

Using number lines to enhance number sense in Prep – Year 3

Factsheet

Key messages

Number lines are important tools for enhancing students' number sense. Incorporating number lines in teaching and learning promotes the active construction of mathematical meaning by strengthening students' mental representations of number magnitude, number relationships and mathematical operations.

Number lines are based on measuring from a fixed point. This requires a shift in thinking from a counting model that focuses on the number of objects in a set to a measurement model that counts units of length. This shift in thinking means that students require explicit and systematic teaching about number lines.

There is a strong correlation between a deep understanding of number lines and the development of more advanced mathematical concepts. Number lines are also an important aspect of the numeracy knowledge and skills that people require to function well in the world. This factsheet provides key considerations for instruction with number lines to promote students' active construction of mathematical meaning.

Bridging experiences for number lines

A number track or number path can help bridge understanding to number lines by connecting the counting model to the number line structure.



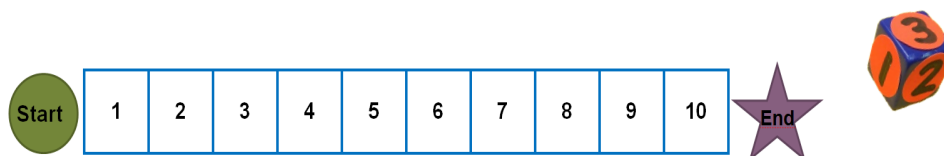
Learning experiences that build students'

understanding of the relationship between number as a symbol and number as a measurement include students working with a large-scale number path, such as the one in the image above, to:

- walk along the track as they count aloud to emphasise the notion of numbers being evenly spaced
- stand on specified numbers by following clues based on the order and relationships between numbers. For example, stand on the number that comes before 7 or move to the number that is 2 less than 5.


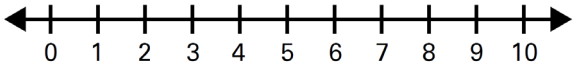
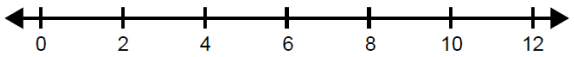
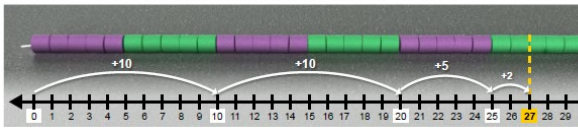
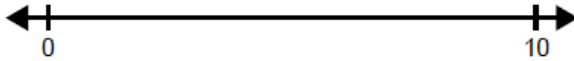
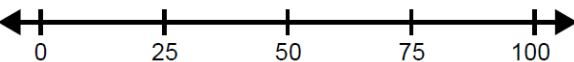
Simple board games that include number paths can also assist in developing the concept of numerical magnitude and assist in more accurate use of a number line. Consider the simple game in the following image where each player rolls a dice and moves forward the corresponding number of spaces, saying each number in turn.

For example, if I am on 4 and I roll a 3, then I would count as I move my counter: 5, 6, 7.



Teaching and learning sequence

Making connections between a range of representations of a number line provides opportunities for students to build their understanding while strengthening their number sense. The following table below shows a suggested sequence for developing students' mental representations of number order, magnitude and relationships.

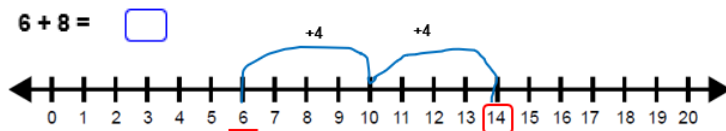
Stage	Description	Visualisation
1	<p>Begin with number paths (number tracks).</p> <ul style="list-style-type: none"> These tools incorporate unit length and can help bridge understanding to number lines. 	
2	<p>Progress to a structured number line with marked segments.</p> <ul style="list-style-type: none"> Introduce the idea of zero and explicitly model counting spaces between the partitions. Students sometimes hold the misconception that number lines involve the counting of lines rather than spaces. Reinforcing the counting of spaces at this early stage is crucial to building understanding of number lines. 	
3	<p>Gradually reduce the amount of number labels.</p> <ul style="list-style-type: none"> Explore skip counting patterns. For example, counting in 2s, 5s or 10s. 	
4	<p>Provide bridging learning experiences to the open number line.</p> <ul style="list-style-type: none"> Introduce how to locate and represent numbers on an open number line using strings of beads that alternate in colour. 	
5	<p>Open number lines.</p> <ul style="list-style-type: none"> Students are given a number line with no partitions except for 0 and 10 and are asked to place other numbers on the line. 	
6	<p>Extend the range of the number line.</p> <ul style="list-style-type: none"> Explore patterns and number referents that will support students in locating numbers and operating with numbers. 	

