DASHing the Way to Scratch

DASHing the Way to Scratch is a series of tasks created with the goal of teaching young students the increasingly more useful skill of computational thinking, as well as supporting their learning and understanding of integers, angles, shapes, and patterns. This task was designed for a grade 4-7 learning skills class, however it can be implemented in classrooms from grades 2 to 8 with only minor changes to the complexity of the shapes the students create.

> *"Students were instantaneously engaged… [They] worked together to solve problems… [and] were not afraid or embarrassed to make errors… Since this session, students have continued to use Scratch at home and at school.*
>
> *"Students were able to apply their learning math concepts to the coding process, making and correcting errors, which helped them gain a better understanding of the concept, as well as determining how they might use it."*
> (Teacher comments, April 2018)

Description of Activity

DASHing the Way to Scratch moves through three different activities which are all guided by the facilitator. The class will need access to the ingredients to make Rice Krispies are required (butter, marshmallows, and Rice Krispies cereal), as well as a microwave, bowl and spoon. The class will also need a DASH robot, iPad, Blockly app (free), masking tape, and laptops with Scratch accounts.

<u>Step one</u> is the introduction which helps students learning their role as programmers to give "detailed instructions" by guiding the facilitator to make Rice Krispies step-by-step.

<u>Step two</u> has groups of students work together to learn DASH the robot. They will learn how to "drive" it by moving it along a number line, as well as making a square and a triangle with DASH.

<u>Step three</u> has students work independently with Scratch, coding the Sprite to do what the class had just done with DASH.

Learning Objectives

- Primary learning objectives
  - Supporting student understanding of integers and interior/exterior angles
  - Understanding the importance and use of coding sequences, loops and functions, and patterns in programming
- Secondary learning objectives
  - Respecting the equipment and their peers
  - Learning from their mistakes and debugging

Math Topic & Curriculum

The math topics explored in this activity are integers, angles, shapes, and patterns. *DASHing the Way to Scratch* specifically aims to meet the following expectations from the Ontario Ministry of Education curriculum documents:

> ***By the end of grade 1, students will:*** *identify and describe various polygons and sort and classify them by their geometric properties, using concrete materials and pictorial representations*
> ***By the end of grade 2, students will:*** *estimate, measure, and record length, perimeter, and area; represent a given growing or shrinking pattern in a variety of ways*
> ***By the end of grade 3, students will:*** *use a reference tool to identify right angles and to describe angles as greater than, equal to, or less than a right angle; identify and compare various polygons and sort them by their geometric properties*
> ***By the end of grade 5, students will:*** *solve problems requiring conversion from metres to centimetres and from kilometres to metres*
> ***By the end of grade 7, students will:*** *identify and compare integers found in real-life context, add and subtract integers, using a variety of tools*
> ***By the end of grade 8, students will:*** *solve angle-relationship problems involving triangles (…) finding supplementary angles or opposite angles*

These expectations are met throughout all the tasks. By creating the shapes, students are classifying geometric shapes, estimating and measuring length, identifying angles, converting units, and solving angle-relationship problems involving triangles. By traveling the number line with DASH, students are converting units, and identifying, subtracting, and adding integers in real life contexts.

Technology & Project type

This activity was developed using the DASH (or Dot) robot with the Blockly app, as well as the Scratch program found at https://scratch.mit.edu/. The Xylo app is also used, as well as the xylophone accessory. Both the Blockly app as well as the Xylo app require the use of an iPad, and Scratch requires the use of a computer with a Flash plugin. This is a step-wise guided activity that starts out with a lot of teacher input while using Dash and ends with minimal teacher intervention while using Scratch. This project expects students to have little to no programming experience, and thus the goal of this is the ignition of understanding of computational thinking through the use of coding, as well as solidifying math concepts with programming.

Implementation

The introduction "hook" of making Rice Krispies is best run with the whole class. This will be teacher lead, and either the facilitator or a student will be the "robot" to make the treats. With all the students there, they can all see that they are the brain behind the robot, and that the robot (or later, the computer) will not perform the tasks correctly if detailed instructions aren't given. This activity should take about ten minutes. Other variations include performing other simple tasks, such as making a sandwich or brushing your teeth.

The main activities (Dash and Scratch) can be done in one session, or over two sessions depending on the needs of the class. The Dash section is best run in groups of 6-8 students, each group having a Dash robot, an iPad, and the Blockly app. This will be teacher lead, where the teacher will issue instructions

for new activities to try with Dash, as well the teacher will provide guidance to groups as they work through the programming. Prepare for this activity by having the masking tape on the floor with marks every 10cm. First allow students to play with Dash's functions for 10 minutes. Once done, have the students move Dash along the number line, to both positive and negative values. The students may not realise it, but they are doing math! Continue allowing student to move Dash in a line for 10-15 minutes, then instruct them to have Dash make a square with a set side length (10-15 minutes). Next, they will make an equilateral triangle with set side lengths (15-20 minutes). This will be more complicated, as Dash will need to rotate 120° instead of the anticipated 60°. If students show more interest in Dash, and if you have the time, you may choose to use the Xylophone accessory and Xylo app to have students identify and recognize patterns (15-25 minutes). Have a 5 minute debrief, and then move on to the Scratch component. This can be done the next day if required. Allow students to return to their desks and go to https://scratch.mit.edu/ on their laptops. Have then complete the same tasks with Dash on Scratch—that is, create a line, a square, and a triangle. This may take up to 25 minutes. Although students are working independently, they should talk to their peers to clarify and solidify their understanding of the programming. Once done, debrief with the class to go over new vocabulary learned and point out computational thinking aspects.

Mathematics Engagement

Mathematical engagement is seen throughout the activities. Even better, students may not always realise they are engaging with math at all! The first activity with Dash has students converting units in their heads. Secondly, students have to move Dash from a positive number on the number line to a negative one. This allows them to practice their positive and negative integers. By having students move Dash to a negative number, they are innately doing integer subtractions and unit conversion all at once!

While creating the square, students are fulfilling the curriculum expectations from grade 1-3. By using Dash, they are able to explore the properties of shapes and further their understanding of concepts they may be struggling with. Similarly, when students move on to creating the triangle, they are once more exploring the properties of shapes, as well as exploring angles and angle-relationship problems (grade 8 curriculum expectation). Lastly, if the Xylo app was used, students can use Dash to explore different patterns and see the connections patterns have to loops in programming.

All of this connects to computational thinking and the seven affordances. By using Dash, students are given a tangible feel to the math they are doing. Similarly, by using Dash, students are able to dynamically model the math, as well as create abstractions and automations (such as loops) to create the shapes. There is both a low floor, high ceiling and a wide walls aspect to this activity, since little to no programming background is required to explore all of these concepts, and there is always more than one way to accomplish the tasks. There are instances of conceptual surprise, especially when Dash turns the wrong way when making the triangle (since it is set to rotate 60° instead of 120°). Above all, students are given agency as they control either Dash or the Sprite while they complete the activity.

Resources for this task:

Other than using the Dash robot and an iPad with the Blocky app and the Xylo app, students will need to go to https://scratch.mit.edu/ to create/log into their Scratch accounts.

For help attaching the Xylophone accessories, go to: https://www.makewonder.com/apps/xylo

I would love to hear from you! If you try Creating a T-Shaped Puzzle with CNC in your classroom or for more information about this task contact **Joyce Khouzam** – *joyce.khouzam96@gmail.com*