Chapter 4

CONVENTIONAL COMPUTING METHODOLOGY

4.1 – Whole Number Operations

- An **algorithm** is a sensible step-by-step procedure for carrying out an operation
  - Knowing an algorithm is within the category of "procedural knowledge"
  - Knowing why an algorithm works the way it does is within the category of conceptual knowledge
- Formation of algorithms
  - Algorithms came into existence as people attempted to become as efficient and speedy as possible in their calculations.
  - Algorithms exist in all levels of education and in all subjects

Different Algorithms for Addition

- Non-algorithmic procedures (conceptual methods)
  - Using base blocks
  - Using an empty number line
- "Standard algorithm" for addition
- "Partial sums" algorithm
  - You should know how to do each of these methods

Different Algorithms for Subtraction

- Non-algorithmic procedures (conceptual methods)
  - Using base blocks
  - Using an empty number line

- “Standard algorithm” for subtraction
- “Negatives” method
- “Equal additions” method
  - You should know how to do each of these methods

Multiplication and Division

- Multiplication and division algorithms are often more difficult for children to understand than addition and subtraction.
  - However, if children have a more conceptual understanding of place value, they can think of multiplication in terms of *partial products*.
  - They can also think of division in terms of the *place value breakdown*.

Different Algorithms for Multiplication

- Non-algorithmic procedures (conceptual methods)
  - Using base blocks
  - Repeated addition
  - Array model

- “Standard algorithm” for multiplication
- “Partial products” algorithm
- “Lattice” method
  - You should know how to do each of these methods

Different Algorithms for Division

- Non-algorithmic procedures (conceptual methods)
  - Using base blocks
  - Repeated subtraction

- “Standard algorithm” for division
- “Partial quotients” method
  - You should know how to do each of these methods

Practice activity

- Practice alternate methods!
  - Partial sums
  - Equal additions
  - Partial products
  - Place value breakdown

Value of base ten blocks while teaching

- Offers a conceptual way for the student to understand each operation
- Expanding the limitations
  - How do we represent the following with base ten blocks?
    - 1.2 ?
    - 37.9 ?
    - 0.67 ?
    - 0.00243 ?
    - 6,273,000 ?
- Limited to four place values?
  - Can represent further, but it loses a lot of the value…

Moving the decimal point rule

$$25.25\overline{)1{,}767.5}$$

$$2{,}525\overline{)176{,}750}$$

Equivalent!

- How does the moving decimal point rule work?
- **Why** does this rule work?

Moving decimal point rule

- Examine the following problems using the rule.

- 42 ÷ 14
- 420 ÷ 140
- 0.42 ÷ 0.14

- What does this tell you?
- What is happening in each case?

Discussion

- Think back about when you first learned standard algorithms
  - What do you remember about learning algorithmic procedures in school?
  - Did you understand these procedures?
  - Did you understand <u>why</u> they worked at the time?
  - Were they easy or difficult to learn?
  - Were they easy or difficult to remember?
- Do you use them often *now*?
- How important is it to be able to do these procedures rapidly with pencil and paper *now*?

Calculators

- Calculators are ubiquitous these days, even amongst young children, and are much faster than human algorithms
  - Why do we need paper and pencil understanding anymore?
- Pen and paper algorithms still offer good practice and help aid conceptual understanding
  - Should we still focus on emphasis on learning how to do simple arithmetic operations quickly?
  - Is the <u>how</u> or the <u>why</u> of an algorithm more important to teach?
- Do calculators inhibit conceptual learning of mathematics?
  - Contrary to what is believed by many, research has shown that the availability of calculators does not hinder the learning of basic skills and can, in fact, enhance learning and skill development when used appropriately

Calculators

- Do calculators inhibit conceptual learning of mathematics?
  - Contrary to what is believed by many, research has shown that the availability of calculators does not hinder the learning of basic skills and can, in fact, enhance learning and skill development when used appropriately
  - Keep in mind that students often don't understand enough about arithmetic operations to be able to choose the suitable operation to be applied to a real world problem; in such cases a calculator is useless.

- The annoyed student may ask "well, Professor Havens, why can't I use a calculator on my next exam?"
  - Not using a calculator helps you future teachers out there learn how to
    - Do the standard algorithms correctly (or practice for those who are rusty)
    - Develop your own personal *number sense* through practice