




*Improving Learning*

Australian Council for Educational Research



# Learning progression for pre-school children and measuring early mathematics ability

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- Warm up (Jen)
- How early is *early* in maths
- Learning progressions
- How do we measure learning and development in early mathematics?
- Using picture books to inspire mathematical thinking
- Critique and wrap up

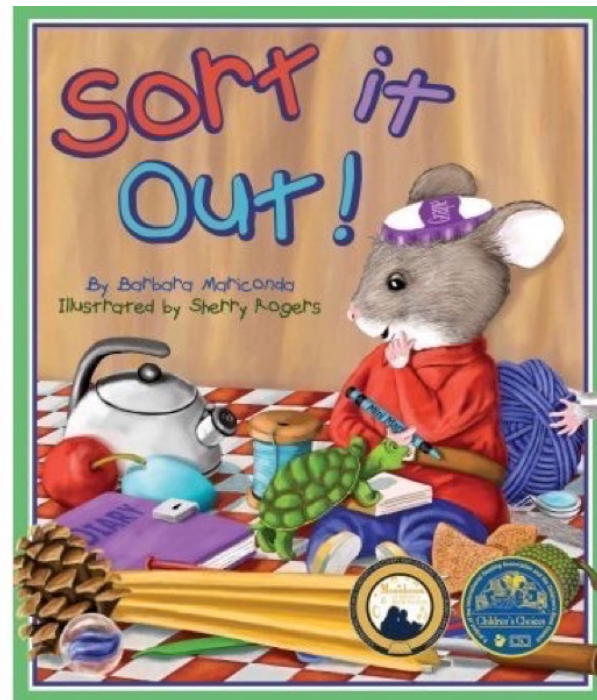
# Warm Up





# Warm Up

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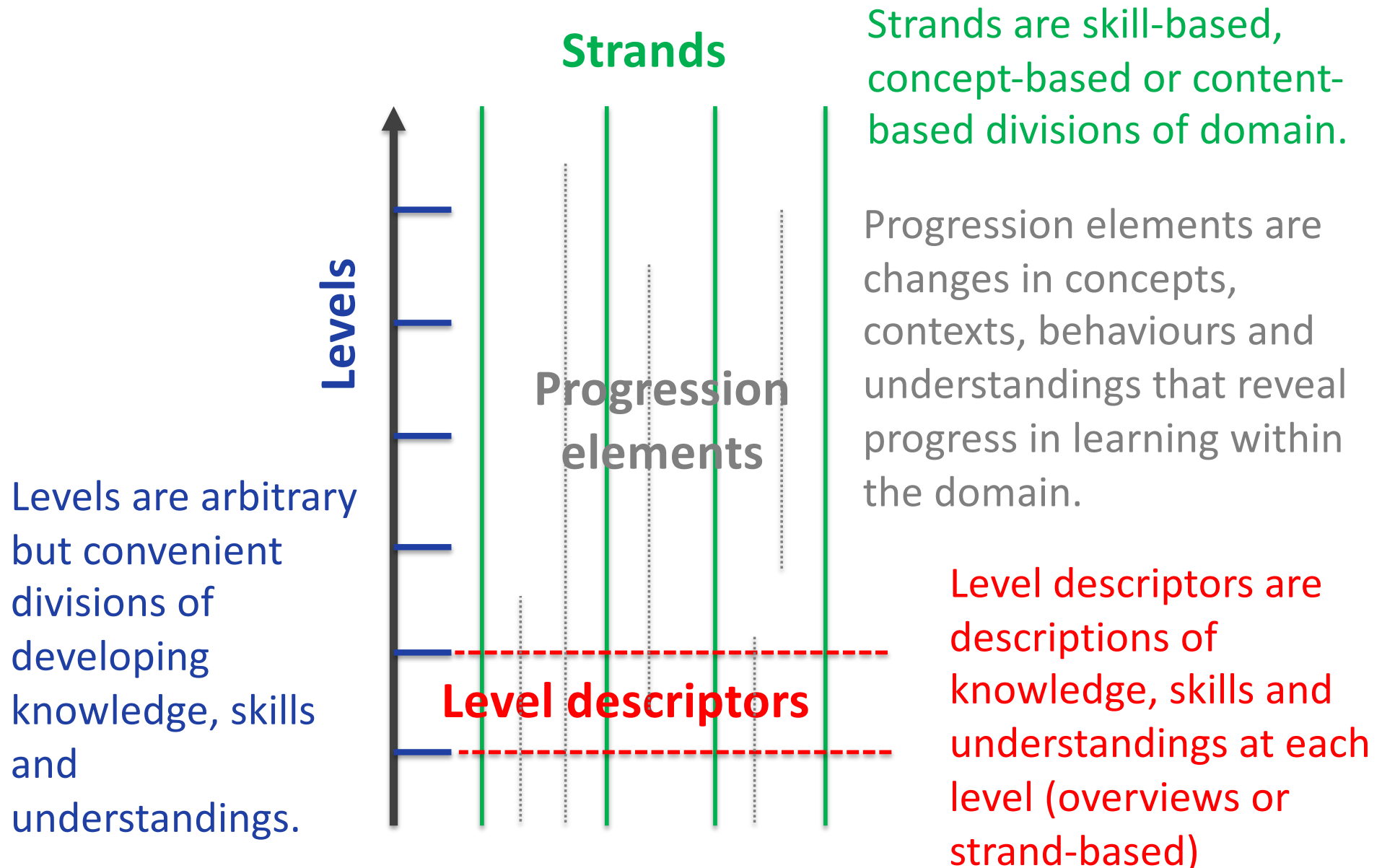




