

# Scaffolding Children's Development of Computational Thinking Skills During Learning with Robotics Activities: Implications for Teacher Training



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- The ability to express ideas in a computationally meaningful way is gradually becoming one of the most essential skills for succeeding in the modern workplace (Papert, 1980, 1993; Wilensky, 2001; Wing, 2006; National Research Council, 2010, 2011).
- When children are taught computational thinking skills at an early age, they are better able to recognize and solve real-world problems (Yadav, Zhou, Mayfield, Hambrusch, & Korb, 2011).

- Computational thinking is conceptualized as a thinking process used during complex problem solving.
- Computational thinking as a thought process that utilizes the elements of:
  - Abstraction (design a model about something),
  - Generalization (to recognize patterns and use a previous solution),
  - Decomposition (to break a complex problem to simpler ones),
  - Algorithmic thinking (sequencing and flow of control), and
  - Debugging (detection and correction of errors).

- We investigated computational thinking only from the point of view of:
  - Algorithmic thinking:
    - Sequencing of instructions and flow of control.
  - Debugging:

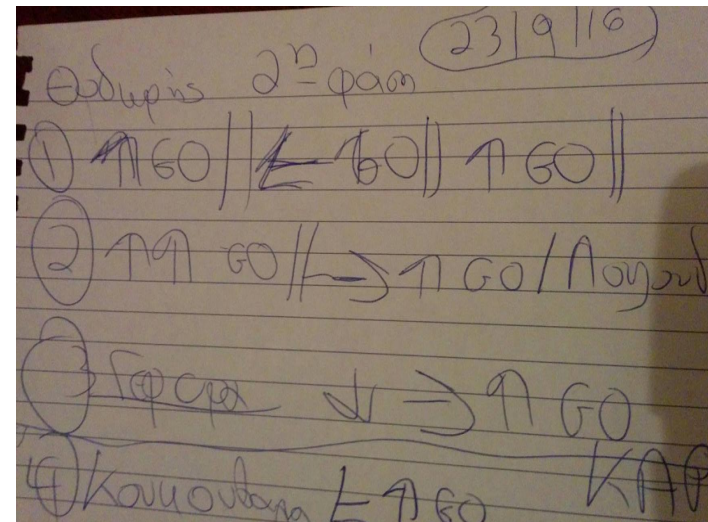
The ability to recognize and fix errors.

- Floor programmable robots



# Instructional Interventions

- Scaffolding techniques that provide external memory support during the educational robotics activities.
- Mat, problem-solving scenario, laminated cards with the commands, symbols to note down the path of the robot, embodied cognition activities.





# Scenario and Floor Mat



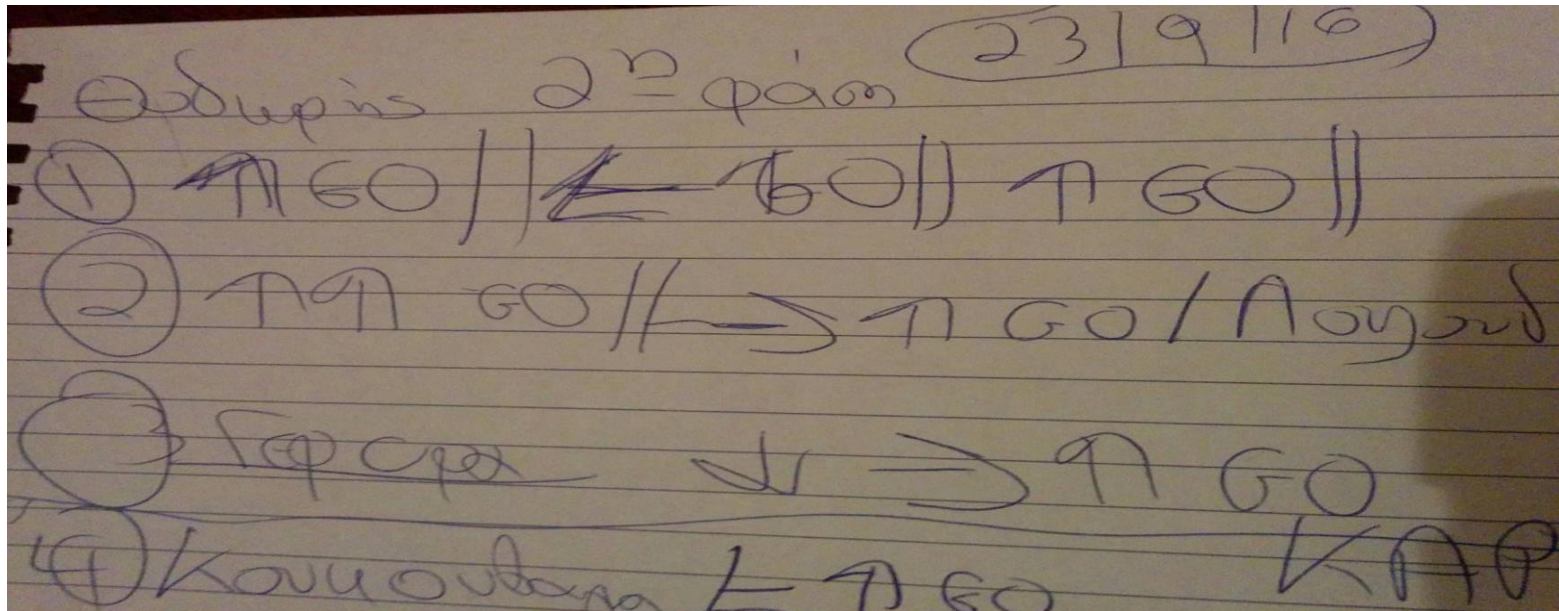
# Memory System





# Memory System

- The child indicates using his/her hand the route on the mat the robot will execute for a task.
- The teacher jots down the path.
- The child programs the robot according to the teacher's notes.



- Boys learn best with Type A external memory systems (putting the laminated cards in a sequence – because it was a technique that enabled them to move around – kinesthetic activity).
- Girls learn best with Type B external memory systems (working with the teacher to write down the sequence of actions).



- Teachers need to understand what computational thinking is.
- Due to the fact that they do not have a background in computing, their training creates challenges in terms of teaching them about designing algorithms and coding.



- Teachers need to use different types of scaffolding techniques to better facilitate children's memory systems as not all floor programmable robots provide a visual representation of the commands children use.
- Gendering seems to play a role, thus, teachers may need to use different teaching techniques for boys and girls.



**Thank you.**  
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