Number operations with the open number line

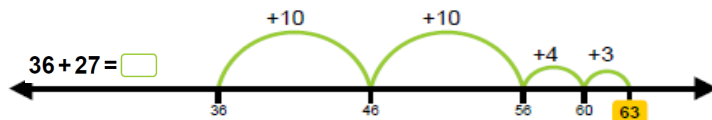
A number line can be an important tool for modelling strategies in addition and subtraction. It supports students to visualise the action of the operation, the magnitude of the numbers and the distance moved (Siemon et al. 2015).

To begin, use a segmented number line to demonstrate strategies for solving simple operations. Model how numbers can be partitioned to make them easier to work with and make thinking processes clear by drawing the steps taken.

In the example below, where 8 is being added to 6, the 8 is partitioned into 4 and 4. This allows the first step of building to 10 by adding a 4 to the 6. The next step involves adding on the second 4 to arrive at the solution of 14.



Students progress to working with an empty number line and recording only the relevant numbers. The example below demonstrates how the effective use of an empty number line to carry out operations requires students to partition numbers flexibly and count by tens, both on and off the decade.



The strategy a student employs will vary according to the numbers involved and their level of understanding and fluency. As strategies become more sophisticated, the number of jumps will generally decrease. It is important to provide opportunities for students to share strategies they used on the number line and demonstrate their reasoning. Subsequent discussions on the strengths of various strategies allow students to refine their thinking and develop increasingly efficient mental strategies.

References

- Australian Association of Mathematics Teachers Inc., 'Number lines',
www.aamt.edu.au/Topdrawer/Patterns/Misunderstandings/Number-lines
- Bobis J 2007, 'The empty number line: A useful tool or just another procedure?', *Teaching Children Mathematics*, 13, 410–413,
www.researchgate.net/publication/237280161_The_Empty_Number_Line_A_Useful_Tool_or_just_Another_Procedure
- Diezmann, C & Lowrie, T 2006, 'Primary students' knowledge of and errors on number lines: Developing an evidence base', In Grootenboer, P, Zevenbergen, R & Chinnapan, M, eds, *Proceedings 29th Annual Conference of the Mathematics Education Research Group of Australasia*, 1, 171–178,
www.researchgate.net/publication/251792227_Primary_Students'_Knowledge_of_and_Errors_on_Number_Lines_Developing_an_Evidence_Base
- Frykholm, J 2010, 'Learning to think mathematically with the number line: A resource for teachers, a tool for young children', The Math Learning Center, USA,
www.mathlearningcenter.org/sites/default/files/pdfs/LTM_Numberline.pdf
- National Council of Teachers of Mathematics (NCTM) 2014, *Principles to Actions: Ensuring mathematical success for all*, NCTM, Reston.
- Simon, D, Beswick, K, Brady, K, Clark, J, Faragher, R & Warren, E 2015, *Teaching Mathematics: Foundations to middle years*, 2nd edn, Oxford University Press, Melbourne.
- Western Australia Department of Education 2013, 'Number — Book 1: Understand whole and decimal numbers, understand fractional numbers', *First Steps Mathematics*,
<https://myresources.education.wa.edu.au/programs/first-steps-mathematics/number>
- Woods, D, Ketterlin Geller, L & Basaraba, D 2017, 'Number sense on the number line', *Intervention in School and Clinic*, vol. 53, issue 4, pp. 229–236



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