# An ACER definition of an LP

- A learning progression describes what it typically looks like for learners to move from early knowledge, skills and understandings to more advanced knowledge, skills and understandings within a domain.
  - ‘progression’ → continuity and coherence – seamless development of learning along core areas of the domain
  - ‘typically’ → may not be an accurate picture of how every student or every student group progresses
  - ‘looks like’ → based on real-world observation of learners
  - ‘knowledge, skills and understandings’ → a range of cognitive states and processes

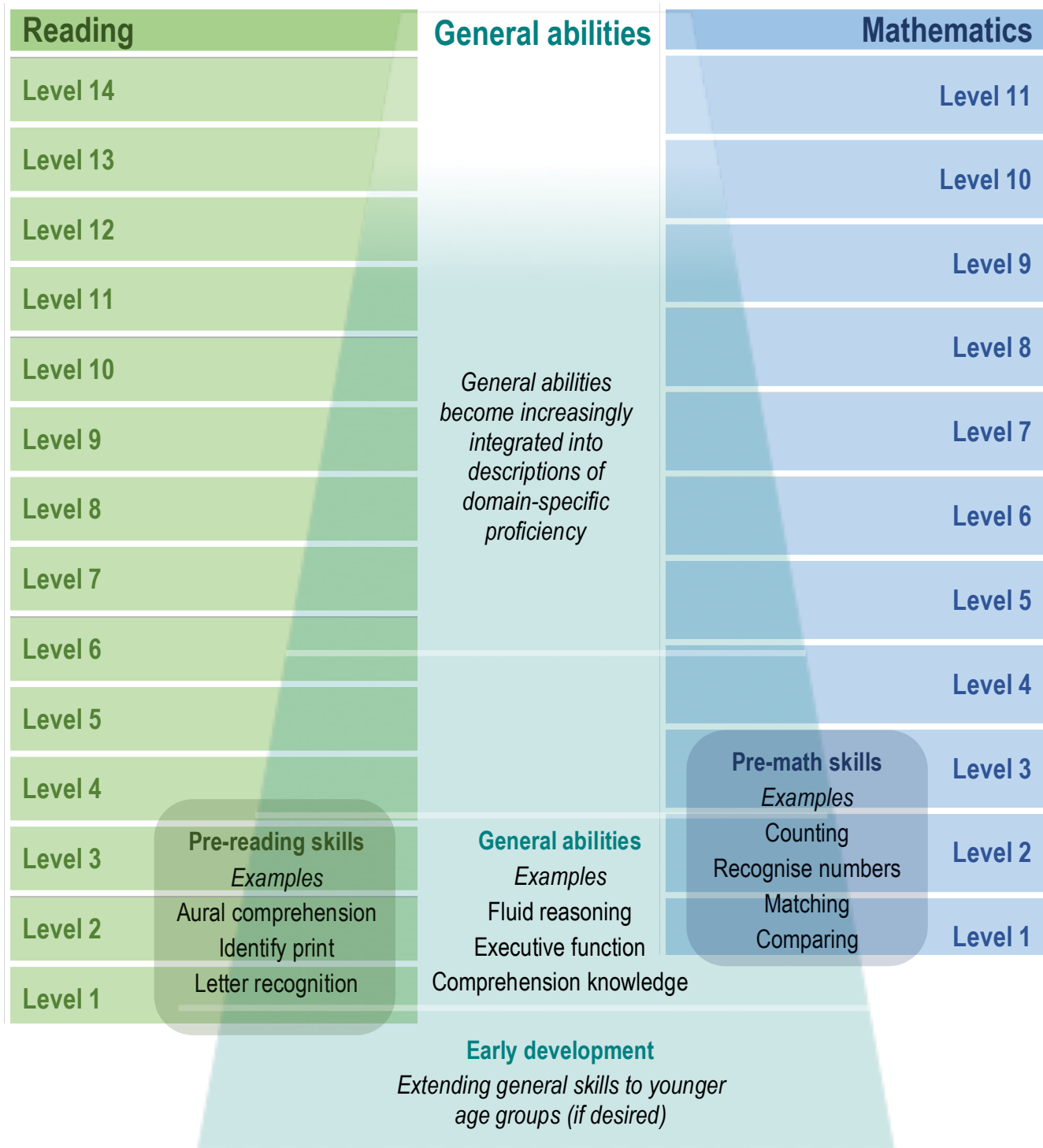
# What are the features of an ACER LP?





