



Improving Learning

Australian Council for Educational Research



What does growth in early mathematics look like?

Dan Cloney, PhD

Dan.Cloney@acer.org



[@dr_dan_c](https://twitter.com/dr_dan_c)



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- Intro
 - how do ECEC educators understand maths?
 - How early is *early* in maths
- Learning progressions
 - Growth!
- How do we measure learning and development in early mathematics?
 - Examples
- Where to next?
 - What do you do now?
 - What can we imagine we might do?



Key links

- Mapping VEYLDF to F-10 curriculum
 - http://bit.ly/veyldf_f10
- Assessing children as confident and involved learners
 - <http://bit.ly/outcome4>
- ACER LPs
 - http://bit.ly/acer_lpe
- MELQO
 - <http://ecdmeasure.org>
- EEF database
 - http://bit.ly/ref_ec_measures



EYLF

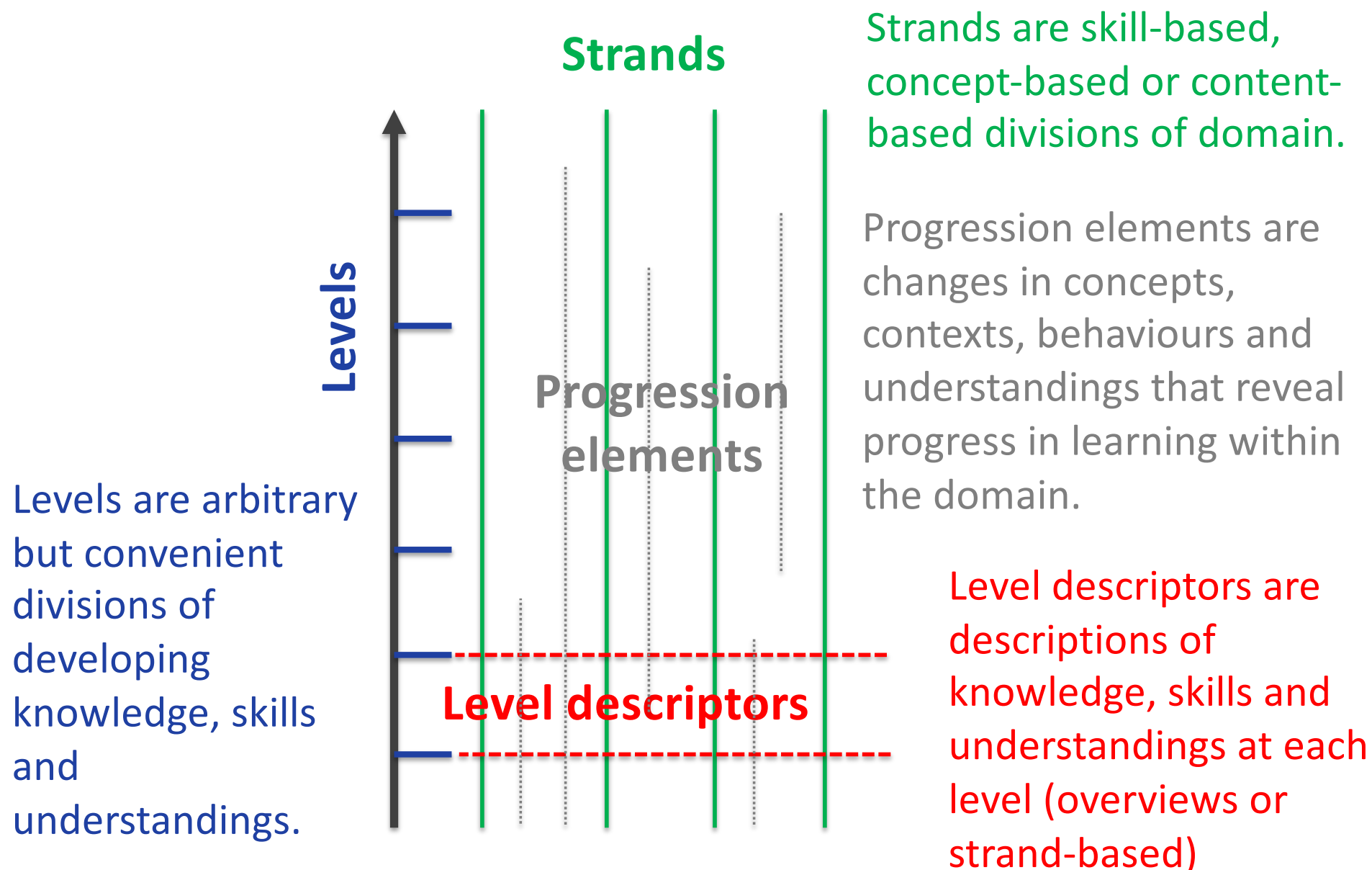
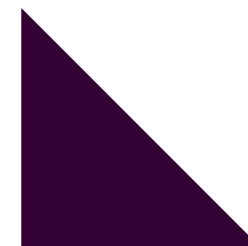
- OUTCOME 4: CHILDREN ARE CONFIDENT AND INVOLVED LEARNERS
 - create and use representation to organise, record and communicate mathematical ideas and concepts
 - generate or identify and communicate using mathematical language and symbols
 - contribute constructively to mathematical discussions and arguments
- OUTCOME 5: CHILDREN ARE EFFECTIVE COMMUNICATORS
 - ***“Educators require a rich mathematical vocabulary to accurately describe and explain children’s mathematical ideas and to support numeracy development.”***



