The coordinated and systematic use of digital technologies to foster, refine and extend students’ problem solving experiences

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Mathematical Education

How can researchers and practitioners construct a system and infrastructure to organise and use accumulated professional knowledge of the discipline to address, as a community, significant problems?
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How can we share and activate research results and developments in a coordinated way worldwide?
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Issues

1

2

3

4

5

How to **constructs** a collaboration network around the world that mobilises accumulated knowledge in problem solving?
Digital technologies are essential tools that people use to sustain individual and social activities. How can these technologies be integrated in research and learning environments?
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Ways to reconcile paper and pencil and digital approaches, empirical and formal reasonings
Mathematical problem solving developments

1945
Polya. How to solve it.
Hadamard. Essay on the psychology of invention in the mathematics field.

1976
English translation of Krutetskii (1968). The psychology of mathematical abilities in schoolchildren

1980
The NCTM agenda for action, Yearbook.

1982
Mason, Burton & Stacey. Thinking mathematically.
Mathematical problem solving developments

1985
Schoenfeld. Mathematical problem solving.

1989
NCTM Standards

1992
Schoenfeld. Learning to think mathematically

2000
NCTM Standards
Mathematical problem solving developments

2005

2007

2007
Törner, Schoenfeld and Reiss. ZDM: The International Journal on Mathematics Education

2014
Stephen Lerman. Encyclopedia of Mathematics Education
Dynamic representation and exploration
Digital technologies and cognition

Digital technology literacy for everyone
Digital technologies and cognition

Efficient connectivity (infrastructure) and tools’ appropriation
Digital technologies and cognition

Selection, synthesis and use of online information

Dynamic representations
Digital technologies and cognition

What types of transformation brings the systematic use of technology to disciplinary knowledge and curriculum?
Digital technologies and cognition

Structure of learning environments to extend mathematical discussions
Digital technologies and cognition

Ways to evaluate learners’ development of mathematical knowledge
Mathematical problem solving

Foundations, principles

Digital technologies

PS and creativity

Design of materials

Frameworks, models and modelling

PS and teachers education

Curriculum proposals and LE

Assessments, local-international

Ways to extend mathematical discussions
Problem solving and the use of digital technologies
Problem solving and the use of digital technologies

1. Comprehension
   What do I (we) know about the problem or concept?
Problem solving and the use of digital technologies

1. 

2. What do I (we) know about the problem or concept? Comprehension

3. 

4. 

5.
Problem solving and the use of digital technologies

How can we represent the problem and what technology could I use? Dynamic representations
Problem solving and the use of digital technologies

How can we represent the problem and what technology could I use? Dynamic representations
Problem solving and the use of digital technologies

Could I use several methods to solve the problem? What partial results can I present and discuss? Can I extend the initial problem?
Problem solving and the use of digital technologies

1. Could I use several methods to solve the problem? What partial results can I present and discuss?
2. Can I extend the initial problem?
Problem solving and the use of digital technologies

What methods, representations, concepts and strategies (ways of reasoning) are important?
Problem solving and the use of digital technologies

What methods, representations, concepts and strategies (ways of reasoning) are important?
Problem solving and the use of digital technologies

Can I use those methods to solve others problems and pose new questions?
Problem solving and the use of digital technologies

Can I use those methods to solve others problems and pose new questions?
Use of Dynamic Geometry Systems

- Accuracy of tasks digital representations
- Dragging and measuring strategies
- Sliders and explorations of parameters behaviours
- Loci as tools to explore and support objects mathematical behaviours
- Multiple interconnected representations
Exemplars
A dynamic triangle
Given a vertex of an equilateral triangle, and a line to which the other two vertices belong, find the location of the other two vertices. In how many ways can you construct such a triangle?
Final Remarks

1. A problematising approach to make sense of contents via the formulation of questions

2. Looking for different ways to represent and solve mathematical problems (contrasting the approaches)

3. Extending mathematical discussions via communication tools, listen to peers, colleagues (continual engagement)

4. Curriculum proposals that incorporates the use of digital technologies (what is essential in contents and ways of reasoning)

5. The use of technology to organise and control learning environments

6. Ways to foster and assess individual and group problem solving achievements including partial assessments