# What are the features of an ACER LP?

- ACER LPs have an underpinning quantitative basis in the form of an interval scale.
  - The scale is derived from analysis of learner performance data.
- ACER LPs have supplementary material associated with them.
  - instructional activities
  - illustrative assessment tasks
  - examples of learners' work





# Describing children's learning

- How can educators measure mathematical ability?
  - Covers a range of learning appropriate to before school
  - Free/low cost
  - Available for use by educators
  - Comparable
- Example measures
  - MELQO, MICS, EGMA, DIBELS-M
  - EEF database



# Example items

- Counting
  - *Now we are going to play some counting games. The first game is a counting out loud game. How high can you count? Start at one and count.*
  - STOP RULES: When a child states a number incorrectly or reaches 30.
  - MELQO #11 Verbal Counting



# Example items

- Number identification

2	9	0	12	30
22	45	39	23	48
91	33	74	87	65
108	245	587	731	989

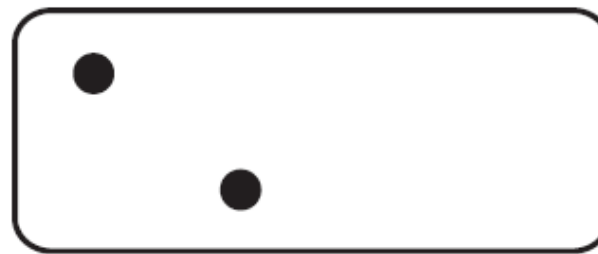
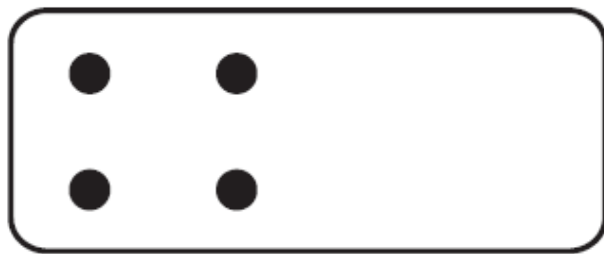
- STOP RULES: 60 seconds
- EGMA Toolkit example





# Example items

- Number comparisons
  - *which domino shows the greater amount?*



- STOP RULES: 60 seconds
- DIBELS Maths K



# Example items

- Producing a set
  - *Now we'll play a game with counters. Please give me three counters.*
  - *Now, please give me six counters.*
  - *Now, please give me fourteen counters.*
  - 20 uniformly sized small objects that can be used for counting (e.g., stones, bottle caps). Items should not be able to roll. No food items should be used.
  - STOP RULES: If child cannot give you 3 and 6 items (first 2 items)
  - MELQO #12 Producing A Set



# Example items

- Operations
  - *Now we'll play a game with counters. Please give me three counters.*

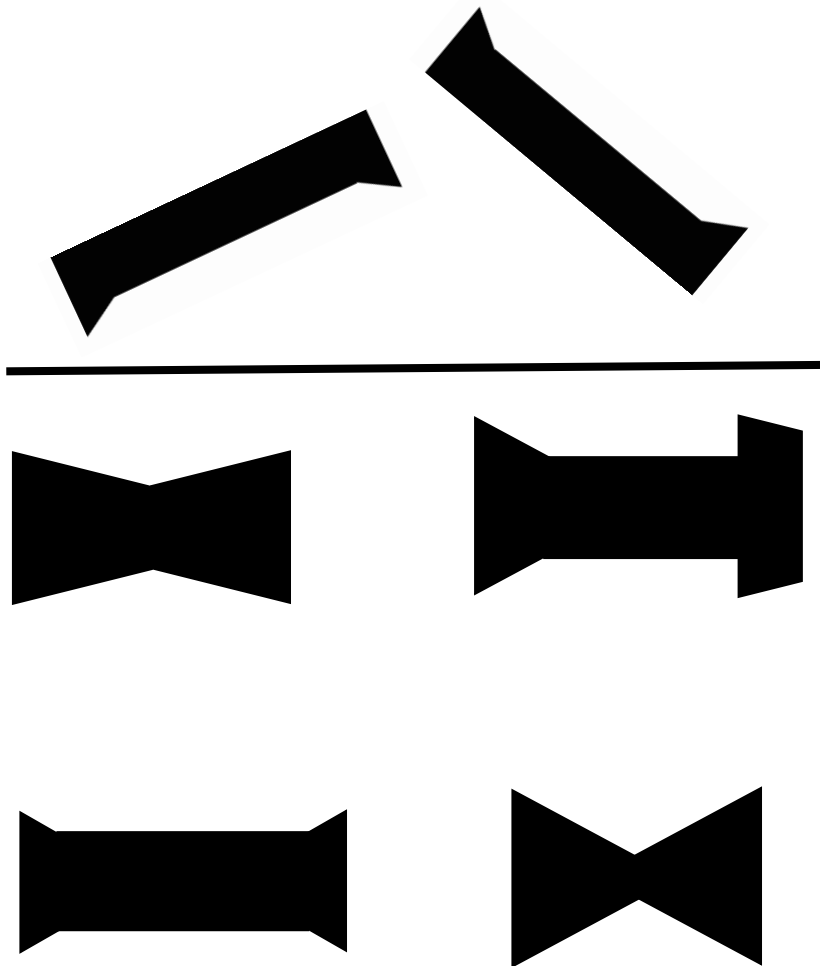
$1 + 3 = \square$	$4 - 1 = \square$
$3 + 2 = \square$	$5 - 2 = \square$
$6 + 2 = \square$	$8 - 2 = \square$
$4 + 5 = \square$	$9 - 5 = \square$
$3 + 3 = \square$	$6 - 3 = \square$

