ACARA
AUSTRALIAN CURRICULUM, ASSESSMENT AND REPORTING AUTHORITY

National Numeracy Learning Progression
Numeracy Progression
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Appendix 1. The evidence base for development

While a wide range of literature was considered in the development of the National Numeracy Learning Progression, three references were of particular significance. These are as follows:


The evidence provided in Adding it up underpins the sequencing of the content of the Australian Curriculum: Mathematics. This National Research Council (USA) report describes what is known about how children learn to be numerate. It provides a synthesis of research with strong academic credentials, based on research that meets standards of relevance, soundness and generalisability (p. 23). Despite its publication date of 2001, it is still considered current and continues to be frequently cited.

In describing what is known about how children learn to be numerate, the report identifies that much more research has been conducted in the domain of number than in the development of spatial sense or data sense. Indeed, within the report, only one chapter is dedicated to research that meets the standards of the synthesis and that pertains to students’ learning about space or helping students learn about data and chance. Extra comment on these areas was sought from those engaged in research in these emerging domains. Where research meeting the same standards of relevance, soundness and generalisability was not available, the Australian Curriculum was used to determine the initial sequencing of levels within the progression.


The National Numeracy Review report has also been influential to the learning progressions. It confirms that research associated with number sense holds a dominant position in the existing literature. It recognises that the balance of research was weighted towards primary education, especially the early years. It also notes, ‘One of the striking features of the numeracy literature is the lack of creative research about the necessary, or possible, mathematical content most likely to support rich numeracy practices’ (p. 10). This finding acknowledges the paucity of evidence about applications of numeracy across learning areas other than Mathematics.


To ensure the most up-to-date research was employed in the creation of the numeracy progression, research drawn from the twenty-third International Commission on Mathematical Instruction (ICMI) 2015 study, titled ‘Primary mathematics study on whole numbers’, was used to supplement the comprehensive research synthesis in Adding it up.

Listings of the literature considered for the elements of the National Numeracy Learning Progression are provided in appendices 2–4.
It is acknowledged that new evidence and research will emerge, perhaps through this project, that may challenge the sequencing of content in the Australian Curriculum. New evidence will be reported in ACARA's annual process for monitoring the effectiveness of the Australian Curriculum, for consideration in future Australian Curriculum evaluations and reviews.

Appendix 2. Key references – Number sense and algebra

Quantifying

Anghileri, J 2008, Developing Number Sense: Progression in the middle years, Continuum International Publishing Group, London.


Australian Securities and Investments Commission 2011, National Consumer and Financial Literacy Framework, ASIC.


**Additive strategies, Multiplicative strategies and Understanding money**


Australian Securities and Investments Commission 2011, National Consumer and Financial Literacy Framework, ASIC.


Battista, M 2012, Cognition-Based Assessment and Teaching of Place Value: Building on students’ reasoning, Heinemann, Portsmouth, NH.


**Number patterns and algebraic thinking**


Australian Securities and Investments Commission 2011, National Consumer and Financial Literacy Framework, ASIC.

Berg, W van der and D van Eerde 1985, Kwantiwijzer (Number diagnostics), SVO/Erasmus University, Rotterdam.


Booker, G & Windsor, W 2010, 'Developing algebraic thinking: using problem-solving to build from number and geometry in the primary school to the ideas that underpin algebra in high school and beyond', Procedia: Social and Behavioral Sciences, 8, pp. 411–419.


Fosnot, CT & Dolk, M 2001, Young Mathematicians at Work: Constructing multiplication and division, Heinemann, Portsmouth, NH.


International Network on Financial Education 2012, Financial Education in Schools, INFE.


Olive, J 2000, ‘Children’s number sequences: an explanation of Steffe’s constructs and an extrapolation to rational numbers of arithmetic’, The Mathematics Educator, 11(1).


**Fractions, Decimals and Percentages**


Australian Securities and Investments Commission 2011, National Consumer and Financial Literacy Framework, ASIC.


Clarke, D & Roche, A 2011, ‘Some advice for making the teaching of fractions a research-based, practical, effective and enjoyable experience in the middle years’, Australian Catholic
University, retrieved 8 September 2011 from


International Network on Financial Education 2012, Financial Education in Schools, INFE.

Kamii, C & Kysh, J 2006, 'The difficulty of “length x width”: is a square the unit of measurement?' Journal of Mathematical Behavior, 25, pp. 105–115.


Lamon, S 1999, Teaching Fractions and Ratios for Understanding, Lawrence Erlbaum Associates, Mahwah, NJ.


Appendix 3. Key references – Measurement and geometry

Measurement


**Geometric properties**


Fox, TB 2000, 'Implications of research on children's understanding of geometry', Teaching Children Mathematics, 6(9), p. 572.


Khan, S, Francis, K & Davis, B 2015, 'Accumulation of experience in a vast number of cases: enactivism as a fit framework for the study of spatial reasoning in mathematics education', ZDM, 47(2), pp. 269–279.


Position and location


Time


Clements, D & Bright, G 2003, Learning and Teaching Measurement, National Council of Teachers of Mathematics, USA.


Appendix 4. Key references – Statistics and probability

Chance


Watson, JM 2013, Statistical Literacy at School: growth and goals, Routledge.


Representing data


Appendix 5. Numeracy experts consulted during development

ACARA acknowledges the contribution of the following numeracy experts who were consulted during the development of the progression:

- Associate Professor Catherine Attard
- Professor Janette Bobis
- Professor Merrilyn Goos
- Dr Peter Gould
- Dr Sally Howell
- Christine Mae
- Professor Joanne Mulligan
- Professor Dianne Siemon
- Emeritus Professor Kaye Stacey
- Associate Professor Jennifer Stephenson
- Emeritus Professor Jane Watson