Unplugged Activity

Title: PROGRAM TO SAVE LIVES

Educational level: third cycle of primary education
Curricular areas: Natural Science
Timing: two lessons (45 minutes each).

Summary

After an earthquake, a group of people is trapped and it is not possible to deliver food or drink to them by human means through the maze of rubble. In this activity, the students will work in pairs to create a program capable of guiding a robot/autonomous vehicle through an unknown maze to find the exit, in order to deliver water and food to those people.

Aims

- Develop all the phases of a design project until generating a program capable of autonomously guiding a robot.
- Work on programming logic by creating a flowchart that represents the actions the robot must execute in each situation.
- Break down a complex problem into simpler ones to create a program that meets the established conditions.
- Enhance collaborative working skills.

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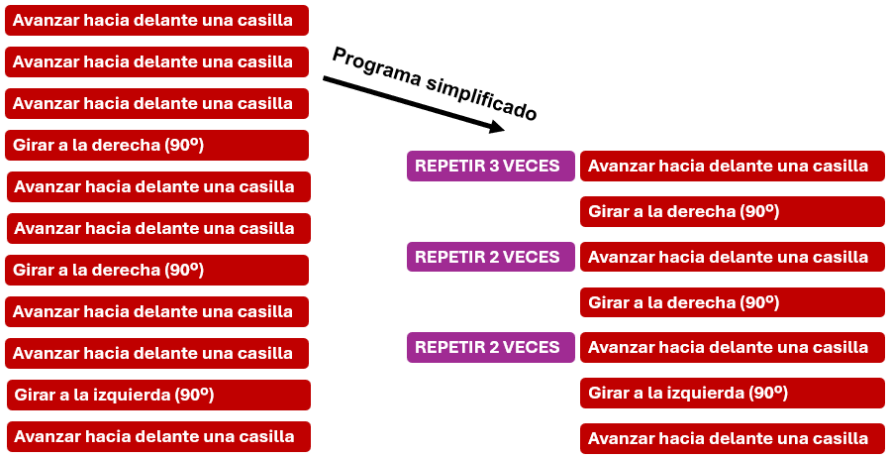
Key competencies to develop: Mathematical competence and competence in science, technology, and engineering; Digital competence; Personal, social, and learning to learn competence

How do we do it?

FIRST LESSON

1. Introduction to the activity, in which students will be motivated by the utility of designing and programming autonomous robots to perform tasks that humans cannot do (e.g., rescue missions). A brainstorming session can be conducted on different situations where these robots are essential.

2. As a whole group, begin by showing a very simple example of a maze (see below) in which the robot should be guided from the start (home) to the exit (goal) through a basic program that students should already be able to develop (solution below). As a first challenge, students can be asked to indicate the commands that the robot (yellow) should follow to get out of the maze. An example can be seen below:



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3. Next, a more complex maze (right) will be shown, and the students will reason about the difficulty of creating a program to solve this maze. The different situations the robot may encounter must be analysed:

    - There is no wall in front.
    - There is a wall in front and only a gap to the left.
    - There is a wall in front and only a gap to the right.
    - There is a wall in front and gaps both to the left and right.
    - There is a wall in front but no gaps to the left or right.

4. Then, pairs will be given a blank flowchart along with cut-out cards showing different conditions and actions to fill it out.

5. Students will complete the flowchart by placing the cut-out pieces in the correct positions.
   **A correct solution is provided in the cards section.*

6. The flowchart will be corrected as a whole group activity, so students can contribute their ideas. Once corrected, students will glue the pieces in the correct places on the flowchart (first delivery).

SECOND LESSON

7. The class begins by explaining its objective, which will be to use the flowchart from the previous session to create the program for the robot.

8. Each pair will be given a sheet with cut-out programming blocks, which they will then cut out.

9. Next, they will create the program (prototyping stage*), placing the blocks in the correct positions on the activity sheet.
   **It can be explained that in this project, a physical prototype will not be created; instead, the final product will be a program for the robot.*

10. Once they have finished, they will need to check that the created program is valid for at least two different mazes (evaluation stage).

11. After confirming the program is valid, students will glue the blocks onto the activity sheet (second delivery).

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Suggestions

Modifications or extensions to adapt the activity for students with more advanced programming knowledge:

- Do not provide the cut-out cards with actions and conditions for filling in the flowchart, so that they must complete it based on the explanations given in class.
- Additionally, ask them to create the flowchart from scratch, only indicating the types of blocks they should use (rectangles for actions and diamonds for decisions). An intermediate level of difficulty can be chosen where the flowchart is provided but the "yes" and "no" texts for each question are removed, so they can complete it.
- The activity can also be extended by providing blank grids for them to design their own mazes, allowing them to evaluate the effectiveness of the developed program.

Resources

- **Human:** teacher and students.
- **Material:** blank flowchart and cut-out cards to complete it, sheet with cut-out programming blocks, maze models, image of the robot to check if the programs work.

Space: classroom.

Type of activity: In pairs (except for the introduction and the flowchart correction, which will be done as a whole group).

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Sheet to submit the flowchart, program, and conclusion (print one per pair).

Sheet to cut out actions and conditions for the flowchart (one for every 4 pairs).

Programming blocks to cut out (print one per pair). **SOLUTIONS**: FLOWCHART PROGRAM

Simple maze with program (to be shown on screen, **DO NOT** print).

Complex mazes and blank grid (print one per pair).

What have we learned?

Assesment criteria	4 Excellent	3 Very good	2 Satifactory	1 Needs improvement
Development of the flowchart (programming logic).	The flowchart is clear and precise.	The flowchart is understandable with few errors.	The flowchart contains errors or is confusing.	The flowchart contains errors or is confusing.
Development of the program with blocks.	The block program is complete and works well.	It has few errors but works.	It has several errors and does not work properly.	It does not work or is incomplete.
Presentation of the sheet (flowchart and program).	It is clean and organised.	It is organised but has some untidy areas.	It is disorganised and has crossings-out.	It is is very disorganised and hard to read.
Collaborative work with classmate.	Excellent, helped and shared ideas.	Worked well but was occasionally less collaborative.	Participated little or did not collaborate effectively.	Did not work collaboratively.

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Computational Thinking

Logic (prediction and analysis): thinking to make predictions, solve problems and make decisions based on available information.

Algorithms (steps and rules): is a step-by-step process that solves a problem or completes a task.

Decomposition (breaking down into smaller parts): breaking down problems into smaller and more manageable parts, which are easier to understand and solve.

More information

In the following videos, you can see two examples of robots solving mazes, one at a school level and another at a competition level:

- Maze-solving robot mbot: https://www.youtube.com/watch?v=xsSRP68nFK4
- Competition maze-solving robot: https://www.youtube.com/watch?v=SxqKwhz9VPE (It can be seen how after traversing the entire maze, the robot is able to calculate the shortest path and on the second attempt reaches the center of the maze much more directly).

Both videos serve to verify the different situations a robot can encounter while navigating the maze, similar to what has been worked on during the activity.

QR codes to the activity resources:

Sheet to submit | **Actions and conditions** | **Programming blocks** | **Easy maze** | **Complex mazes**

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