

Building Early Numeracy Skills to Gain Greater Access to Age Equivalent Curriculum

Presented by

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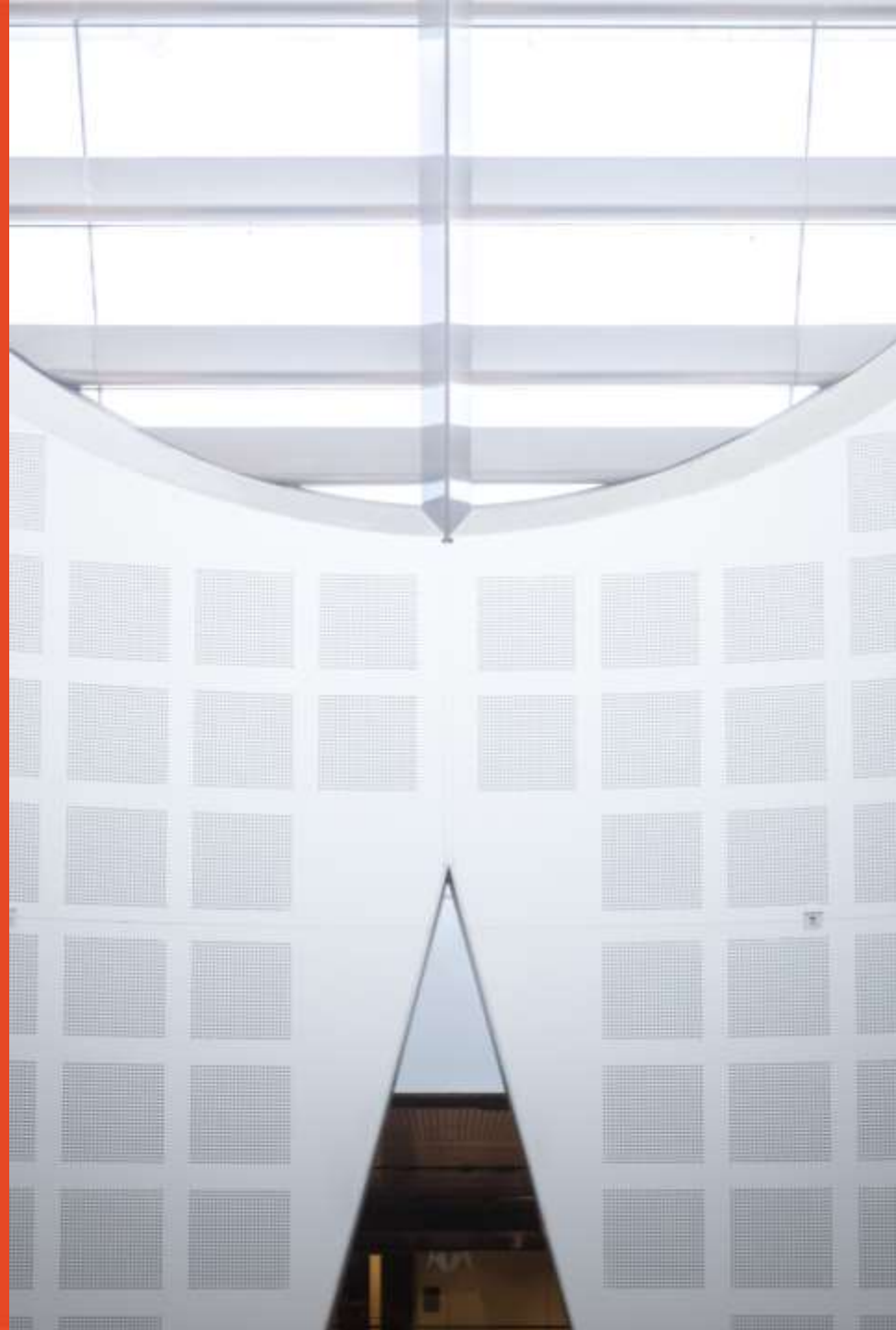
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Criterion of the Least Dangerous Assumption (Donnellan, 1984)

- “We should assume that poor performance is due to instructional inadequacy rather than to student deficits.”
- In other words, if a student does not do well, the quality of the instruction should be questioned before the student’s ability to learn.

Snell (2003) reminds us that in addition to their collective diversity and need for lifelong supports, individuals with severe disabilities share a fundamental human trait, the “capacity to learn” (p. 221).

Disability Standards for Education (2005)

- The education provider must take reasonable steps to ensure that the course or program is **designed** in such a way that the student is, or any student with a disability is, able to **participate in** the learning experiences (including the assessment and certification requirements) of the course or program, and any relevant supplementary course or program, **on the same basis as** a student without a disability, and without experiencing discrimination.
- Despite international conventions and national legislation ...

Review of the DSE (2012)

- Key findings include:
 - There are examples of students with disability being **unable to access and participate in education on the same basis as other students** and where the intent of the Standards is not being met in practice [2012, p.vii]
 - Information and advice is needed for users and providers on incorporating emerging technologies such as universal design in existing education practice. [2012, p.viii]

Review of the Australian Curriculum (2014)

- The Review ... stated that, “*an area in which the Reviewers are convinced the Australian Curriculum is manifestly deficient is its inclusiveness and accommodation of the learning needs of students with disability*”.
- Recommendation 10 - “ACARA, guided by special education experts, improve the inclusivity of the Australian Curriculum by more appropriately addressing the needs of students with disability, particularly those working towards the Foundation level”.

