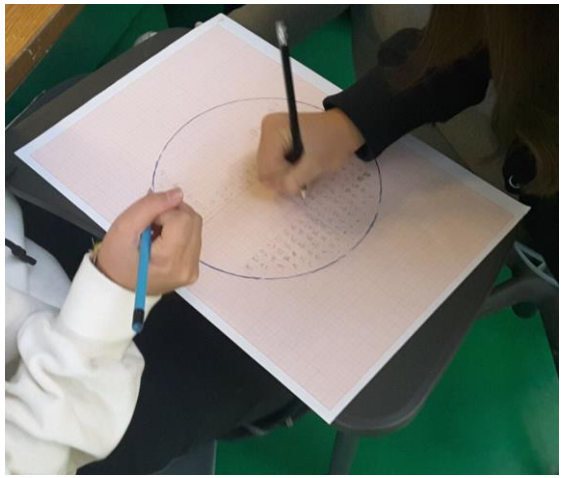


1. Circle area measurement

Students prepared the satellite model with a pen and programmed it in order to draw a circle on the millimeter paper.

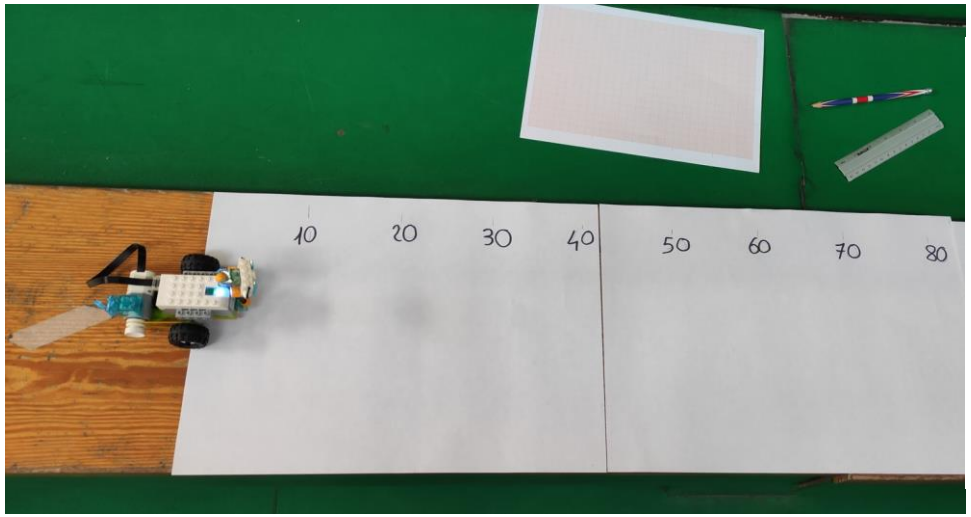
They counted the cm^2 included in the circle and compared this approximation to the area calculated by measuring the radius (distance from the center to the pen).

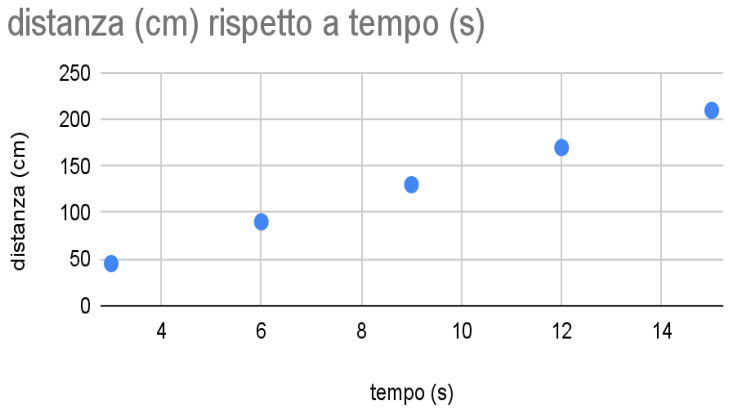




3. Linear motion

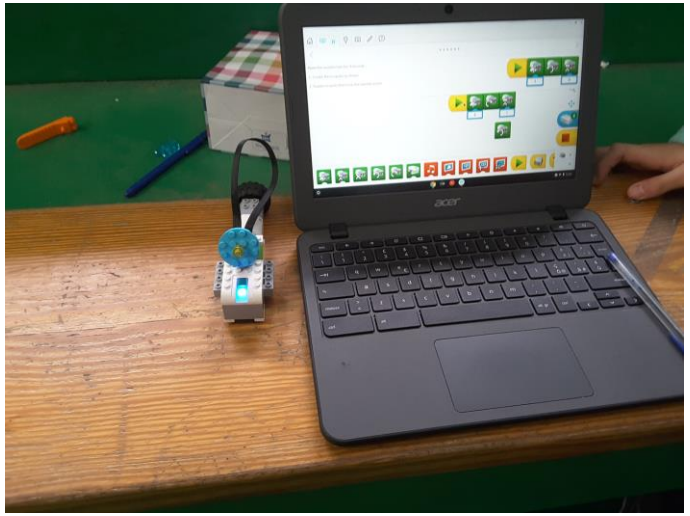
Students prepared a unit line on paper sheets and programmed the rover model to run on the line with a chosen engine power (according to the programming app). They measured time and distance in order to calculate the speed and made a distance-time plot.

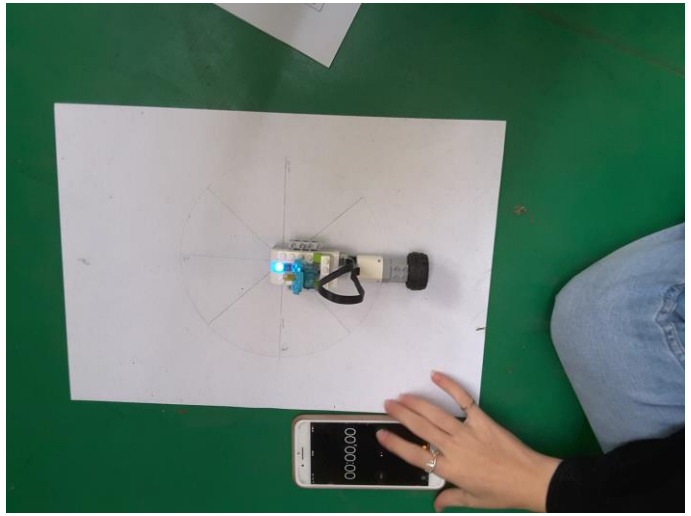




4. Circular motion

students prepared an angle plot on a paper sheet and programmed the robot to move around its center. They measured the time needed to make a 360° angle and found different angular speeds depending on the programmed engine power.





potenza	tempo impiegato per girare di 360°	velocità (gradi/secondi)
1	6 sec.	360/6= 60
2	5 sec.	360/5= 72
3	4 sec.	360/4= 90
4	3 sec.	360/3= 120
5	2 sec.	360/2= 180

Assessment

In each activity the work group was self-assessed by students using a rubric with questions about their cooperation. The individual learning outcomes were assessed by teachers checking the worksheets answers.

Students also prepared slides to present their data and used them in oral tests at the final exams. The impact on motivation was significant.

The activity was also presented at the annual School Maker Day event and in the STEM Discovery Campaign Blog.