- STOP RULES: 60 seconds
- EGMA Addition and Subtraction Level I
- Note, MELQO uses counters + verbal response



# Example items

- Mental transformation

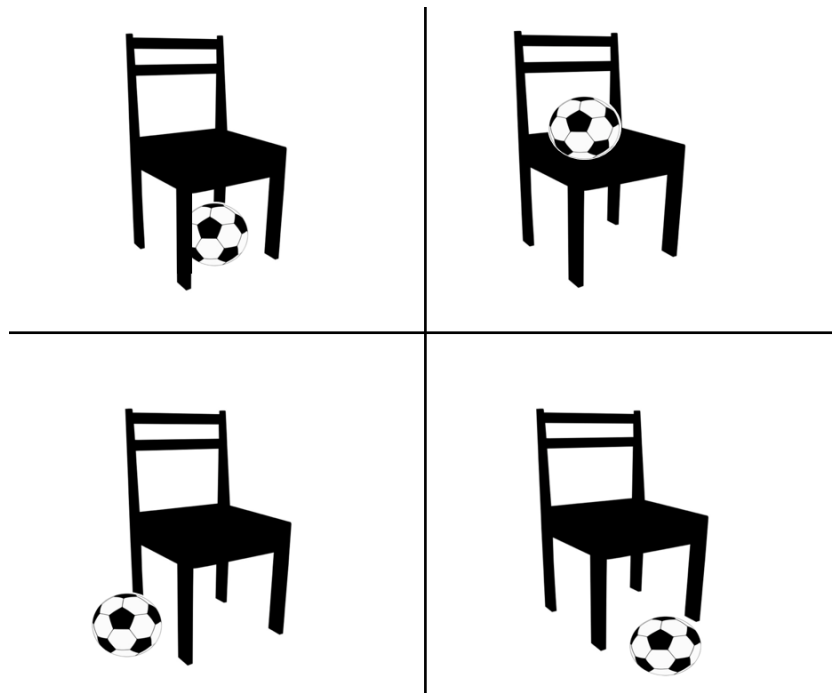


- *In this game, we are going to look at some shapes and some pieces of shapes.*
- *If you put these pieces together, they will make one of these shapes. Point to the shape the pieces make.*
- STOP RULES: none
- MELQO #16 Mental Transformation



# Example items

- Visual Spatial



- *Point to the picture with the ball on the chair.*
- *Point to the picture with the ball under the chair.*
- *Point to the picture with the ball in front of the chair.*
- *Point to the picture with the ball next to the chair.*
- STOP RULES: none
- MELQO #10 Receptive Spatial Vocabulary



# Are these good items?

- A question of breadth
  - Other aspects of number
    - Subtraction, multiplication, division
    - fractions and decimals
  - Measurement and geometry
  - Statistics and probability
- A question of progression
  - How does this connect with maths in F-3, or 4+?
  - Psychometrics are weak
  - Developing world focus
- How do you measure growth in early maths?



# Linking mathematics to children's literature

The main benefits for integrating children's literature into mathematics lessons are:

- to help children learn mathematical concepts and skills
- to provide children with a meaningful context for learning mathematics
- to facilitate children's development and use of mathematical language and communication
- to help children learn mathematical problem solving, reasoning, and thinking
- to provide children with a richer view of the nature of mathematics
- to provide children with improved attitudes towards mathematics.

Schiro (1997)



