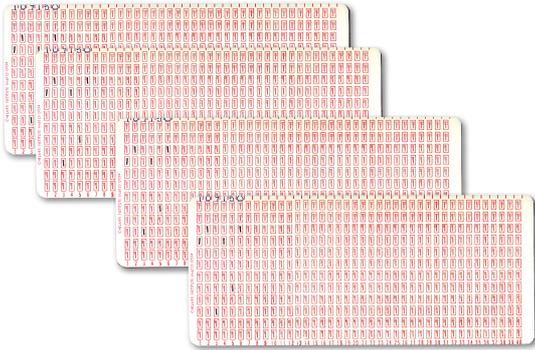


Algorithms
+ Data Structures
= Programs

Richard Millwood
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Institute for Educational Cybernetics
University of Bolton

@richardmillwood

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4

What research?

There **is little research to be found** related to the development of Algorithmic Thinking ...

... findings in Computer Science and Computer Education concerned older students and focussed on programming.

By contrast, in the field of mathematical education in general, and the psychology of mathematical education in particular, there is a **wealth of research and accepted theories**, developed over many years (Costello, Teaching and Learning Mathematics 11-16)

5

Research findings in Mathematics

Concepts in Secondary Mathematics and Science (1974-79)

wrong answers from inappropriate strategies, sometimes invented

maths is difficult, huge range of attainment amongst pupils of the same age

6

Research findings in Mathematics

Assessment of Performance Unit (1977-82)

development of an assessment framework based on concepts, skills and application dividing mathematics into topics - basis for National Curriculum

answered the question - "what percentage of students at what age have accurate understanding"

7

What thinking?

facts recall of terms, simple relationships

skills standard well-established procedures

conceptual structures complex and dynamic relationships, mental models

problem solving strategies analysis, creativity, execution

attitudes determination, motivation, love of subject, concern for quality & detail

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2005

ANGLIA RUSKIN UNIVERSITY

Developing of Algorithmic Thinking
in Middle School Pupils in Israel

NILI NAVEH

A Dissertation in partial fulfillment of the
Requirements of Anglia Ruskin University

For the degree of
DOCTOR OF PHILOSOPHY

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Algorithmic Thinking

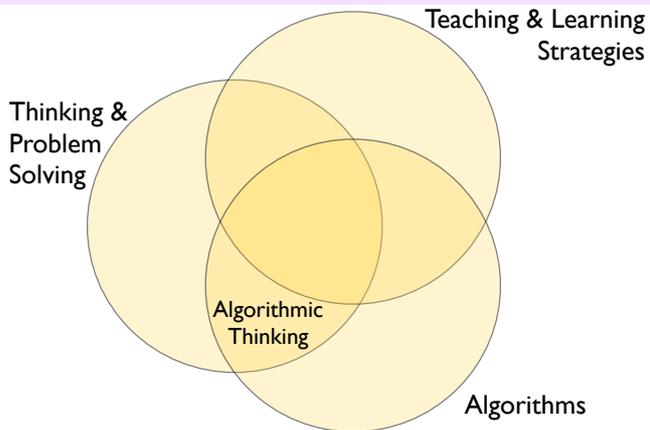
An algorithm can be defined as a collection of unambiguous executable instructions, whose step by step execution leads to a predefined goal, within a finite number of steps.

Algorithmic thinking occurs in the development of algorithms

Algorithmic Thinking is a **complex intellectual process** of thinking, combining facts, skills, etc.

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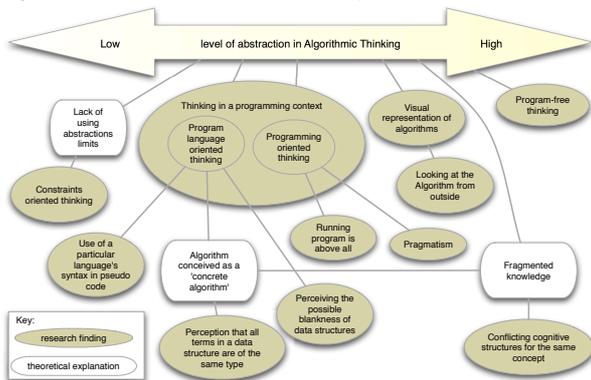
Nili's Conceptual framework



11

Nili's findings

Figure xx - Phenomena observed at different levels of abstraction, and the relationships between them



12

Questions:

1. What other research is there into computing thinking, whether about algorithmic thinking, data structures or programs - facts, skills, conceptual structures, problem solving strategies or attitudes?
2. How can learners benefit?
3. How can practitioners contribute, in the modern age of online collaboration?

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