

# Mathematical Knowledge for Teaching with Technology

6<sup>th</sup> Grade School

Lecture 3 – 09/03/2023

Technology in Mathematics Education

+ How can technology support and promote thinking mathematically?



# Main Goal: Developing Students' Mathematical thinking

Mathematical thinking gives attention to the processes rather than content, although both are important for learning mathematics, and both are typically represented in school mathematics curricula, specially referred to as problem-solving.

TWO FONDAMENTAL PROCESSES:

1

- specialising
- generalising

2

- conjecturing
- convincing

# Cognitive technologies for Mathematical Education



Purpose functions



Process functions

# Purpose functions

Promoting the formation of pro-mathematics belief systems in students and thus ensure that students become mathematical thinkers who participate in and own what is learned. Students benefiting from purpose functions are no longer mere storage bins for or executors of "someone else's math. (according to Dewey's and Piaget's theories)

*Ownership*

*Self-worth*

*Knowledge  
for action*

*Functional  
Environments  
that Promote  
Mathematical  
Thinking*

*Social  
Environments  
for  
Mathematical  
Thinking*



(Pea, 1987)

# Process functions

Helping students understand and use the different mental activities involved in mathematical thinking. Process Functions that can be clearly identified for cognitive technologies in math education. Each provides important cognitive support:



tools for developing conceptual fluency



tools for mathematical exploration



tools for integrating different mathematical representations



tools for learning how to learn



tools for learning problem-solving methods.





## Tools for developing conceptual fluency

Fluency tools are programs that free up the component problem-solving processes by helping students become more fluent in performing routine mathematical tasks that could be laborious and counterproductive to mathematical thinking. Computer technologies can promote fluency by allowing individually controlled practice on routine tasks, thus freeing students' mental resources for problem-solving.



## Tools for mathematical exploration

### Learning by Discovery

The computational discovery learning environment provides a rich context that helps students broaden their intuition.



## Tools for integrating different mathematical representations

These tools help students develop the languages of mathematical thought by linking different representations of mathematical concepts, relationships, and processes.

Their goal is to help students understand the precise relationships between different ways of representing mathematical problems and the way in which changes in one representation entail changes in others. The languages of mathematical thought, which become apparent in these different representations





## Tools for learning how to learn

This category refers to software programs that promote reflective learning by doing. They start with the details of specific problem-solving experiences and allow students to consolidate what they have learned in episodes of mathematical thinking.



## Tools for learning problem-solving methods

This category of tools encourages *reasoning strategies* for mathematical problem-solving.

# Tool: Mathigon - Polypad



<https://mathigon.org/polypad>



Tool's exploration

Curriculum interrogation

Activity planning

