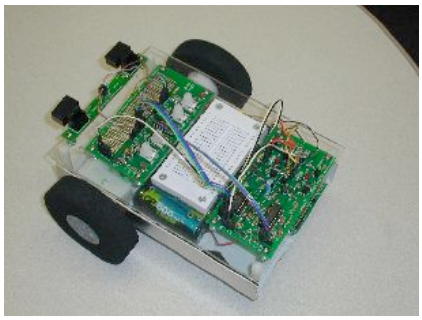

The SPIRIT Project

Educational Robotics

Lesson Building Block

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Grade Level: **Developmental (Beginning) Algebra at the college level**

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Directions: Definition of a Lesson Building Block: This is a "Lesson Building Block" from the SPIRIT educational robotics institute. A 'lesson building block' is in essence an educational activity that might be later turned into a more formal classroom lesson by a creative teacher. The SPIRIT Institute is striving to put a variety of "lesson building blocks" up on the web for the potential use of teachers as they try to prepare more formal educational lessons using the TekBot robotics platform.

I. Concepts (Give a list of one or more concepts that might be taught using this activity)

Using the Cartesian Coordinate System to indicate the location of a point via its associated ordered (x,y) pair and, given an ordered pair, to plot the corresponding point onto the rectangular coordinate system. Also, to illustrate the existence and usefulness of rational numbers (in particular, fractions and decimals) as well as irrational numbers, over and above just utilizing the integers in real life.

II. Standards

(Give a list of one or two local, state or national standards that appear to apply)

The following is excerpted from Omaha's Metropolitan Community College Mathematics Department Course Description for Beginning Algebra – Part II:

COURSE OBJECTIVES:

1. – 6. …
7. Graph linear equations/inequalities and write linear equations.

Unit 5. Graphs and Linear Equations

Upon completion of this unit, each student will be able to:

1. Plot points on the rectangular coordinate system.
2. …
3. Graph linear equations by plotting points.

4. – 8. …

III. Learning Activity Context (Describe the overall context for the learning activity)

Context: X Moving TekBot __ Building a TekBot __ Engineering / Notebook __ Other

Abstract: (Give a 1 paragraph abstract of the activity)

The ability to determine the position of a point in a two-dimensional plane and to plot points (ordered pairs) is a basic requirement at the very beginning levels of algebra instruction will assist students in understanding many of the algebraic concepts to be presented. These skills also are helpful for the "visual learner type" students in aiding the comprehension of relationships between variables such as linear, quadratic, polynomial, exponential, logarithmic, and so on. Some students do not easily grasp these concepts from having them presented on a board in the front of the room. A moving (and movable) artifact, such as a TekBot, can be used to show location definition and the plotting of (x,y) pairs in a hands-on, real-world scale environment. The concept(s) can then be more easily abstracted to a rectangular coordinate system on paper. First, establish an origin (0,0) in the room and lay out horizontal and vertical axes with masking tape on the floor. Then move the Tekbot at random around the room, stopping and instructing how to properly determine, speak, and write the appropriate coordinates. Then provide some (x,y) pairs to the students and have them move the TekBot to the proper location(s). This is where rational numbers (in the form of fractions) and irrational numbers (flowing from the results of Pythagorean Theorem calculations) may be introduced in an effort to show how the world is not necessarily sufficiently described by integers alone.

IV. Teacher and Student Suggestions/Tips

(Provide some general tips or suggestions for trying the activity)

Introduce the TekBot in a very visual, striking manner, perhaps by leaving the room and then re-entering driving the robot. Choose the origin (0,0) to be somewhere near the center of the cleared space and then divide the class into teams in order to construct the axes using masking tape stretched tight at right angles, crossing at the origin. Use a yardstick to mark large units (about every two feet) and label appropriately. Use random numbers to dictate the length of time and direction the TekBot travels and then stop. Locate using (x,y) pairs. Then reverse the process and provide locations using only 2 values (x and y) and have the students drive the TekBot to the site. Label the 4 quadrants with the proper Roman Numeral designations. Refine the locations by using fractions instead of integers only. Calculate (using Pythagorean Theorem) a location and illustrate with an irrational coordinate, such as the square root of 2.

V. Teacher Questions

(Give a list of questions that teachers might ask students during the activity)

Where in the room should we place the origin? Does it matter?

When we define the TekBot's location as an ordered pair, does the sequence matter? Does (a,b) = (b,a) in terms of finding TekBot?

What about refining our representation of the ordered pairs to include fractions? How would that impact our accuracy? Why?

What if we changed the scales on the axes? Would it matter? Why?

If we want to know the distance between 2 points on the grid, and we use the Pythagorean Theorem to calculate that distance, what happens when we get an irrational number as the distance? How do we estimate the actual distance?

VI. Assessment Ideas

(Give an idea or two about how the lesson activity might be assessed)

Translate lesson to graph paper and provide ordered pairs that generate a "familiar" object, i.e. a "happy face" or a "square".

Provide several pictures of plane geometric figures and have the students generate ordered pairs that, when plotted, will form the figure.

VII. Other Information

(Give any other information that might be useful or a visual or two)

This exercise can be used to model the "fly on the ceiling" heuristic that Rene Descartes developed in the 17th century.

VIII. Items to Have Readily Available

Stopwatch
Yardstick
Dice (preferably different colors – for x & y)
Masking tape
Erasable markers

TekBot (with directional operating controls) - fully charged batteries
Graph paper, straight-edge, pencil