

Teacher support materials

What is numerical reasoning?

Estyn defines numeracy as ‘the ability to apply simple numerical facts, skills and reasoning to real-life problems’¹. Similarly, the Welsh Government defines numeracy as ‘identifying and applying numerical reasoning in order to solve a problem, and carrying out the numerical procedures which enable people to work out and show their solutions’².

Procedural knowledge focuses on the ability to recall numerical facts and procedures. Numerical reasoning focuses on the ability to apply those facts and procedures within a wide range of contexts. It is about ‘making sense’. It requires active engagement from the learner to think mathematically, choosing what to do and how to do it.

An example may help to clarify the difference between applying procedural knowledge (what to do) and applying numerical reasoning.

Procedural knowledge	Numerical reasoning
■ Multiply 345 by 27	■ If you know that 345×27 is 9315, how could you quickly work out 345×54 ?

Multiplying 345 by 27 requires the application of a process of steps that, applied correctly, leads to the answer of 9315. Provided the learner can remember the process, they can apply the steps with little or no understanding.

In contrast, the unfamiliarity of the numerical reasoning question requires learners to stop and think. It requires insight (that 54 is double 27) and a depth of understanding about relationships within the number system (that because 54 is double 27, 345×54 must be double the answer to 345×27). It offers a springboard for further thinking: what else could you work out if you know that 345×27 is 9315?

The numeracy component of the National Literacy and Numeracy Framework (LNF) sets out expectations for the development of numerical reasoning. It requires learners to do the following.

■ Decide for themselves what numerical skills to use

For numerical reasoning, getting started may require information to be pulled together in order to break into a problem. Learners choose for themselves an appropriate and efficient method. They may also need to decide what information is relevant, and what is not.

For procedural knowledge the relevant skill is clearly identifiable and, provided the relevant numerical skills have been taught and remembered, the route to the solution is clear.

■ Apply their method to work towards a solution

Sometimes, once the hurdle of knowing what to do has been overcome, the implementation of the chosen method may simply require the application of procedural knowledge. However, in more complex, multi-step problems, such as the example above, learners must work logically and analytically in order to make decisions about how to proceed.

¹ *Numeracy in key stages 2 and 3: a baseline study* (Estyn, June 2013)

² *National Numeracy Programme* (Welsh Government, September 2012)

■ Give coherent mathematical explanations

The ability to explain, orally and/or in writing, is a key component of numerical reasoning. Learners need to be able to articulate their thinking, using words, diagrams, and/or symbols, so that others can make sense of their work.

■ Reflect on the outcomes

Sense checking is an integral part of numerical reasoning. The application of common sense and number sense require learners to stop and think if their solutions make sense, and if not to revisit their method and working in order to establish what has gone wrong and why.

The role of the teacher

Learners learn by exploring, noticing and discussing. If they are to become self-reliant, independent mathematical thinkers, they need a wide range of opportunities to choose and apply their numerical skills and understanding. Open tasks and problem-solving activities support them in understanding that some problems have more than one solution, and encourage learners to be open to finding, and reviewing, different methods.

The teacher's role in this development is key; not only by providing a range of different activities but also in using effective questioning techniques to probe learners' thinking. Adopting a day-to-day approach that encourages and challenges learners to think about what they are doing (the 'why' as well as the 'what'), helps learners to become proficient in choosing their own methods, communicating effectively and reviewing their work.

Reasoning in the classroom – teacher support materials

For each year group, the Welsh Government has provided a range of tasks that support numerical reasoning. The Reasoning in the classroom materials provide teachers with an array of different activities, using a wide range of delivery approaches with coverage across the LNF. These activities can be found at <http://learning.wales.gov.uk/learningpacks/reasoning-in-the-classroom/?lang=en>