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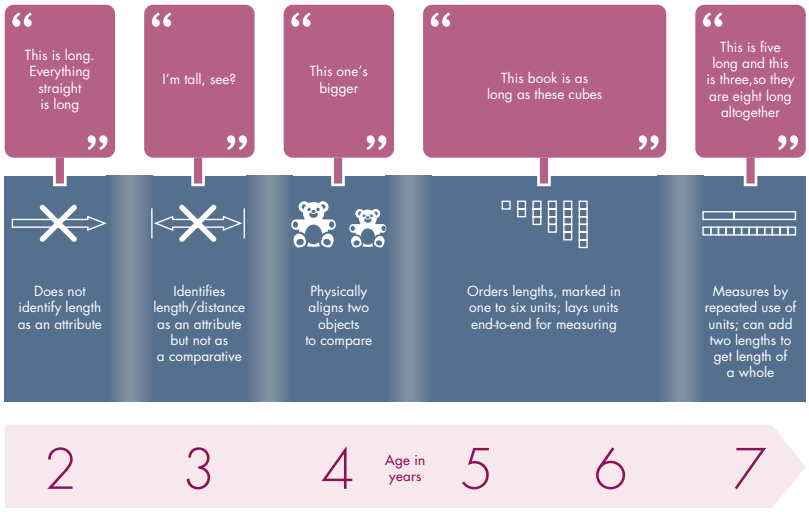
TALKING POINT:

HOW MIGHT RESEARCH HELP IN THE EFFECTIVE TEACHING OF EARLY MEASUREMENT?

IN SUMMARY

- The concept of early measurement is complex and important but not currently as well researched as number
- At least four important ideas are embedded in the overall concept of measurement
- The development of mass, volume and angle follow approximately the same structure as length
- Pupils must begin with a thorough understanding of and ability to use language to describe physical attributes of objects
- Attention should be drawn to the idea of identical units, the size of units versus the quantity needed, and actions that conserve the measure
- Pupils should then design, make and use their own tools to read off measurements, considering the need for a standard unit
- Benchmark units such as centimetres, metres, kilograms, litres and right angles should be introduced and pupils should use them to make sensible estimates

How does length measurement develop over time?



(adapted from Clements & Sarana 2009)

1

Early conceptual development of mathematics requires experiences in two areas: number, and geometry & measurement, with concepts of the number line and counting linking the two[3]. However, 'research on teaching and learning measurement is less robust and less extensive than research on other domains such as number'[1].There is evidence for 'an intuitive understanding of length'; even children as young as two to four can use the same three types of measurement standards that adults use: *perceptual* (comparing things to one another), *normative* (comparing to a standard stored in the memory) and *functional* (asking if things are the 'right' size)[3] . However, measurement is a complex idea. It contains (at least) four main concepts which build on each other: the relationships between the attribute being measured and the unit; the relationship between size of unit and how many units you need; the need for repeated units; and the need for identical units[2,3,8]. This general progression in developing a sense of measure is mostly described in the literature in terms of length but can also be applied to volume, mass and angle, with some adaptation and consideration of specific misconceptions.

IMPLICATIONS: Both number and geometry & measurement are areas that early mathematical development should focus on, although number is currently much more thoroughly researched

The concept of measurement is complex and the developmental building blocks which are common to all measures should be carefully attended to in planning

'Measurement applies some of the earliest mathematics that children learn, and there are many informal and formal opportunities to support this development in the classroom. In play, measurement is already very meaningful, particularly around fairness.' **Linda Platas**

'comparison is needed to meaningfully describe length...For example, to say "my pencil is long" does not have a lot of meaning, but to say "my pencil is longer than yours" is meaningful'
New Zealand Maths Education guidance

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The first step towards early understanding of measurement is appreciating and understanding the attribute to be measured[3]. Through play, pupils are given opportunities to develop an awareness of physical qualities and, alongside, develop the language to describe them[4]. It is particularly important to consider the language of time and length because many words used to describe length are also used to describe time[7]. Pupils develop a sense of measure through comparison; firstly, without numbers. This includes visual comparisons: directly and eventually indirectly using a third object, which in the case of length might be string or something similar[5]. This stage may also involve rearranging, transforming or ordering a series of objects according to a specific attribute[3,7]. Pupils often mistakenly start at 'one' rather than 'zero' (the origin principle) as they make simple links to counting rather than considering more developed ideas of space-covering[3].

IMPLICATIONS: To begin to understand measure, pupils must first appreciate and understand that there are different physical attributes that can be measured

Teachers should encourage language development carefully to support concepts of measurement, including differentiating between geometric length and time concepts

Teachers should be aware of the importance of, and plan for, play in the conceptual development of measure Links to number lines and counting should include exploring the different uses of zero in number and measure

3

In *pacing off* (iterating a unit to measure) pupils progress to using repeated non-standard unit measures to match the object being measured, and count it as it is repeated. This process may begin with gaps, overlaps or other errors including choice of unit in the wrong dimension[6,7]. It is important to focus on the importance of identical units at this stage[6], to explore the significance of using smaller units[8], as well as helping pupils to recognise actions that conserve the measure – for example, decomposing and recomposing the area of 2D shapes, or pouring liquid into different containers[4,3].

IMPLICATIONS: As pupils start to use/count a repeated unit measure (with errors to begin with), teachers should draw their attention to the idea of identical units

Other important factors to highlight are the relationship between the size of unit and the number counted, and actions that conserve the measure

4

The more advanced stage in developing a sense of measure is *reading off* (choosing/using a tool to read measurements from), where pupils design, make and use their own measuring tools, using them to measure and read off values. They explore the need for a standard unit of measure and start to gain an intuitive feel for a limited number of standard benchmark units that the teacher introduces which allows them to start to make sensible estimates: for example centimetres, metres, kilograms, litres and right angles.[3]

IMPLICATIONS: Pupils should be encouraged to design, make and use their own tools to read off values, progressing to using standard units

A small number of standard benchmark units should be introduced to give pupils an intuitive sense of their size and allow them to make sensible estimates

Lucy Rycroft-Smith, Rachael Horsman & Lynne McClure, 2018

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