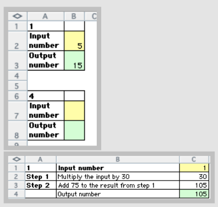
Promoting algebraic thinking in the middle grades using spreadsheets.

Spreadsheets and algebra



Promoting algebraic thinking in the middle grades using spreadsheets

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What is *Algebra*?

- Using and manipulating [algebraic] symbols
- Solving equations

Algebra Standard

Instructional programs from prekindergarten through grade 12 should enable all students to—

- Understand patterns, relations, and functions
- Represent and analyze mathematical situations and structures using algebraic symbols
- Use mathematical models to represent and understand quantitative relationships
- Analyze change in various contexts

Expectations for grades 6–8

Understand patterns, relations, and functions

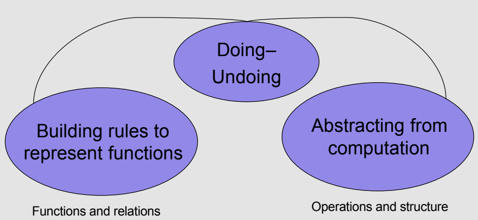
- represent, analyze, and generalize a variety of patterns with tables, graphs, words, and, when possible, symbolic rules;
- relate and compare different forms of representation for a relationship

Represent and analyze mathematical situations and structures using algebraic symbols

- develop an initial conceptual understanding of different uses of variables

Algebraic thinking

Algebraic thinking habits of mind:



Driscoll, Mark (1999). *Fostering algebraic thinking: A guide for teachers, grades 6–10.*

Spreadsheets

- Dynamic nature
  - Ability to see immediate results of calculations
  - Ability to perform many operations at once (or the same operation over a range of values)
- Students seem to like spreadsheets!

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Spreadsheets

- A *natural* environment for the introduction of the concept of *variable*
- Students learn to be explicit about what are they doing:

"Multiply by 3" vs "Multiply the number in A1 by 3"

Spreadsheets

- Spreadsheet applications haven't changed much in many years
- There are versions for every kind of computer and operating system

Practical considerations

- Use a big size font!
- Plan in advance, adjust the software preferences accordingly.
- Make sure students have pencil and paper.

Hardy and Ramanujan

Once, in a taxi from London, Hardy noticed its number, 1729. He must have thought about it a little because he entered the room where Ramanujan lay in bed and, with scarcely a hello, blurted out his disappointment with it. It was, he declared, "rather a dull number," adding that he hoped that wasn't a bad omen. "No, Hardy," said Ramanujan, "it is a very interesting number. It is the smallest number expressible as the sum of two cubes in two different ways."

Guiding questions

- How does the rule work?
- Can I write a mechanical rule that will do this job once and for all?
- Now that I've found my rule, how do the numbers (parameters) in the equation relate to the problem context?

Difficulties of generalization

- Students may generalize too quickly
- Pattern spotting can remain trivial
- Students can generalize about the wrong properties

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Justification

- Students must give convincing arguments for the rules, to justify their generalizations.
- Many patterning activities are difficult to justify, and are not helpful to encourage students to build explicit rules from recursive relationships.

Levels of sophistication in procedural thinking

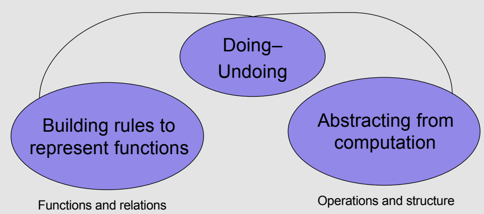
1. Students' knowledge of a procedure is restricted to performing it
2. Students see a procedure as applicable to numerous instances rather than one particular case
3. Students can reflect on, decompose, and analyze a numerical procedure

Guiding questions

- How is this calculating situation like/unlike that one?
- When I do the same thing with different objects (numbers), what still holds true? What changes?

Algebraic thinking

Algebraic thinking habits of mind:



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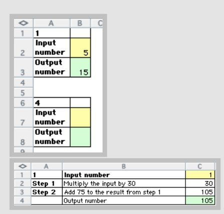
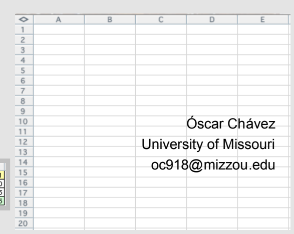
Copies of the handout and the Excel files can be found at:
http://www.missouri.edu/~oc918/mctm02





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