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

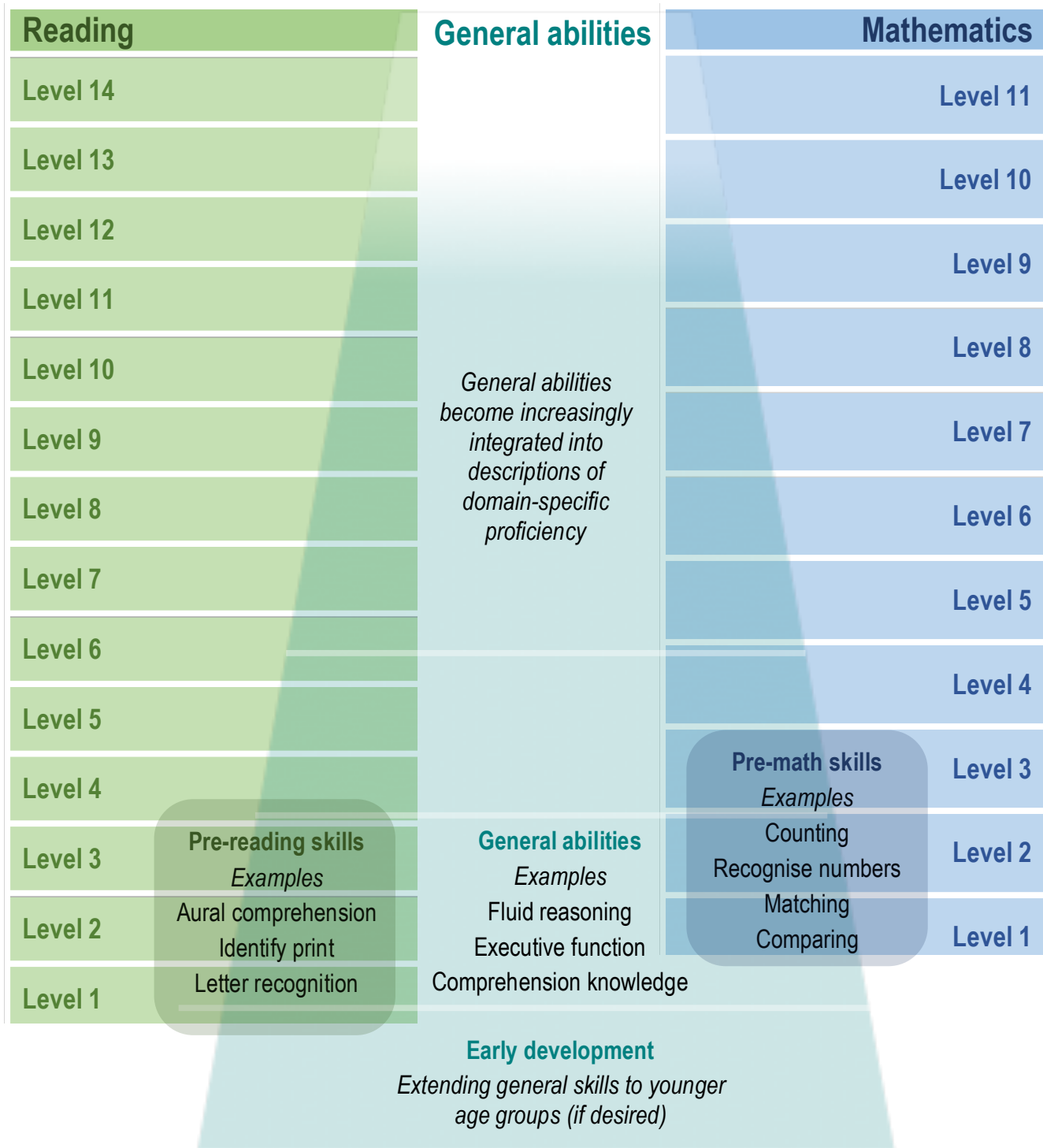
What are the features of an ACER LP?