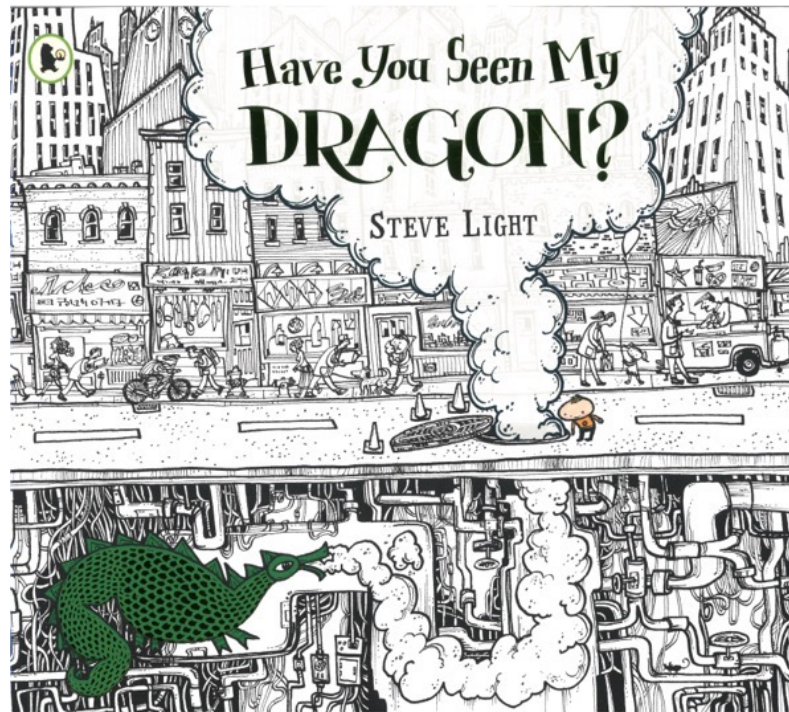
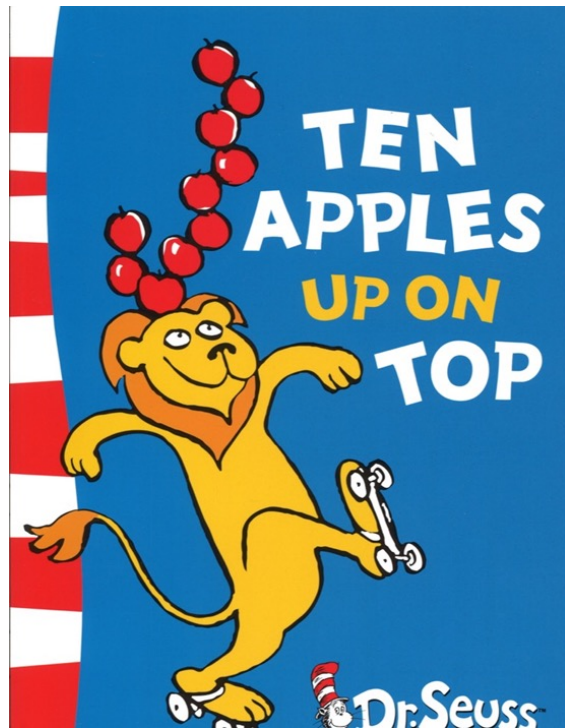
# Types of Picture Books

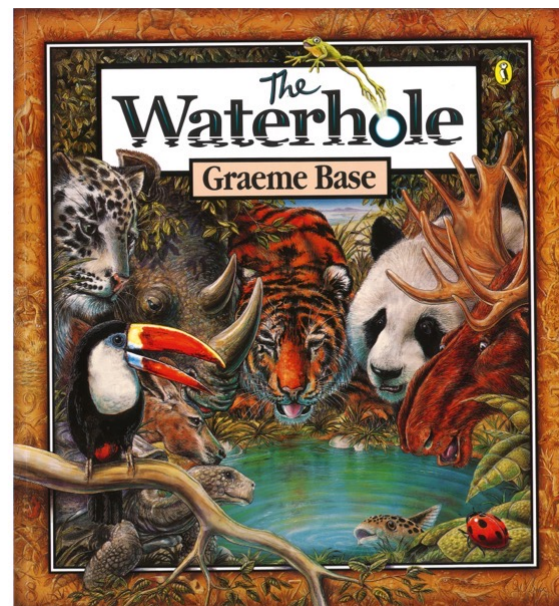
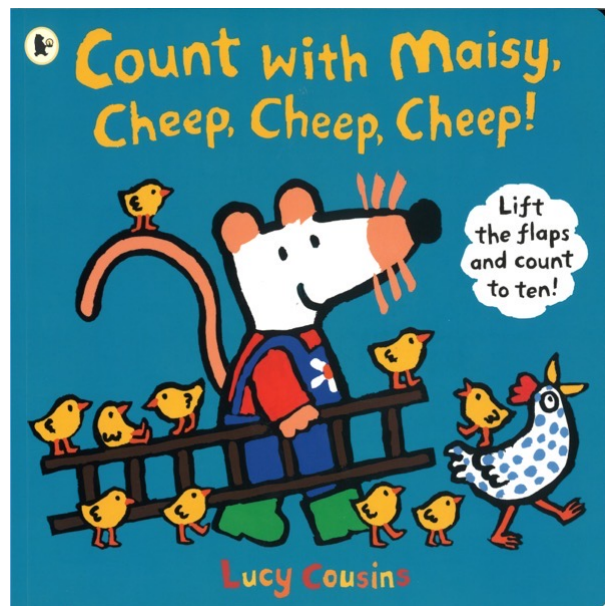
Marston (2010) identifies three different types of mathematical picture books:

