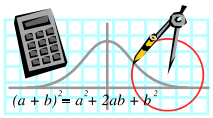

Exemplar 12 : Verifying Points Lying on the Line Do Satisfy the Linear Equation

Objective : To verify that points lying on the line will satisfy the linear equation

Key Stage : 3

Learning Unit : Linear Equations in Two Unknowns

Material Required : Dynamic geometry software such as *Geometer's Sketchpad*

Prerequisite Knowledge :
(1) Coordinates
(2) Simple substitution
(3) Graphical representation of a linear equation.

Description of the Activity :

1. Before the lesson, the teacher uses a dynamic geometry software such as *Geometer's Sketchpad* to prepare the graph $y = x + 1$. The graph is shown in Figure 1 and is used as an illustration for the activity.

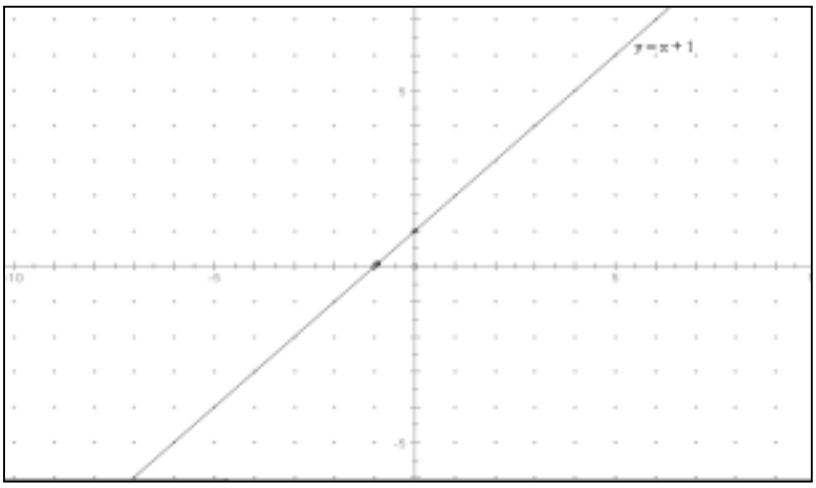

Figure 1

2. An arbitrary point on the straight line in Figure 2 is plotted and labelled as “A”. Students calculate the values of the two data “*y*-coordinate” and “*x*-coordinate plus 1” for the point A. See Figure 2.

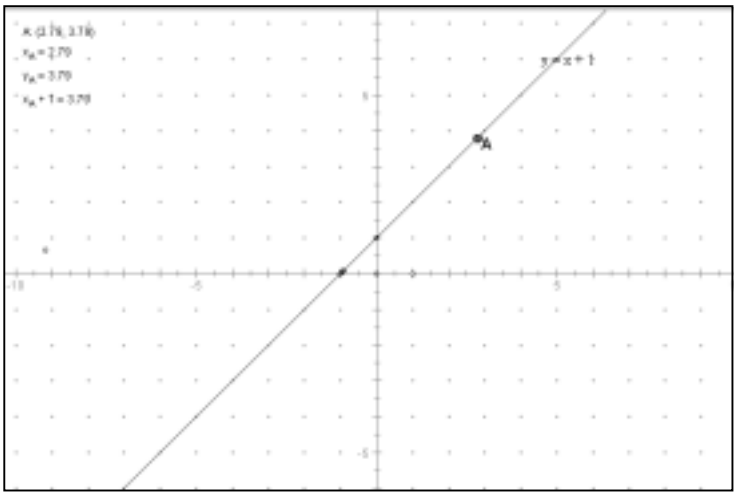

Figure 2

3. The teacher asks students to drag the point A along the straight line and observe the change in values of y_A and x_A+1. They are expected to find that these two values are equal no matter where the point is.

4. The teacher instructs students to add a point B in the graph, which does not lie on the straight line. Students measure its coordinates (x_B, y_B) and calculate the values of y_B and x_B+1. See Figure 3.

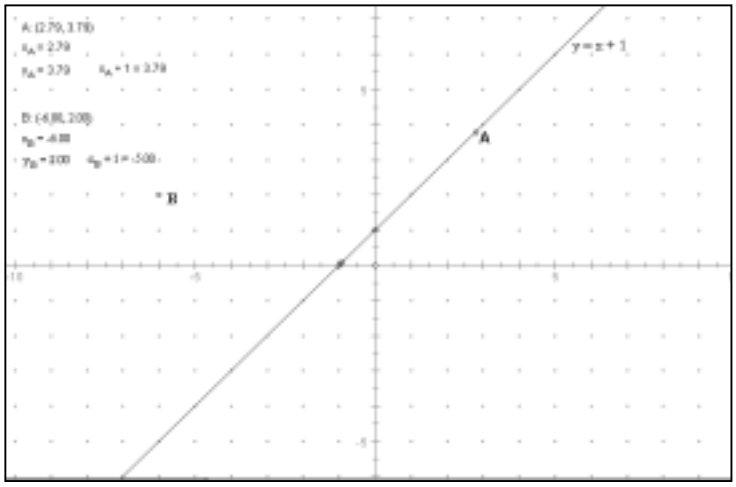

Figure 3

5. The teacher asks students to move the point B freely on the coordinate plane and observe the values of y_B and $x_B + 1$. They are expected to find that these two values are not equal unless B lies on the straight line.

6. For more able students, the teacher can ask them what pattern they can find from observing the changes in the values of y_B and $x_B + 1$. If necessary, the teacher may guide students by asking the following questions:
   (a) Which one is greater? Where does this happen?
   (b) How can you explain these findings?

7. The teacher guides students to draw the following conclusion:
   If the point (x, y) lies on a straight line, the corresponding values of x and y satisfy the equation of the given line.
   If the point (x, y) does not lie on the straight line, the corresponding values of x and y do not satisfy the equation of the given line.

8. The teacher can further ask students the following questions:
   (a) How many points lie on the graph?
   (b) How many ordered pairs satisfy the equation of the line?

9. The teacher introduces the "Algebraic Method" for students to determine whether a point lies on a given straight line:
   (a) Substitute the values of the x-coordinate and y-coordinate into the Left Hand Side and the Right Hand Side of the equation of the line.
   (b) Compare these two values.
   (c) If they are equal, the given point lies on the line. Otherwise, the point does not lie on the line.

10. Students repeat the steps in Points 2 to 6 and Point 9 for the following graphs to consolidate the concepts in Point 7.
    (a) $y = -0.5x - 1$
    (b) $y = 2x + 3$.

Notes for Teachers：

1. The teacher should discuss with students that there are infinitely many points that lie on the graph of a linear equation, and hence there are infinitely many ordered pairs that satisfy a linear equation.

2. (a) For more able students, they are expected to find out that if point B lies on the upper half-plane then $y > x + 1$ while if point B lies on the lower half-plane then $y < x + 1$. The teacher should point out that this conclusion (the "direction" of the inequality sign) does not hold for some linear equations in standard form. For example, consider the graph of $x – y + 1 = 0$. Points that satisfy the inequality $x – y + 1 < 0$ lie on the upper half-plane while points that satisfy the inequality $x – y + 1 > 0$ lie on the lower half-plane.

   (b) When point B lies on the straight line, then the equation of the straight line is $y = x + 1$. Furthermore, the teacher can explain that any straight line divides the plane into three distinct parts, namely the upper half-plane, the line and the lower half-plane.

3. The teacher may also consider horizontal and vertical lines in the activity.