

Meaningful counting skills

John Munro

Meaningful counting is to do with ordering and sequencing numerically. Many mathematics learning difficulties can be overcome by developing the relevant meaningful counting knowledge.

Meaningful or rational counting ? Rote counting : reciting the number names in order.
Meaningful or rational counting : manipulating numbers using their ordinal properties Examples:

- arranging a set of quantities in either an increasing or decreasing counting order,
- extending counting patterns, applying the counting properties to unfamiliar numbers
- applying counting number sequences in real-life contexts to interpret , solve problems,
- deciding whether a particular counting pattern is increasing or decreasing,
- counting down or up from any number a certain number of steps,
- identifying repetitive properties of counting sequences, and
- recognizing when a set of numbers is / isn't in counting order.

Physical counting strategies : order quantities and recognize patterns among quantities. **Mental counting strategies:** apply counting to numbers, manipulate numbers mentally, when we

- decide that one number is larger than another,
- make a mental picture of the numbers in order and
- act on this picture, move up and down through the sequence of numbers.

meaningful physical counting -----> ^{internalize} meaningful mental counting

Meaningful counting : A basis for mathematics learning at all levels.

- understanding order among numbers.
- recalling a portion of the numbers in order.
- linking a mental action with each mathematical operation.
- developing mental arithmetic skills.
- learning and performing measurement skills and for reading scales.
- making a mental picture or visualization of the numbers in order.

Helping students to picture mentally a section of the counting sequence Many mathematics underachievers have difficulty visualizing a portion of the numbers in order and using this picture. Students begin with a concrete or pictorial representation of the numbers and act on it. As their competence develops, the amount of physical action and pictorial information are gradually withdrawn, and they perform more of the task mentally. Gradual fading out is important. Many student can't move from concrete, physical contexts to mental manipulation. They need several smaller steps. An example is shown for counting on three steps from a 2-digit number.

- (1) students count on three steps on a complete number path or ladder, touching each number if necessary,
- (2) students count on three steps on the path or ladder but don't touch the numbers,
- (3) students count on three steps on partly obscured number path, and provide the missing numbers,
- (4) more of the number path is gradually obscured until all students see is the initial number and they need to count on the three steps mentally,
- (5) students imagine the ladder, with 42 on the first rung and the other rungs numbered. They take one step, two steps, etc.

The gradual withdrawal of the model is tied to students' skill to do more of the mental work. It must not be too swift. Students can say aloud what they are doing and picturing. They can count aloud as they move up the mental ladder or say the number they are placing on each rung before counting.

Useful concrete and pictorial models for developing counting skills

- Quantities and quantity cards
- Number ladders and number paths
- Number cards
- Number sequences in contexts
- Number lines and rays.

A sequence for teaching counting strategies I recommend working on meaningful counting skills for each of the following ranges of numbers:

●----- ●-----●-----●----- ●-----●-----●----- ●----- ●----- ●----- ●-----
 0 to 10 0 to 20 0 to 100 0 to 1,000 0 to 1,000,000 >1,000,000 1-dec. pl. 2-dec pl. directed numbers.

Within each range of numbers, counting strategies be developed in the following sequence:

1. Order or sequence quantities in counting order, interpolate extrapolate.
2. Oral or number count forward or up from the starting number in steps of one.
3. Oral or number count backward or down from terminal number (20, 59, etc) in steps of one.
4. Oral or symbol count forwards or up from any number within the range in steps of one, point one, point zero one etc.,
5. Oral or symbol count down or backwards from any number in steps of one point one, point zero one etc.,
6. Oral or symbol count forward and backward from any number across discontinuities (count between ranges) in steps of one, point one and point zero one,
7. Oral or symbol count up or down a specified number of steps from any number, first within a range, and later between ranges,
8. Use terms such as *more, less, before* and *after* to relate numbers in the range,
9. Oral or symbol count the number of steps from one number to another.

This set of skills can be developed for each of the areas of numbers described above.