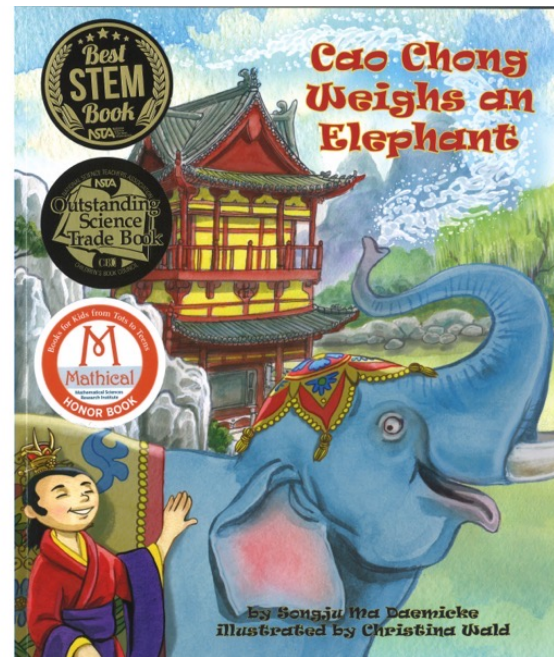
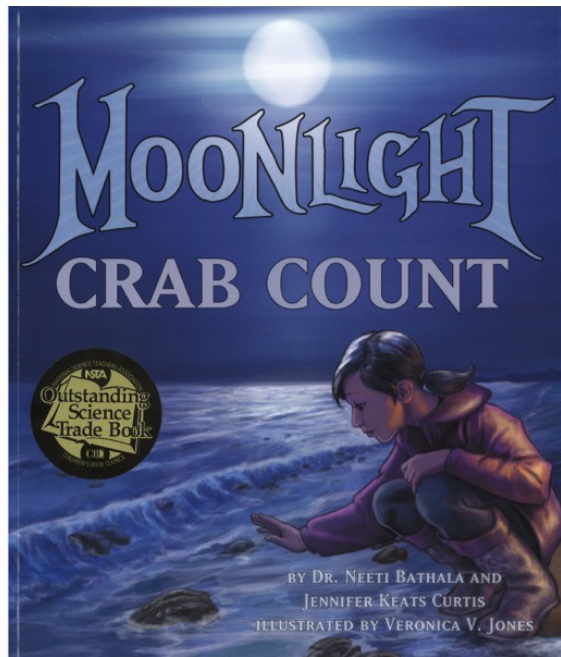
1. Explicit: books purposefully written for teaching and learning in the mathematics classroom, e.g. [Counting on Frank](#) (Clements, 1990) or [How Big is a Foot?](#) (Myller, 1962);
2. Perceived: books with incidental mathematical concepts as perceived by the teacher e.g. Goldilocks and the Three Bears; and
3. Embedded: books that have embedded mathematical ideas but written to entertain rather than specifically for teaching and learning e.g. [Uno's Garden](#) (Base, 2013)

Catherine Attard (Engaging Maths, 2016)



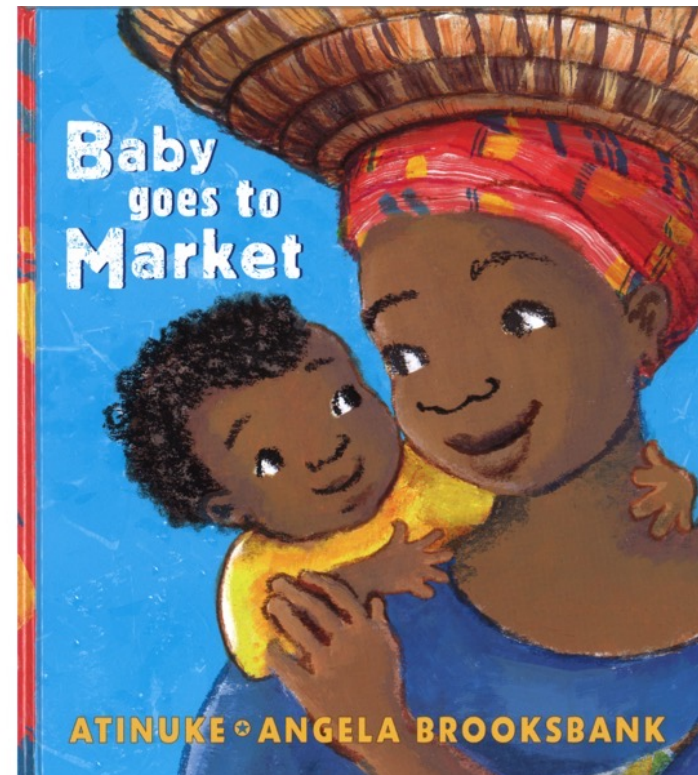
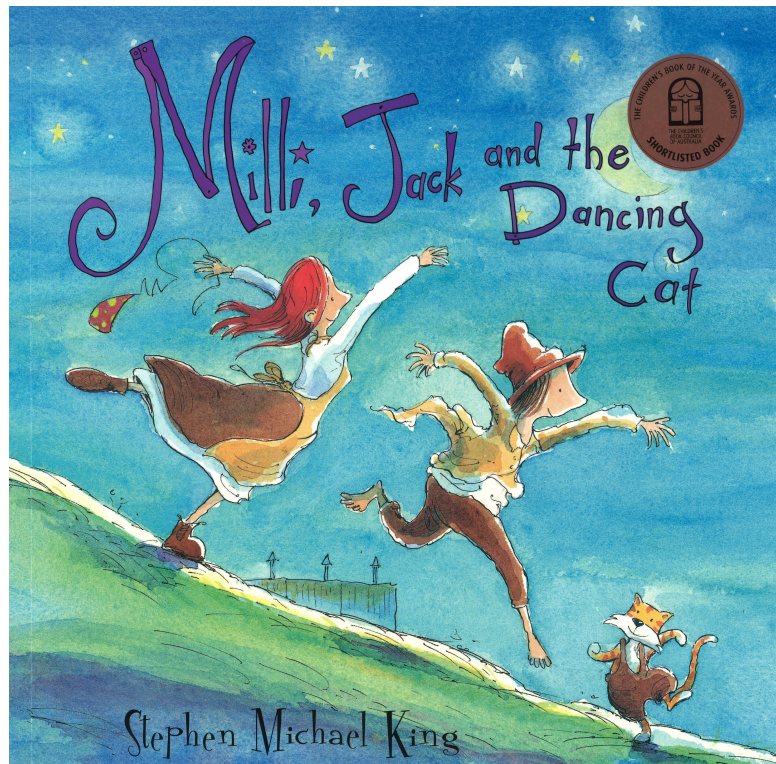




