Teacher's Guide

Objective and Learning Goals

M.8.2.2.2. Recognizes the coordinate system with its features and shows ordered pairs.

(For New Curriculum) MAT.8.2.1. Analyzing the Cartesian Coordinate System through Real-Life Situations

a) Identifies the components of the Cartesian coordinate system (plane, axes, ordered pairs, etc.).
b) Determines the relationships between the components of the Cartesian coordinate system.

Aim of the Activity

- **Understanding the basic properties of the coordinate system**: Recognizing axes, origin, and identifying ordered pairs correctly.
- **Solving first-degree linear equations**: Determining the coordinates of a point on a line.
- **Enhancing mathematical thinking and strategic decision-making**: Supporting true decisions under time constraints to find the correct point.

Students both individually and with groups provide opportunities to practice these abilities in the classroom.

Story of the Activity

The story of the game is based on finding lost treasure in an ancient world. Students try to find the treasure by trying to find the point according to the given line equation on a map drawn on papyrus paper.

Pedagogical Foundation of the Activity

Digital game-based learning, a pedagogical strategy that incorporates gaming elements into educational situations to improve motivation, engagement, and conceptual understanding, is the foundation of this activity.

Digital educational games combine interactive gaming features with educational content to increase engagement and reinforce learning, offering special chances to develop students'

knowledge and abilities (Gui et al, 2023). Specifically, mathematics education is changing as a result of the development of digital and mobile technology, which are enhancing traditional teaching methods with dynamic and engaging materials. Students have a unique opportunity to study mathematics in dynamic, interactive formats through digital mathematical games. With the aid of these materials, learners can manipulate and visualize concepts related to mathematics, increasing their level of engagement and comprehension (Larkin & Calder, 2016). One study, for example, demonstrates that digital mathematical games can enhance students' mental calculation skills, especially when used in connection with interactive learning platforms (Aktaş, Bulut, & Aktaş, 2018). Moreover, Prensky (2001) and Nussbaum & Beserra (2014) emphasize that transforming mathematical tasks into enjoyable challenges helps create positive learning environments. By using this fact, I tried to create enjoyable challenges in this “Find the treasure” game. For example, students are trying to find the accurate ordered-pair on the given line equation while they are under time pressure and their score is influenced by their mistakes so they should be careful before giving answer. Also, through a trial-and-error methodology, digital games promote discovery as students try out various answers and naturally uncover mathematical connections (Arnab et al., 2015). However, I wanted the students to act strategically, not randomly, even in this trial-and-error method. Therefore, the game starts at maximum points and 5 points are lost for each mistake. This is designed to develop the ability to think carefully under a certain amount of time for each move. Also, the flexible structure of digital games offers significant advantages over static exercises by dynamically adjusting to students' actions and providing immediate feedback based on their decisions. This real-time feedback loop fosters deeper cognitive engagement than traditional methods and encourages students to continuously refine their strategies (Clark et al., 2016; Devlin, 2011).

In addition to these, the activity aims to achieve the following:

1. **Active Learning**:
   Through the application of their understanding of linear equations in a dynamic, practical setting, students actively engage with mathematical concepts. This promotes deeper cognitive engagement by changing the learning process from passive observation to active participation.

2. **Problem-Solving and Critical Thinking**:
   Students are encouraged to strategically identify the right place on the line by analyzing the provided linear equation. This helps them develop critical thinking and problem-solving skills, which are crucial for learning in the 21st century.

3. **Immediate Feedback**:
   The game provides instant feedback through visual cues (treasure or error messages). This prompt response reinforces learning in real time by assisting pupils in recognizing errors and self-correcting.

4. **Motivation and Engagement**:
   The "find the treasure" theme and scoring system create an enjoyable, competitive atmosphere. By establishing specific objectives, the activity keeps students motivated and reduces the boredom that comes with regular exercises.

5. **Mathematical Connections**:
   The exercise assists students in creating links between symbolic and visual representations by connecting abstract algebraic equations to their graphical representations on the coordinate plane. This alignment promotes the growth of mathematical fluency and conceptual comprehension.

All things considered, the pedagogical foundations of this activity reflect contemporary teaching methods, integrating behavioral, affective, and cognitive elements to produce a comprehensive effective learning process.

Classroom Usage Instructions

- This game should be played after making sure that students can solve a linear equation with one unknown and recognize the coordinate system. There are three activities in this book for recalling this previous knowledge. One of these activities is about solving linear equations created by Tmoorehead (2017) called "Solving Linear Equations practice". Another one of these activities is about recognizing cartesian coordinate system created by Erlina Ronda (2022) called "A3. The Cartesian Coordinate Plane". Other one is about

points on coordinate system created by Randy Krueger and Samantha Garcia (2020) called “1.6 Graphing Points in the Coordinate Plane”

- Students can play this game either individually or in groups.
- Each round lasts 90 seconds, encouraging students to think and act quickly yet carefully.
- At the end of the activity, students can share their strategies and reflect on their mistakes. This promotes conceptual understanding and collaborative learning.

Duration of the Activity

- Each student should play at least two rounds.
- Total duration: Approximately 15-20 minutes (including gameplay, instructions, and discussions).

Implementation

1. **Starting Screen**
   Players click the "Start New Game" button to begin, which launch timer and active score slider.
2. **Using the Pointer X**
   Points can be travelled over by using the X cursor. The X cursor is left on the point that is considered to be correct. Students use the pointer to move over the points on the screen and select a point on the line.
3. **Check Button**
   Clicking on the check button checks the accuracy of the point on which the cursor is located. Treasure animation for a correct choice or an error message for an incorrect one.
4. **New Points**

   As the correct points are found in the game, new points are provided by clicking the” Hit the button to find the treasure again” button.
5. **Final Score**

When there is a “Time is up!” warning on the screen, student’s round is over. The score shown on the screen at that moment is the student’s score. If students are playing with their friends, it is the turn of other players. They can start the game again by clicking the “Start new game” button. If they are playing individually, they can start the game again by clicking the same button.

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