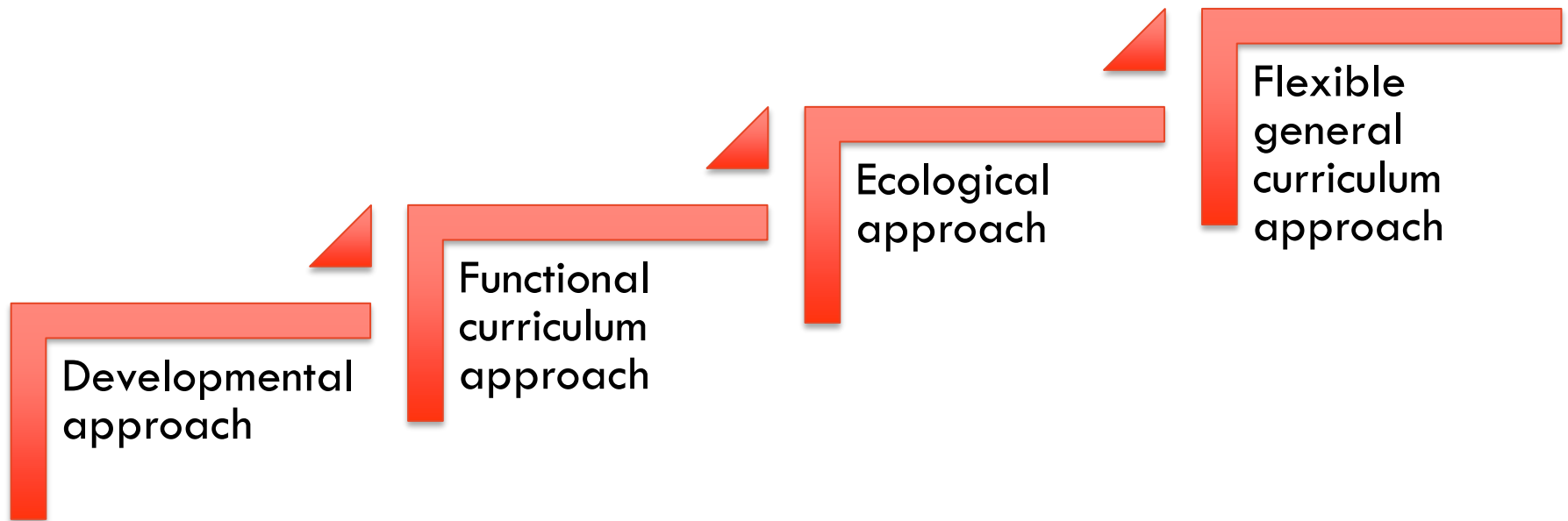
NSW Context

- *“However, it is not yet possible to determine overall school performance in improving the learning outcomes of students with disability.”* [NSW Auditor-General, 2016]
- *“All the international research data tells us that we should be including children with a disability into the mainstream classroom unless there are extremely high level of disability needs, but schools are not doing that. In fact, in New South Wales we are growing our numbers of units and using our funding that way the children are taken away and **not given a proper curriculum to be taught** and it manifolds the ongoing issues and increases the challenges and the complaints.”* [Legislative Council, Parent, 2017]

NSW Context

- *“There is the concept that all students, even the most profoundly disabled students, deserve educational provision. If you looked at the stretch of curriculum from early stage one to the end of high school, you would see that a large group of students sit below early stage one. Teachers are inventing that level of curriculum and hooking it on to the bottom outcome and calling it differentiation.”* [Legislative Council, SSP Principal, 2017]

Curricular Approaches for Students with Disabilities: A Historical Perspective



(Dymond & Orellove, 2001; Shurr & Bouck, 2013)