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



Range of descriptions for 4.2.1





Level I of the LP for mathematics

- **Have an awareness of quantity and attend to properties of objects**
- *Conceptual understanding*
- Learners understand the concept of quantity. ...
- *Procedural fluency*
- Learners can count small sets of objects. They can classify and sort familiar objects by their properties...
- *Strategic competence*
- Learners can keep track of where they are up to in a simple task such as sorting objects. ...
- *Adaptive reasoning*
- Learners use properties of objects to compare and informal quantitative language (eg more, longer) ...



Level 1 of the LP for mathematics

- **Strands**
- *Number and algebra*
- Recognise and use the concept of quantity and recognise that number symbols and names can be used to represent quantities.
- *Measurement and geometry*
- Label, classify and sort familiar objects by their measurable properties such as height, length, size (area, volume) or weight (mass)
- *Statistics and probability*
- Classify and sort familiar objects into groups according to their attributes (eg colour, number of legs, type of toy).



Describing children's learning

- How can educators measure mathematical ability?
- See <http://bit.ly/outcome4>
- Assessment addresses
 - established components of children's learning describe a continuum of learning
 - valid, reliable and fair
 - enhances engagement and relationships
 - includes children's self-assessment
 - involves the child's community informs professional partnerships
- Example measures
 - MELQO, MICS, EGMA, DIBELS-M, see also 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

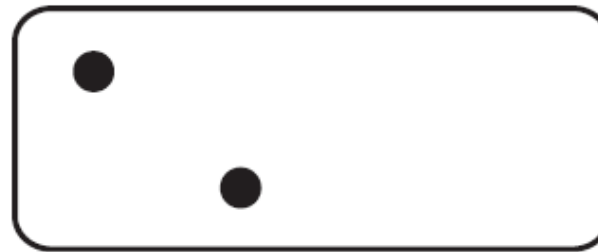
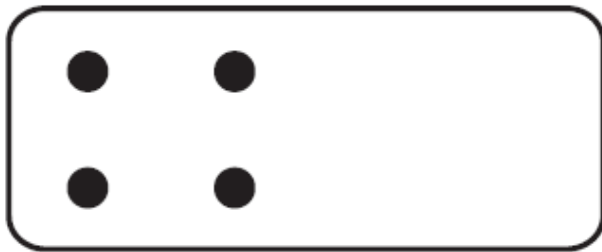
2	9	0	12	30
22	45	39	23	48
91	33	74	87	65
108	245	587	731	989

- 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.*

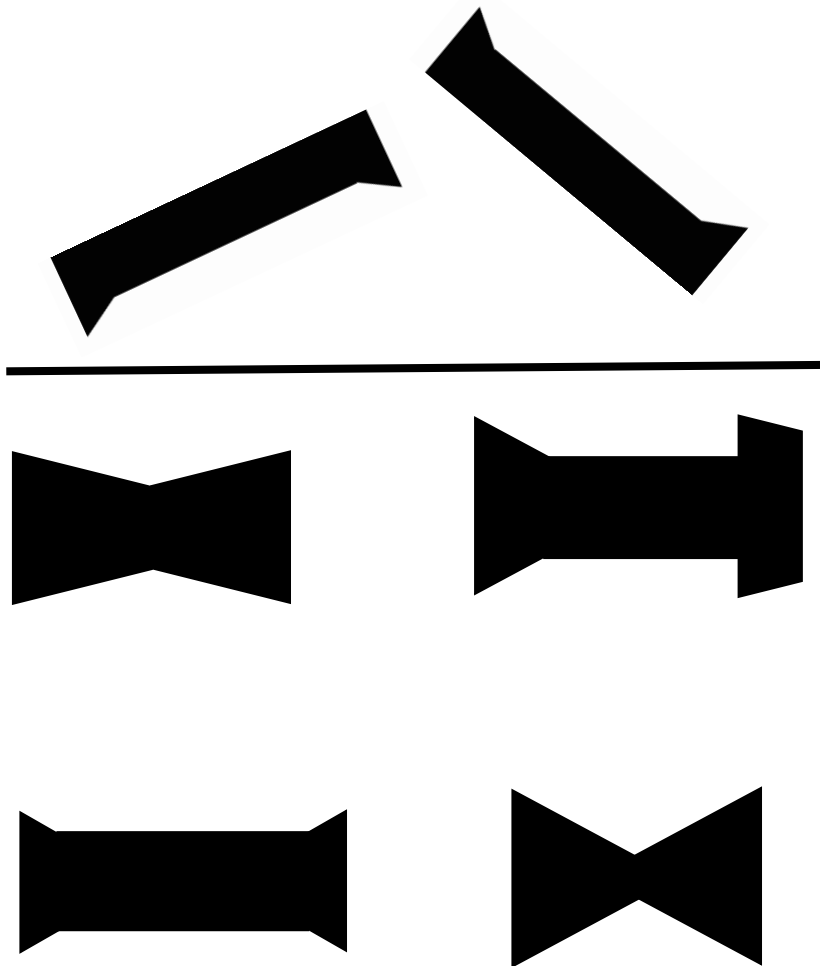
$1 + 3 = \square$	$4 - 1 = \square$
$3 + 2 = \square$	$5 - 2 = \square$
$6 + 2 = \square$	$8 - 2 = \square$
$4 + 5 = \square$	$9 - 5 = \square$
$3 + 3 = \square$	$6 - 3 = \square$