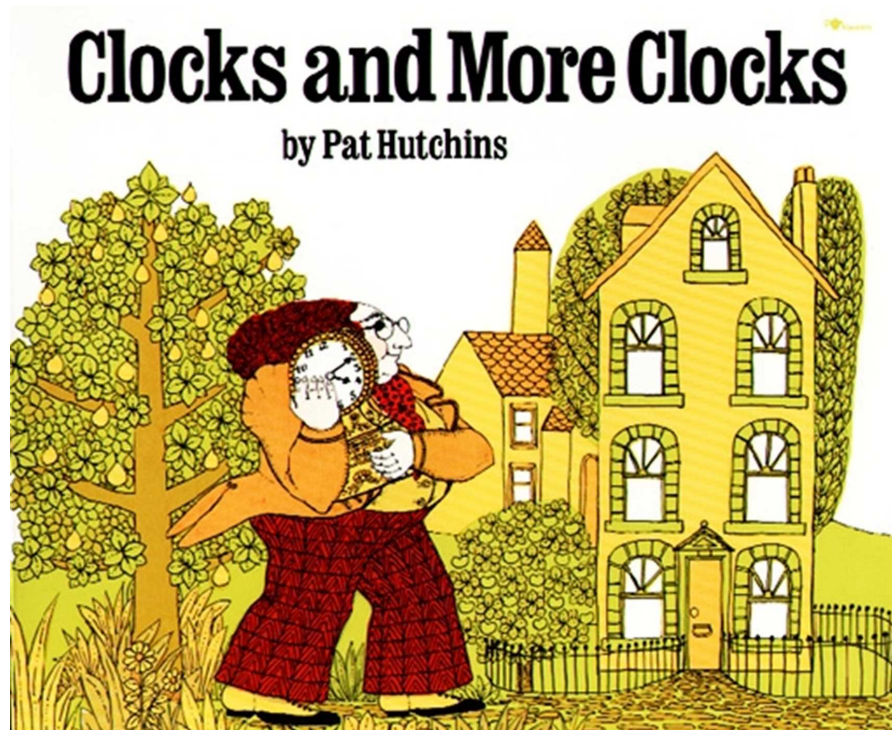




# Inspiring creativity

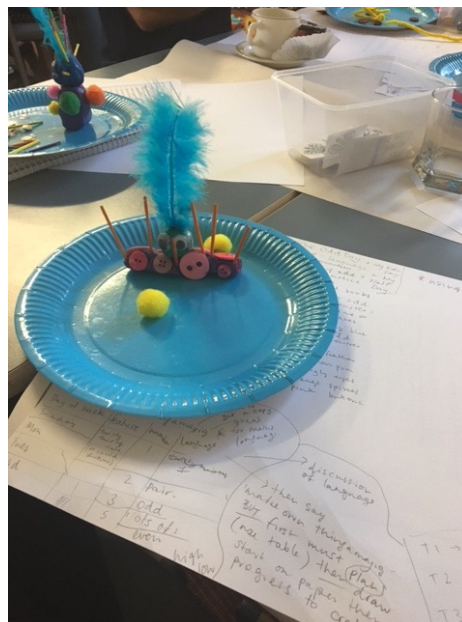
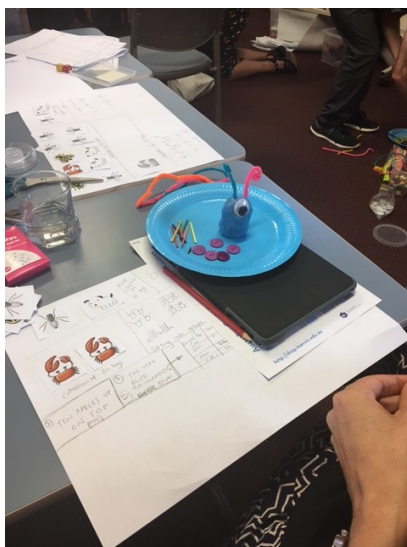