Australian Curriculum

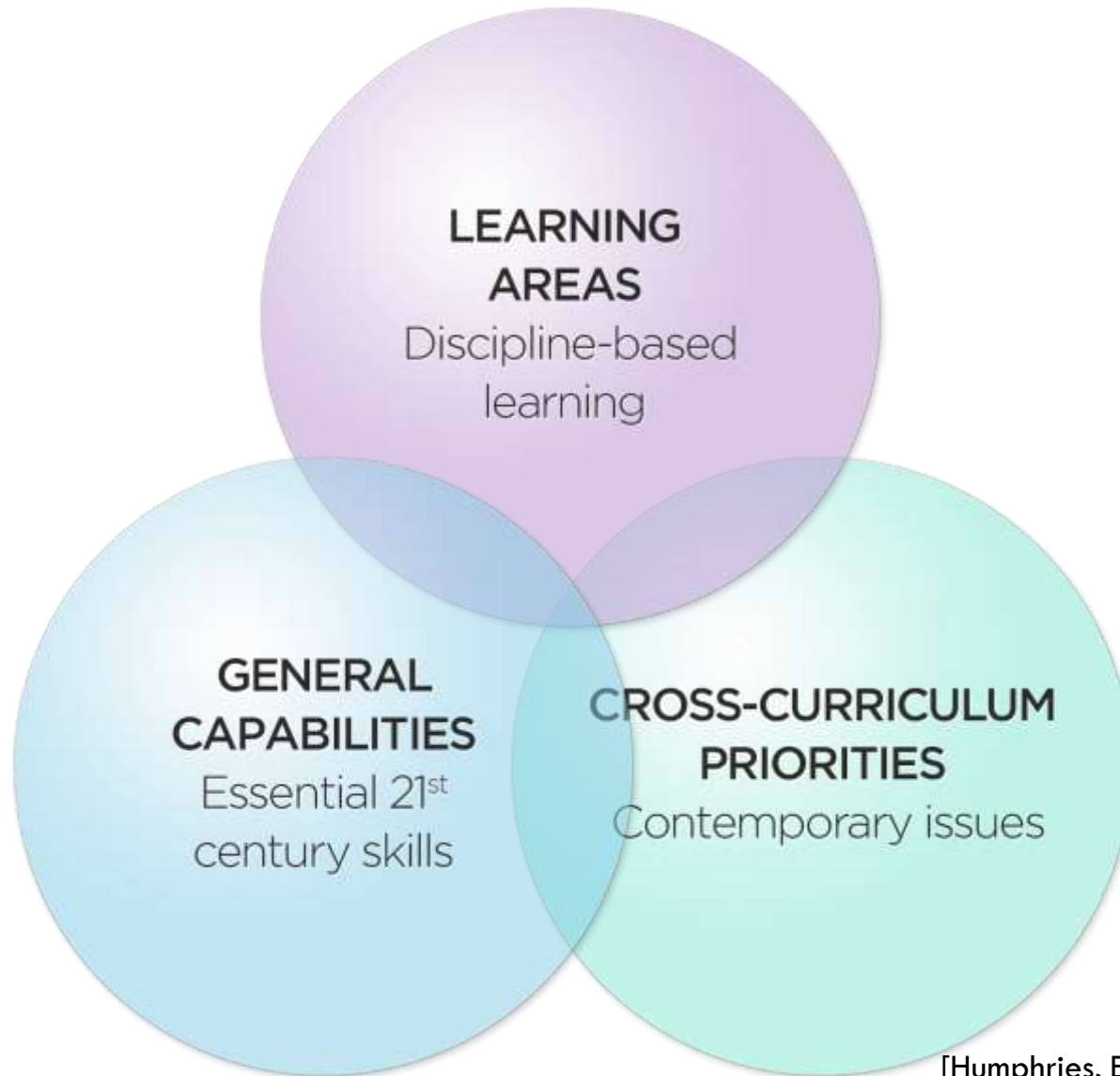
- Teachers refer to the Australian Curriculum learning area content that aligns with their students' chronological age as the starting point in planning teaching and learning programs.
- Teachers take account of the range of their students' current level of learning, strengths, goals and interests and personalise learning where necessary through adjustments to the teaching and learning program, according to individual learning need, by:
 - Drawing from learning area content at different levels along the Foundation to Year 10 sequence
 - Using the general capabilities and/or cross-curriculum priorities to adjust the learning focus of the age-equivalent learning area content
 - Aligning individual learning goals with age-equivalent learning area content
- Teachers assess students' progress through the Australian Curriculum in relation to achievement standards. Some students' progress will be assessed in relation to their individual learning goals. Approaches to assessment and reporting will differ across the states and territories.

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[Students Diversity and the Australian Curriculum, 2016]

Flexible Curriculum Design



[Humphries, Evans & Gray, 2015]

