# Classroom Tips for Teaching Measurement

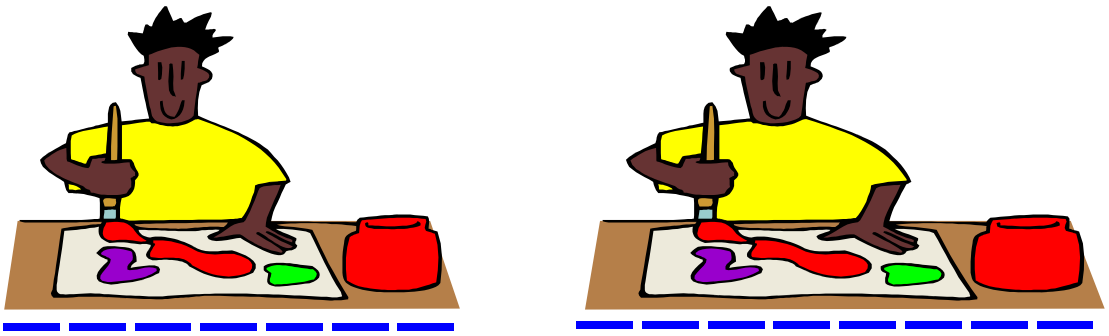
**By Mairéad Ryan**

A national mathematics test in 1999 found that Irish pupils performed best on items dealing with data and chance, number and algebra and poorest on items with measures and shape and space. One possible reason for this is that teachers placed considerable emphasis on teaching number and the areas that received comparatively less emphasis were the content areas on which pupils did relatively poorly. 'The availability of suitable mathematics equipment and the development of appropriate learning environments in which to use such equipment may affect the allocation of time' to non-number strands (Sheil & Kelly, 2001). Coupled with the need to allocate more time and resources to the teaching of measurement is the need to consider a better approach to teaching it.

Research in the US (Kamii and Clark, 1997) reveals that something is something clearly wrong with the instruction given in the measurement of length. Kamii and Clark suggest a better approach that presents problems and encourages children to modify their ways of thinking.

## Piaget's Research

Unit iteration is the repeated use of a non-standard or standard unit to measure (see diagram). Transitive reasoning is the ability to deduce a relationship from two or more other relationships of equality or inequality.



Which table is wider? Unit iteration to compare the widths of the tables (gaps between blue sticks are for illustrative purposes only)

Many four year olds can deduce that the stick A is longer than B at a quick glance. When A is removed and hidden and C is positioned beside B, there is again no difficulty answering that B is longer. However when asked ‘is this stick (C) as long as the hidden one (A), or is this one (C) longer, or is the hidden one longer, four year olds usually answer they don’t know because they cannot see A and C together. When they later become able to deduce, usually at the age of seven or eight that A is longer they are said to have transitive reasoning. (Piaget 1970)

Kamii and Clark state that the two cognitive abilities necessary for children to measure length are transitive reasoning and unit iteration. Unit iteration is constructed out of transitive reasoning. Transitive reasoning in the example given involved comparing the whole of A with the whole of C, by means of a third term, B (i.e. if A is longer than B and B is longer than C then A must be longer than C). Unit iteration, on the other hand, involves making a part-whole relationship within each of these wholes. They believe that typical instruction treats measurement as a mere empirical procedure (based only on observation) rather than as a procedure requiring reasoning. Aligning paper clips along a pencil and counting them is an empirical procedure. In contrast, transitive reasoning is the mental ability to compare two lengths using a third term. Unit iteration involves mentally making a part-whole relationship between the total length and the length of a smaller object viewed as part of the whole length. Kamii and Clark are critical of the way measurement is presented in many textbooks. The purpose of measurement is to compare things that cannot be compared directly. This idea of comparison is absent from textbooks. The usual format is ‘How many cms, grams, litres etc’?’ and motivate only to give a number to the teacher. Skinner (1990) defines a problem as a question, which engages someone in searching for a solution. She contends that the use of ‘contrived problems’ that appear in textbooks is often merely gimmicky. They can become useful problems, but only if adopted by the problem-solver for some purpose beyond satisfying a teacher’s requirement.

# Activities that encourage the development of transitive reasoning and unit iteration

We want to put a chart on the door with all the children's names. The sheets of cardboard of different sizes are stored in the office. How do we find a sheet (first time) that will fit on the door?

Possible solutions to this open-ended question:

* **Transitive reasoning:** a piece of string or ribbon
* **Transitive reasoning and unit iteration**: pencil, ruler or metre stick

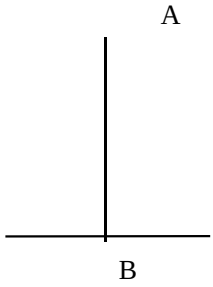
  - Is the doorway wide enough to bring in a large table?
  - Will a box of bricks fit on the shelf?
  - Is there room against the wall to fit the computer desk?

These questions must be answered by indirect comparison and not through an empirical procedure. Encouraging children to interpret the problems and communicate different approaches to solving the problems will develop and extend their understanding. These problems promote student engagement with authentic mathematical activity. 'Instruction must encourage children to think hard and to modify their thinking, rather than teach empirical procedures that do not take their thinking into account'. (Kamii and Clark 1997)

Giving the children a reason to measure that has relevance to them will encourage active engagement in the task. At times measurement activities can become an arduous task within the confines of the classroom so why not consider moving out into the corridor or the P.E. hall.

## Some suggestions for measuring for a reason

* How many plates will fit along a shelf?
* How much ribbon do you need to wrap around different sized boxes and tie a bow?
* Which line is longer A or B? (Optical illusions can be a good source of these questions.)




* Measure the distances to different parts of the school and design signs to display the distances.
* Arrange a skittle game with empty 2 litre and 3 litre plastic bottles and a hoop. Bottles must be placed 5 metres from the hoop. Estimate the distance. How many metre sticks do you need? Can you use just one metre stick? Could you use anything else?

## References

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