# Time





# Creativity with picture books



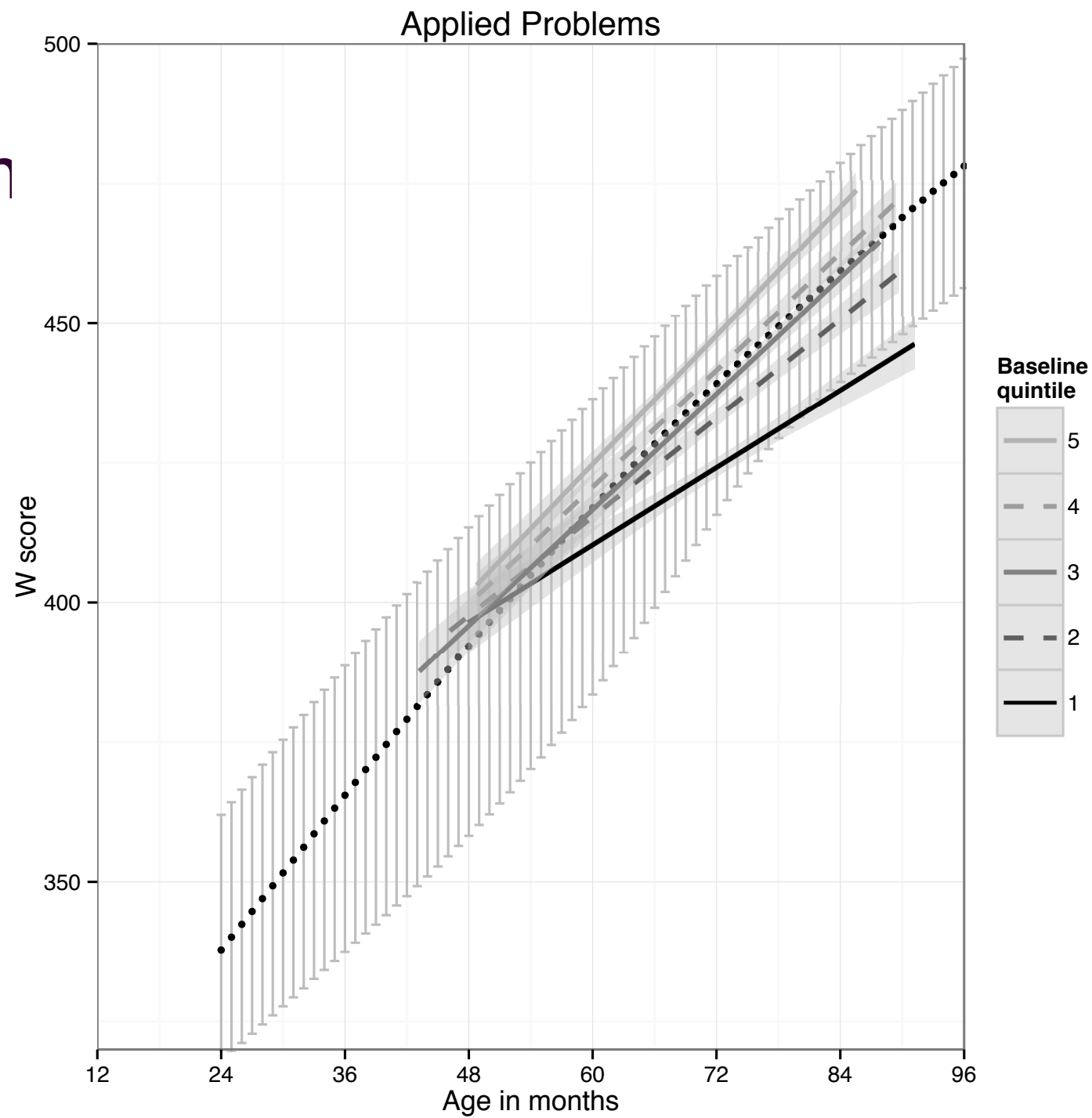


# What's the benefit?

- Linking early learning to later school-age achievement
  - Helps define lifelong learning
  - Links the work of EC educators to long-term outcomes
  - Helps quantify the benefit of fostering domain-general capabilities
  - Puts rigour around words like *holistic* and pre-mathematics

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