Australian Curriculum

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Mathematics and Numeracy

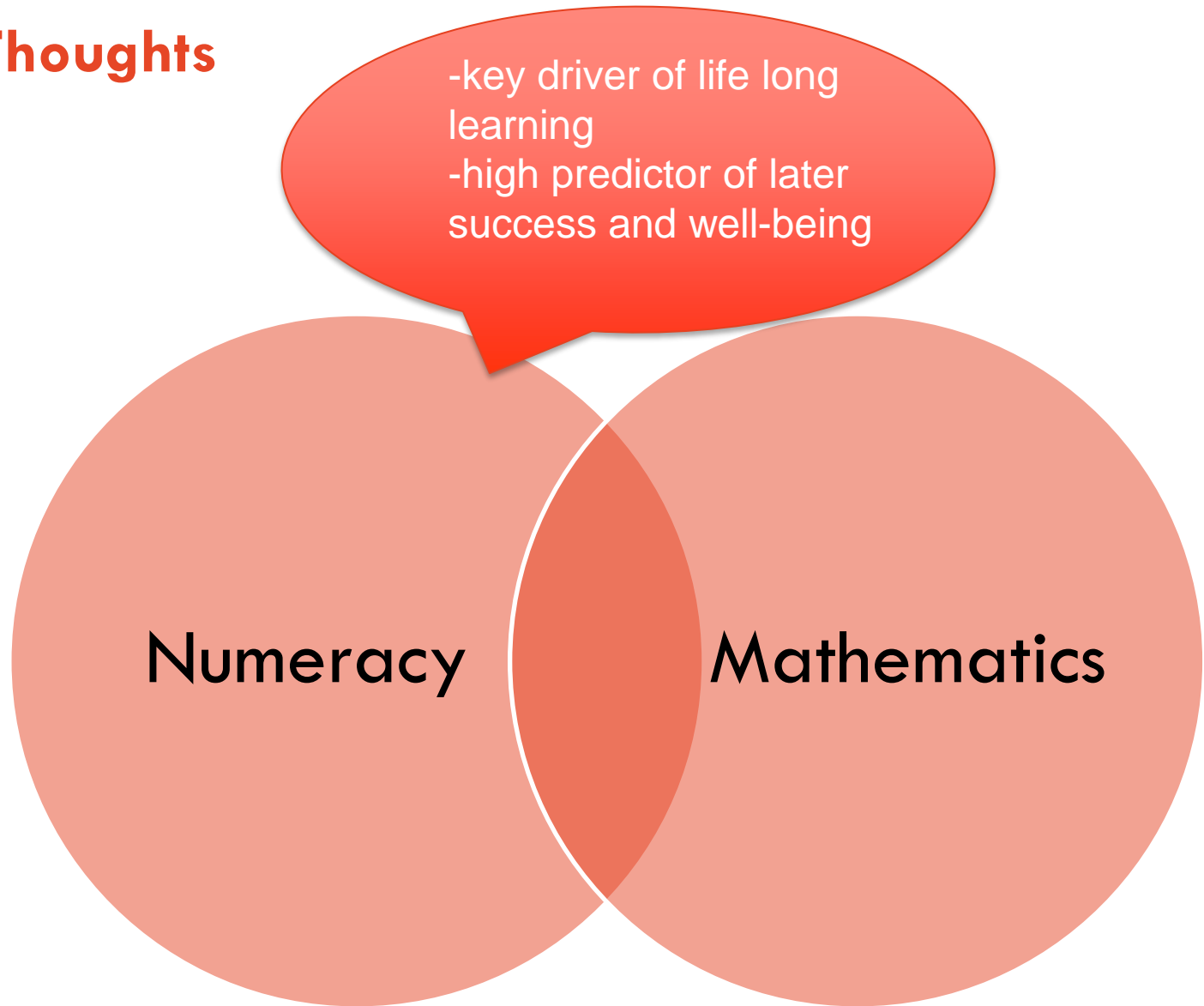


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What We Know...

- Math reasoning begins in infancy and grows during first 5 years.
- Children typically develop math skills without our help.
- Some children need explicit and intensive teaching of early math skills.
- Just as phonological awareness builds the foundation for reading, number concepts build the foundation for math.

Initial Thoughts



What Is Early Numeracy?

Number sense

an individual's ability to understand numbers and operations and use these concepts and strategies to make judgments and for more complex problem solving

