How Does the Move Steering Work?

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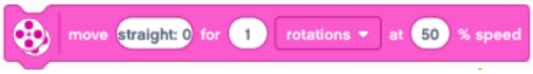
Task Description

This is a great mathematical modeling task, and your students will love the hard thinking this task evokes! Programming a robot to steer promotes a surprising amount of mathematics learning.

Understanding how the <Move> programming block turns the robot requires mathematical problem-solving skills. When students model the robot's turning, they gain contextualized and spatialized experiences with measurement, shape and space, patterns and relations, fractions, percentages, data collecting, data interpretation, and more.

<Move Steering> Block
(older EV3 software)



<Move> Block
(Scratch-based version)

Overview

We have implemented this task several times in Grades 4 – 7 classrooms and each time found students highly engaged and amazed. There are **three parts** to the Move Steering Task, and each part explores important mathematical concepts that we explain in the following. We estimate approximately 45 minutes for each part, and a total time of 2 hours and 15 minutes.

On the following pages, we identified

- a **learning goal**,
- an overview of **students' mathematical engagement** while working through the robotics task,
- **teaching suggestions**, and

- a section on **assessment of student understanding** for each part.

Mathematics Concepts

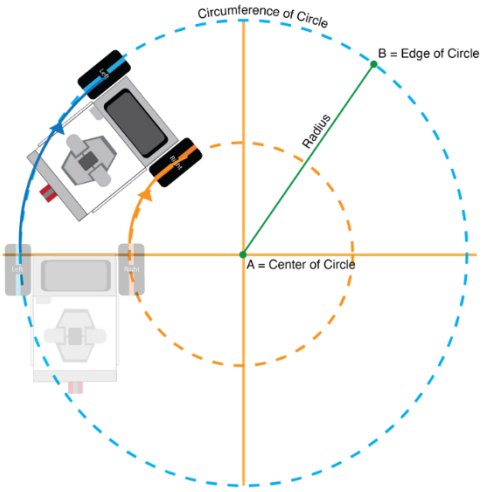
Students mathematically model how the <Move> Programming Block on the *Lego Mindstorms Education* software turns the robot. In doing so, students learn about mathematical concepts of Grades 4-7 such as **operations and algebraic thinking**, **fractions**, **measurement of data**, **shape and space**, as well as **ratios** and **proportional relationships**.

Mathematical Competencies

The Move Steering Task promotes student engagement, reasoning, collaboration, communication, use of appropriate tools, finding patterns and regularity, and persistence in problem solving.

We found that students also use and develop many spatial skills, especially when spatial representations of the mathematical concepts mentioned above are included in the tasks. For example, a number line representation can help students understand number as measurement, whereby numbers are expressed as a position or motion along a path (see Part 1). Spatial conceptualizations of number are essential for understanding rational numbers and algebra.

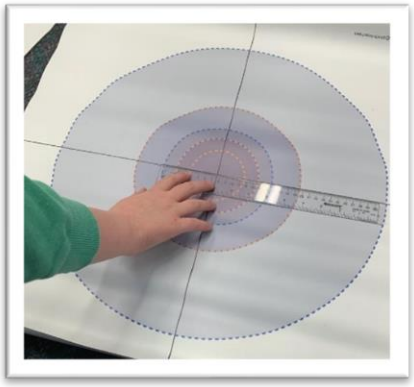
Describing and Modeling the Robot's Turn with Spatial Representations of Mathematics Concepts



Materials Needed

- EV3 **robot** built according to the instruction manual
- Additionally, Part 2 requires:
  - **Rulers** for measuring the radii
  - A vinyl printout of the **steering mat**, available at http://stem-education.ca/wp-content/uploads/2020/01/Steering-mat.pdf
  - Alternatively, four concentric circles with diameters 48 cm, 24 cm, 16 cm, and 12 cm (draw on the floor or poster board)
- **Recording Sheets**, available for each part (see individual sites)

Student Measuring Radius on Steering Mat



Note for Teachers

For teaching the Move Steering Task, we have some general suggestions:

- Implement clear and consistent terminology: We adopted the convention that the **wheels rotate** and the **robot turns**
- Promote student collaboration: Pairs of students works best; but roles in larger groups of 3 to 4 can be assigned
- Some exemplary student roles include observer/feedback provider, recorder, programmer, and measurement taker