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



Example items

- Mental transformation

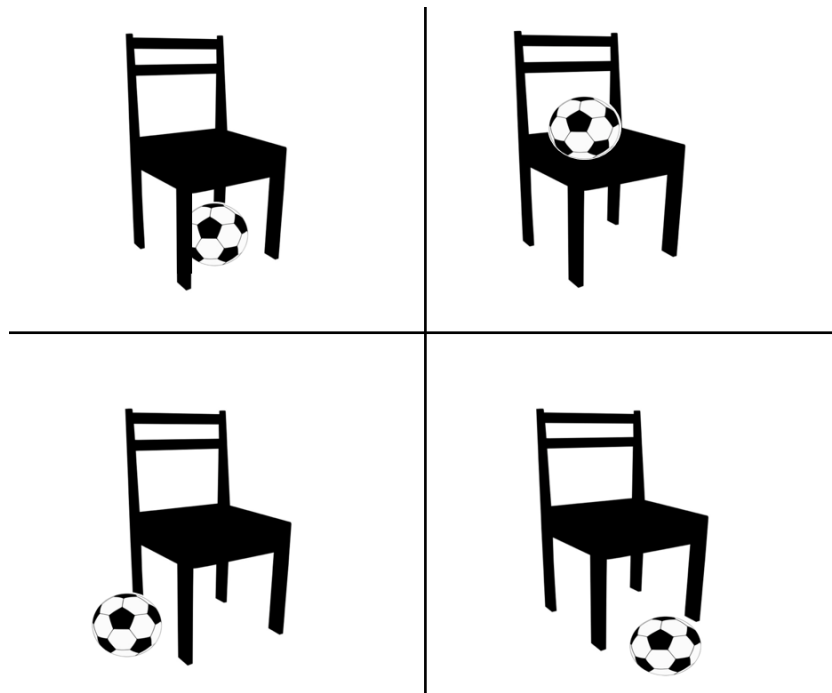


- *In this game, we are going to look at some shapes and some pieces of shapes.*
- *If you put these pieces together, they will make one of these shapes. Point to the shape the pieces make.*
- STOP RULES: none
- MELQO #16 Mental Transformation



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?



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



5	
4	
	X
	X
3	XX
	XXXX
	XXXXX
2	XXXXXXXX
	XXXXXXXX
1	XXXXXXXX
	XXXXXXXX
0	XXXXXXXX
	XXXXXXXX
-1	XXXXXXXX
	XXXXX
-2	XXXX
	XXX
	XX
-3	XX
	X
	X
-4	X
	X
-5	

15c	altogether?	the le
	<p>If you have four <counter objects>... And I give you two more <counter objects>, how many balls will you have altogether?</p>	nun

	14	
	20	

<p>Point to the shape (point to each of the 4 choices) these pieces make (wave hand over set of 2 pieces).</p>	
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<p>SHOWS what I say.</p>
<p>Point to the picture with the ball <u>on</u> the box.</p>



What's missing?

- Domain general skills?
 - Memory
 - Strategy
 - Problem solving (visual spatial covers it?)
- Links to curriculum and pedagogy
 - *So what?* What about growth
 - What should I do now?
- How to embed this in practice
 - Multiple booklets



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