-NCTM

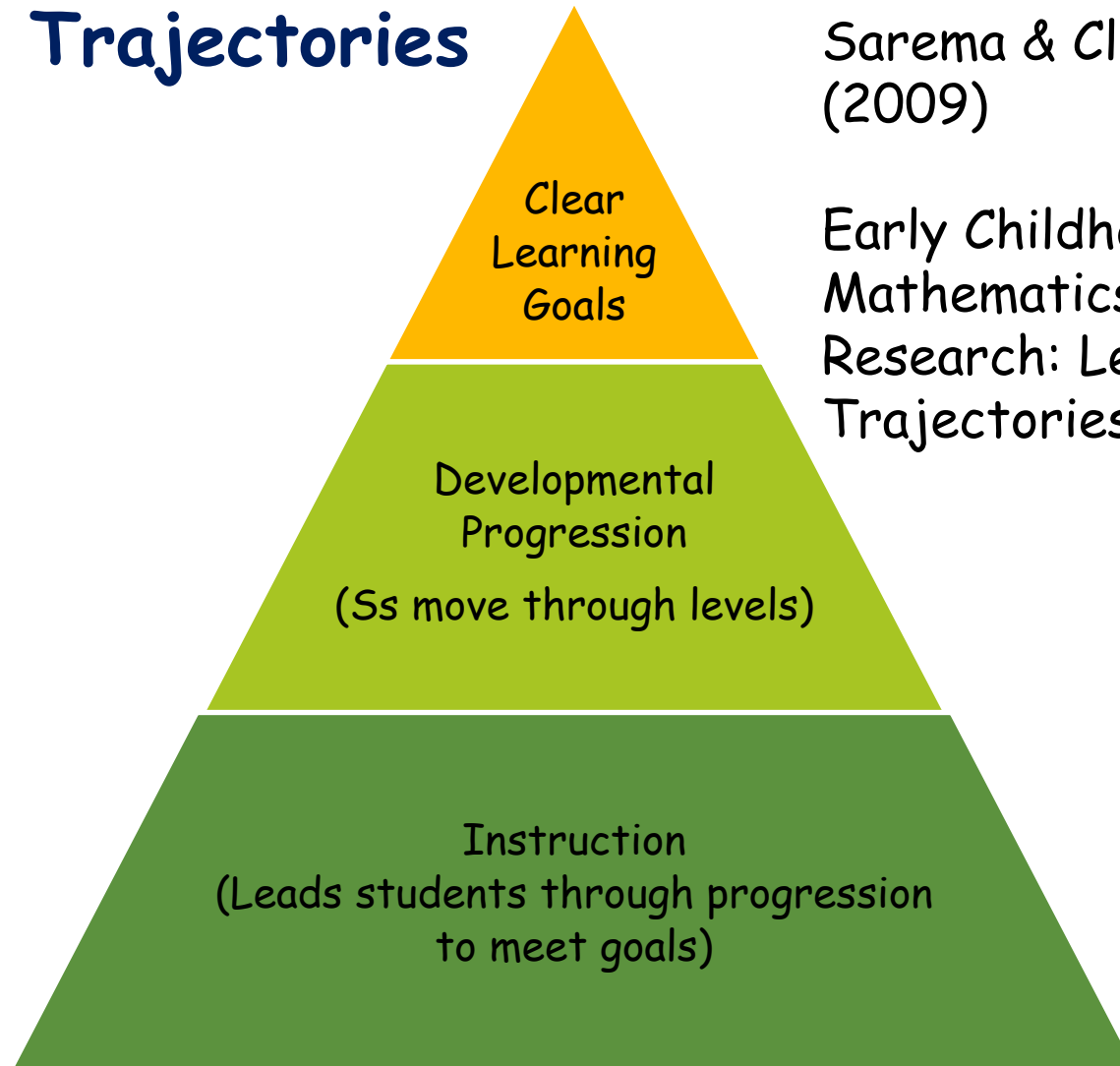
Number concepts

- Numeral identification
- Understanding that a number refers to a set of items
- Counting with one-to-one correspondence
- Rote counting
- Breaking apart and putting together sets of items
- Number conservation
- Patterning
- Adding and subtracting quantities

Learning Trajectories

Sarema & Clements
(2009)

Early Childhood
Mathematics Education
Research: Learning
Trajectories



- Many early numeracy skills develop before children have any type of formal schooling, ***some children may not have these critical skills*** due to
 - lack of experiences or exposure within their environment, culture, education (e.g., high quality preschool instruction)
 - because of slow developmental progressions
