Exploring place value through decimal fractions in Years 4–6

Factsheet

Key messages

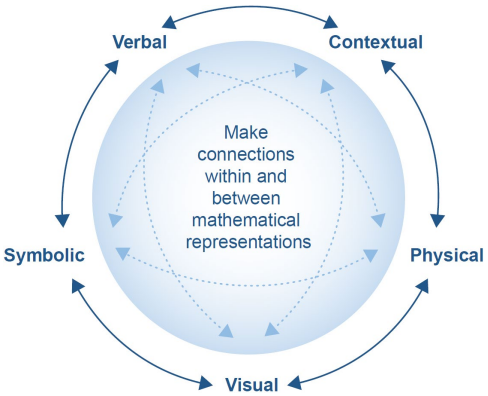
Decimal numbers are an integral part of the numeracy skills we need to operate in everyday life. Students require a deep understanding to be able to read, comprehend and manipulate decimal numbers. The following information focuses on the early fractional constructs underpinning decimal numbers and research-based strategies for developing place-value understandings of decimal numbers through a focus on decimal fractions.

Foundations of decimal fraction thinking

Decimal fractions need to be understood as fractions before they are introduced as an extension of the base-10 number system (Siemon et al. 2015).

Mathematical representations

Mathematical representations are extremely important in developing fractional thinking. Students who can efficiently partition area, set and line models, and name fractions in a variety of ways are more likely to have a deeper understanding of the link between fractions involving tenths and the base-10 number system. Effective teaching of number engages students in making connections within and between the five types of representations: physical, visual, symbolic, verbal and contextual (National Council of Teachers of Mathematics 2014).



Essential fractional constructs

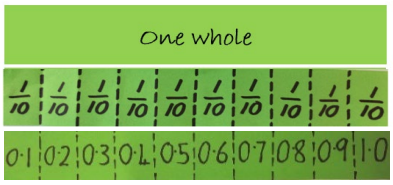
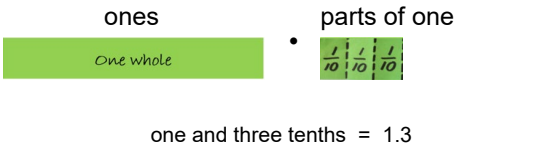
A literature review on the relationship between fractions and decimals (Smith 2017) identified the essential fractional constructs, or conceptual stepping stones, necessary for students to develop meaningful understanding of decimal concepts.

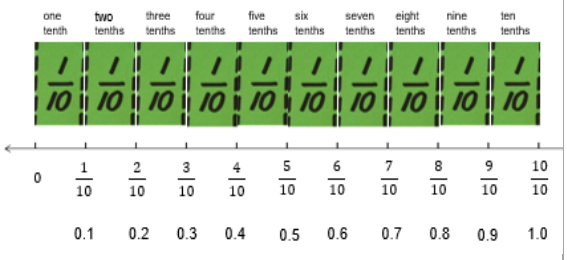
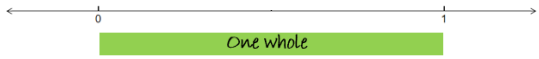
Fractional construct	Explanation
Notion of a whole	The value of all fractions is determined relative to the value of the unit or whole.
Whole can be partitioned into equal-sized unit fractions	This builds understanding of the inverse relationship between the number of pieces created when partitioning the whole and the size of the resulting unit fraction.
Repetition of unit fractions	The repetition of unit fractions is used to create non-unit fractions, e.g. I have $\frac{1}{5}$ and $\frac{1}{5}$ and $\frac{1}{5}$. I have three fifths.
Benchmark fractions	Benchmark fractions are commonly used fractions, such as $\frac{1}{2}$, $\frac{1}{4}$ and $\frac{3}{4}$, that help visualise fractional quantities, equivalences and location on a continuum.

Developing decimal understanding

Decimals should be introduced in much the same way that hundreds and thousands were introduced into the whole number system — by making, naming and recording new numbers in relation to what is already known (Siemon et al. 2015).

Below are suggested activities for building students' understanding of key concepts when establishing **tenths as a new place-value part** in relation to **one whole** that is already known.

Activity	Visualisation
Decimals are fractions with denominators that are powers of 10. Students construct tenth fraction strips and use them in activities, such as counting in tenths, comparing magnitude of various fractions involving tenths or comparing one tenth to other unit fractions.	
The decimal point separates whole numbers from parts-of-whole numbers. Support students' understanding by linking decimal recording to models they have made and reinforce the language of decimal numbers.	
Decimals can be partitioned in the same way as whole numbers. Draw students' attention to the connection between facts to 10 and decimal facts to 1. While working with tenths, pose questions such as: • How many more tenths do I need to make a whole? • If I take away five tenths, how many tenths remain?	Shade seven tenths  Write seven-tenths as: • a fraction $\frac{7}{10}$ • a decimal 0.7

Activity	Visualisation
Decimals are numbers that can be located on a number line. Provide opportunities that establish the link between physical representations and the number line, e.g. count in tenths, jointly create a 0 to 1 number line and mark the tenths. Eventually extend this number line beyond 1.	
Benchmark decimals assist in ordering, visualising magnitude and equivalence. Emphasise the benefits of using fractional benchmarks such as five-tenths or ten-tenths to locate other decimals. Explicitly discuss strategies used to visualise the magnitude of a given ‘tenths’ number, e.g. when locating seven-tenths, students may have found five-tenths and worked up, or started at ten-tenths (one whole) and worked back.	Ask students to: • draw a line horizontally across a landscape A4 page • mark 0 and 1 based on a physical ‘one whole’  • mark where a ‘tenths’ number would be, e.g. seven tenths • share the thinking used to figure this out • check accuracy using the marked fraction strip.

To build students’ understanding of decimals beyond tenths, incorporate similar activities to those already discussed, where students are making, naming and recording decimals.

References

National Council of Teachers of Mathematics (NCTM) 2014, *Principles to Actions: Ensuring mathematical success for all*, NCTM, Reston, ISBN 978-0-87353-774-2.

Siemon, D, Beswick, K, Brady, K, Clark, J, Faragher, R & Warren, E 2015, *Teaching Mathematics: Foundations to middle years*, 2nd edn, Oxford University Press, Melbourne, ISBN 978-0-19552-382-9.

Smith, S 2017, ‘An exploratory study of fifth-grade students’ reasoning about the relationship between fractions and decimals when using number line-based virtual manipulatives’, *All Graduate Theses and Dissertations*, 5625, https://digitalcommons.usu.edu/etd/5625.