Exemplar 9 :
To Verify that the Points Lying on a Line Do Satisfy the Equation of the Line

Objective : Students will be able to verify that the points lying on a line do satisfy the equation of the line by using dynamic geometry software and an algebraic method.

Dimension : Number and Algebra

Learning Unit : Linear Equations in Two Unknowns

Key Stage : 3

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

Prerequisite Knowledge :
(1) Coordinates
(2) Graphical representation of a linear equation

Main HOTS Involved : Inquiring Skills, Conceptualizing Skills, Reasoning Skills

Description of the Activity :

1. Before the lesson, the teacher uses dynamic geometry software such as *Geometer's Sketchpad* to prepare graphs of (a) $y = x + 1$
(b) $y = -0.5x - 1$
(c) $y = 2x + 3$.
The graph of (a) is shown in Figure 9.1 and used as an illustration for the activity.

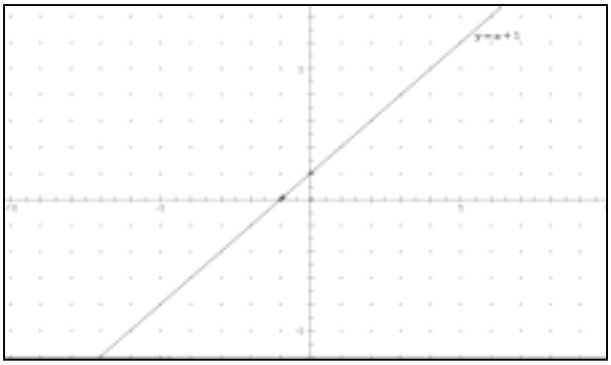

Figure 9.1

2. Choose any arbitrary point on the straight line in Figure 9.1 and label it as "A". Calculate the values of "*y*-coordinate" and "*x*-coordinate plus 1" for the point A. See Fig. 9.2.

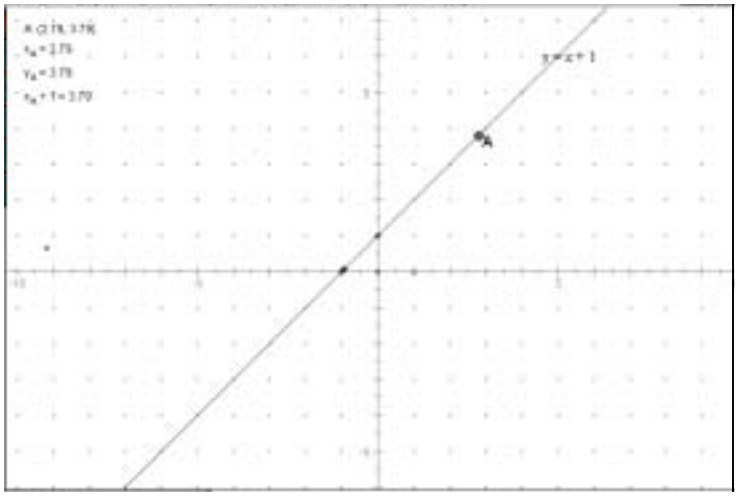

Fig. 9.2

3. Encourage students to drag the point A along the straight line. Ask them what they can observe from the 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. Instruct students to add a point B, which does not lie on the straight line. Measure its coordinates (x_B, y_B) and calculate the values of y_B and x_B+1.

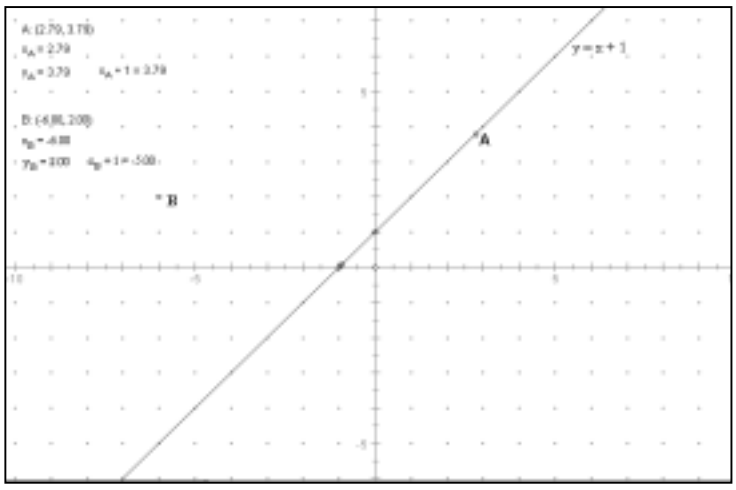

Fig. 9.3

5. Encourage students to move the point B freely on the coordinate plane. Ask them what they can observe from 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. Guide students to draw the following conclusion:
   If the point (x, y) lies on a straight line, then the corresponding values of x and y satisfy the equation of the given line, or vice versa.
   In other words, if the point (x, y) does not lie on the straight line, then the corresponding values of x and y does not satisfy the equation of the given line, or vice versa.

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" to 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, this implies that the given point lies on the graph. Otherwise, the given point does not lie on the graph.

10. Repeat the steps in Points 2-6 and Point 9 for the graphs of (b) and (c) in Point 1 to consolidate the concepts in Point 7.

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 observe that $y > x + 1$ when point B lies on the upper half-plane while $y < x + 1$ when point B lies on the lower half-plane. The teacher should point out that this conclusion does not hold for some linear equations in standard form. For example, consider the graph of $x – y + 1 = 0$. $x – y + 1 < 0$ for points lying on the upper half-plane while $x – y + 1 > 0$ for points lying on the lower half-plane.

   (b) When point B lies on the straight line, then $y = x + 1$. Furthermore, the teacher can explain that any straight line divides the plane into three distinct parts.

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