- For these students, more intensive interventions are needed to explicitly teach lacking early numeracy skills beginning in kindergarten and extending through the elementary years (based on work of Sarema & Clements, 2009: *Early Childhood Mathematics Education Research: Learning Trajectories*)
- Who are these students? (contrast of expectation and present level of functioning)
 - Competency in Numeracy (Towles-Reeves, Kearns, Kleinert, & Kleinert, 2009; Kearns, Towles-Reeves, Kleinert, Kleinert, & Kleine-Kracht Thomas, 2011).

Early Mathematics Outcomes: Impact

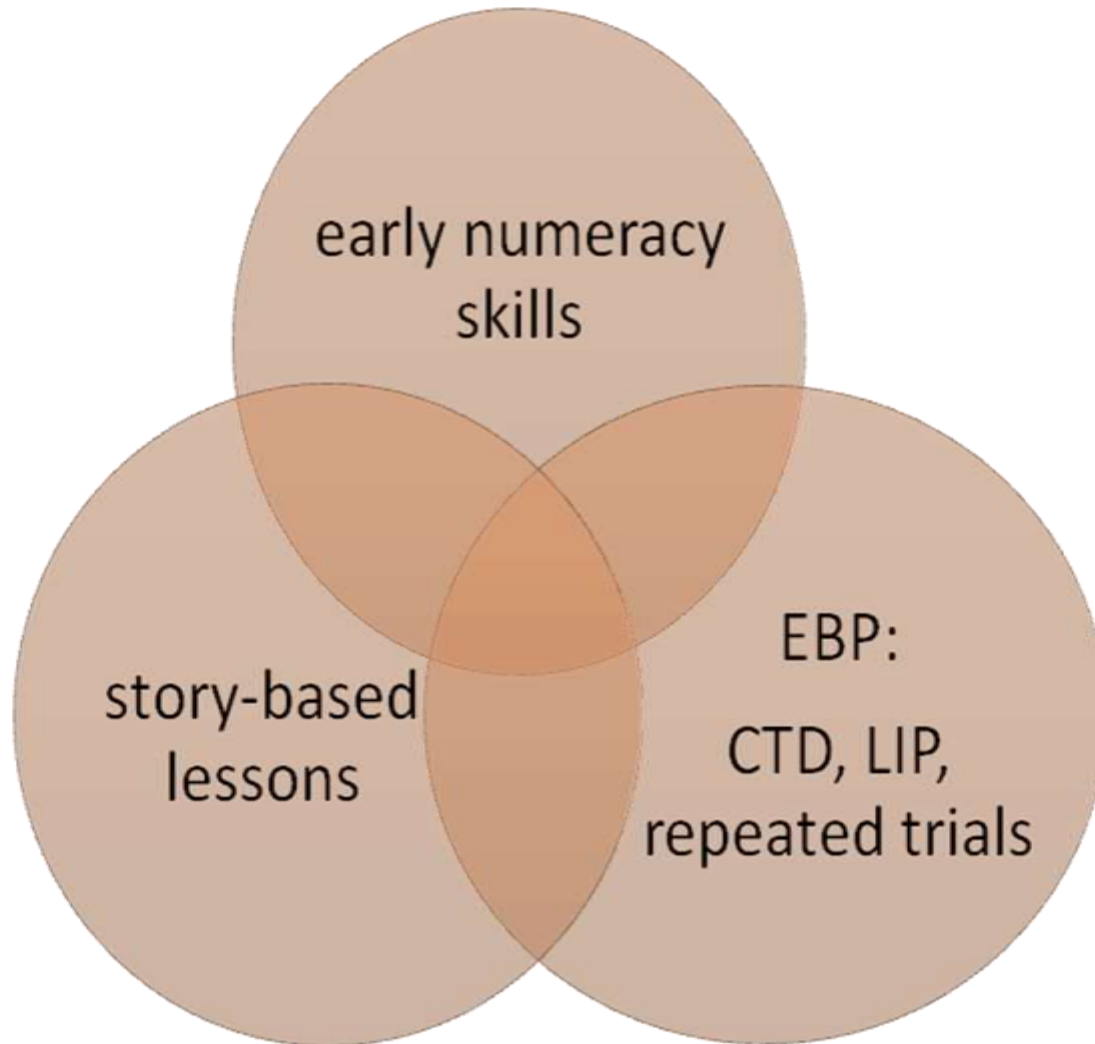
- Yet, students with disabilities ...
 - 12% can rote to 5 [Kearns et al., 2011]
 - 3.3% could apply basic computations to real world problems [Towles-Reeves et al., 2009]

“Longitudinal data shows the association between early mathematics achievement and later outcomes is stronger than that for reading achievement.” [Duncan et al., 2007, p. 1443]

Access to the General Curriculum

- ... designed ... participate ... on the same basis as ... [DSE]
- Sets high expectations ... least dangerous assumption
- Personalised learning ... self-determination
- Enhanced teacher professional knowledge ... across all educational contexts

How Early Numeracy is Developed

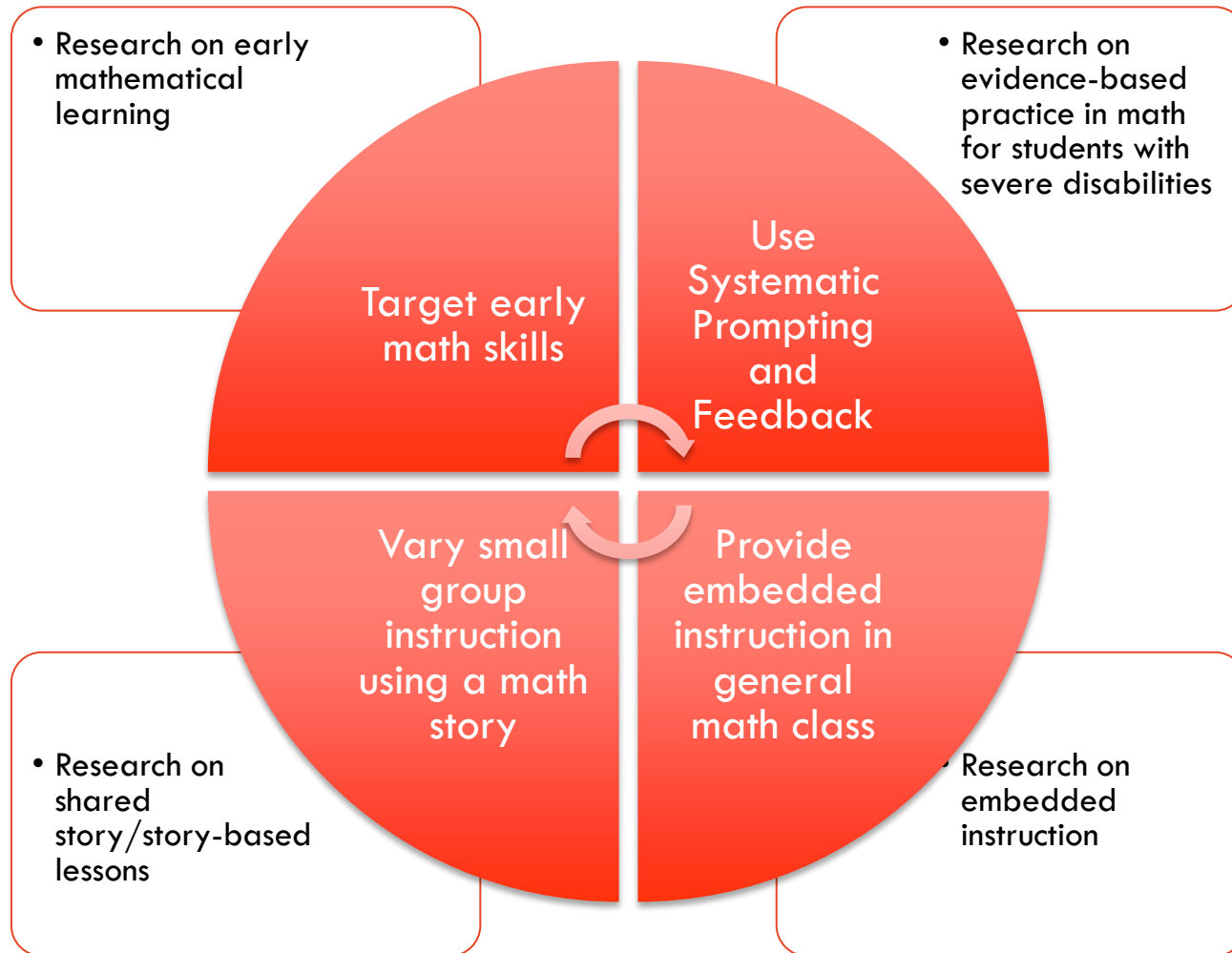


Numeracy and Mathematics

- ... the development of numeracy requires experience in the use of mathematics beyond the mathematics classroom, and hence requires an across the curriculum commitment. [Numeracy Review, 2008, Recommend 1]
- Students become numerate as they develop the knowledge and skills to use mathematics confidently across all learning areas at school and in their lives more broadly. Numeracy involves students in recognising and understanding the role of mathematics in the world and having the dispositions and capacities to use mathematical knowledge and skills purposefully. [Australian Curriculum, 2016]

[<http://v7-5.australiancurriculum.edu.au/mathematics/general-capabilities>]

Conceptual Model



[Browder, Jimenez et al., 2012, p. 211]

TABLE 3 Early Numeracy Goals and Skill Progression

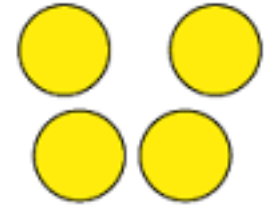
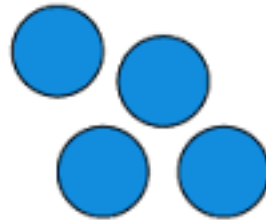
Goal Area	Rationale for Goal	Progression of Skills in Early Numeracy	Instructional Method
Counting with one-to-one correspondence	Counting objects with one-to-one correspondence may be arguably the most important early numeracy skill. Students must have this skill to begin subitizing and to build on higher skills, such as place value (Sarama & Clements, 2009).	Higher numbers are introduced in later levels (e.g., 1–5 objects are introduced in Units One and Two; 1–10 objects in Units Three and Four). Also, the skill progresses from movable and nonmovable objects in a line, to scattered objects, to counting objects from a group where more objects are provided than needed.	Least Intrusive Prompts
Numerical identification	Students must recognize that numbers have numerical representations and verbal names (Sarama & Clements, 2009).	Higher numbers are introduced in later levels. For example, in Unit One numerals 1–5 are introduced and in Unit Two, numerals 1–10 are focused on. Students must identify numbers expressively in Units Three and Four.	Time Delay with Feedback
Rote counting	Students must know the verbal sequence of numbers in order to develop number sense (Sarama & Clements, 2009).	Higher numbers are introduced in later levels. For example, in Unit Two, students rote count 1–10; in Unit Three, students rote count 1–15; and in Unit Four, students rote count 1–20.	Least Intrusive Prompts
Composing sets	Students must understand the effect of combining objects to create sets (Sarama & Clements, 2009).	Students are required to create larger sets in later levels. In the highest level, students must create sets in the context of a story.	Least Intrusive Prompts
Addition with sets	Students must understand the effect of combining, and eventually decomposing sets of objects. Also, this is a prerequisite skill to understanding the meaning of operation symbols (+, −, ×, ÷) (Sarama & Clements, 2009).	Unit One uses premade sets, with sums of 5 or less. In Units Two and Three, students create sets and add sums of 5 or less and 10 or less, respectively. In Unit Four, students create sets with sums of 10 or less in context (word problems are introduced).	Least Intrusive Prompts

Jimenez, Saunders, & Browder (2011). Early Numeracy Curriculum

In Practice

— Early years

- Language and vocabulary
- Problem-solving
- Fractions
- Number
- Personalised needs
- [Time]



— High School

- Language and problem-solving
- Probability
- Money
- Personalised needs
- [Time]



In Practice

- Adjust the content load – focus on the big ideas
- Universal design for learning framework
 - Multiple ways of Engagement, Representation, Action and Expression
- Evidence-based practices
 - Explicit instruction
 - Graphic organisers
 - Embedded instruction
 - Explicitly teach vocabulary and language
 - Manipulatives



Create a Math Story for Read-Aloud

- Write to address math standard
- Adapt word problems
- Focus on activities students prefer or are familiar with
- Change stories so students do not memorize




Display Easel and Manipulatives





Graphic Organizer


- To keep track of steps to solve the problem


WHAT DO WE NEED TO FIND OUT? CHECK THE BOX. ☒


☐ 1. What food will Kurt get next? 


☐ 2. What store will Kurt go to next? 


D  Dairy

E  Deli

P  Produce

F  Frozen

B  Bakery

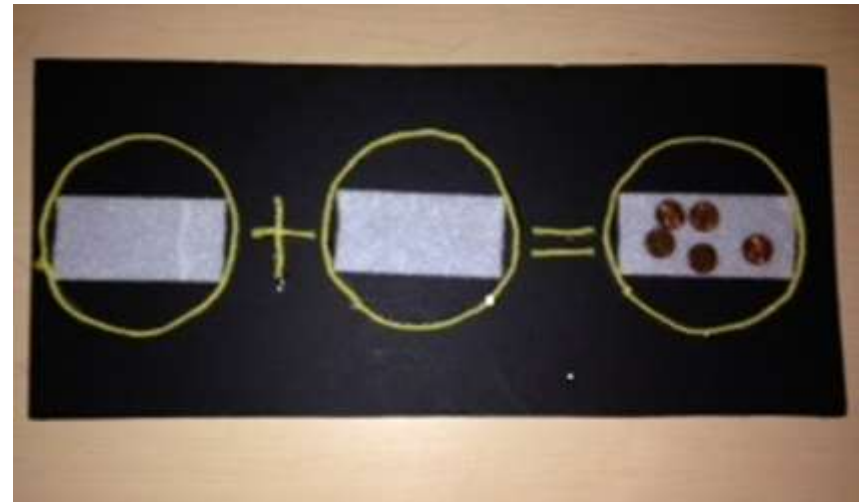
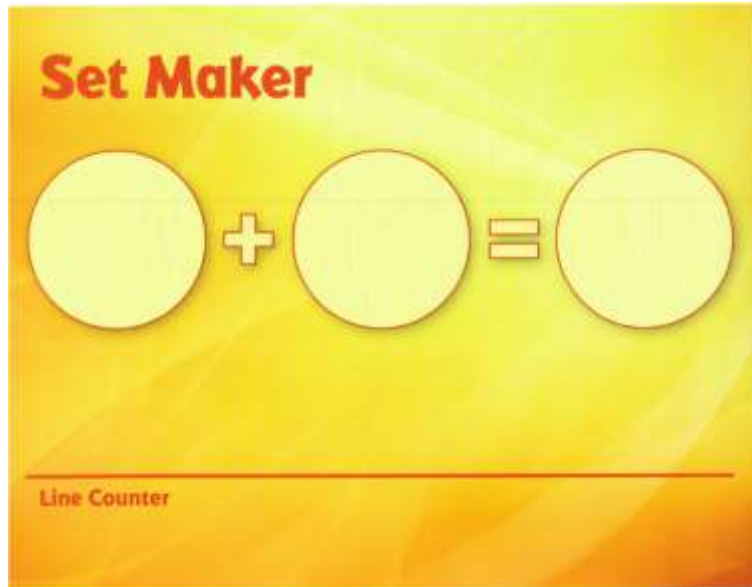
C  Cereal

A Enter/Exit

Grocery store map

Food: _____

Set Maker



Task Analysis

- Steps the students will follow to apply the mathematical processes (e.g., steps to plot points on a plane)

Story 1. Kurt plans ahead



LEVEL OF SUPPORT

This unit begins by providing an intensive level of support to students. Model the steps, then have students follow your model immediately.

MATH VOCABULARY

map, point, line segment, plane

MATERIALS

- Picture of a world map
- Concept Maps from Appendix: point, line segment, and plane;
- Math Work, pages 8–9
- Grocery Map Poster for “Kurt Plans Ahead”

OPTIONAL MATERIALS

- Picture of a local grocery store
- AAC device preprogrammed with map, point, line segment, and plane; problem statement; points A, P, D, E, F; line segments AP, PD, DE, EA; plane APDE; dairy, milk
- Pointer/light pointer or eyegaze board
- Response cards printed from the Image Library: map, point, line segment, plane, dairy, and milk
- Problem statements printed from the CD-ROM

OPENING

Explain the lesson objective by saying to students, *Today we’re going to learn about the math we use to help us picture the world around us. We use math in our lives every day. Geometry is math that helps us make pictures of the world around us.*

Task Analysis

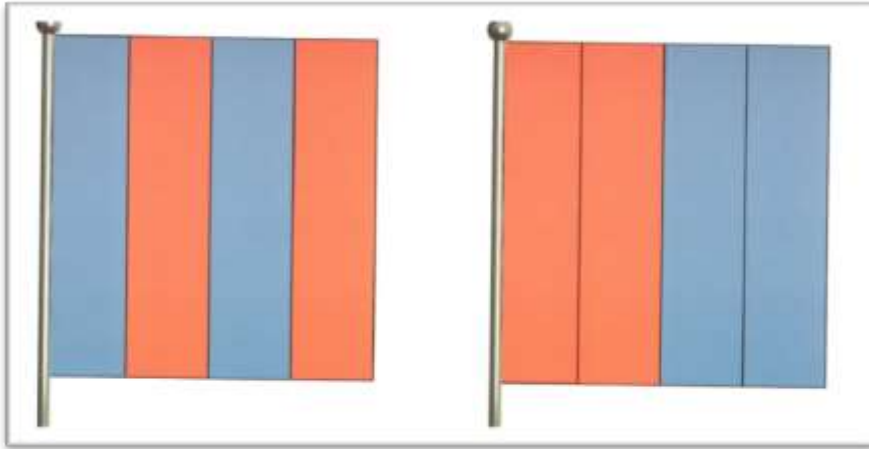
1 Introduce math terms, grocery store map, and story.

- Introduce the following geometry terms: *map*, *point*, *line segment*, and *plane* using a map of the world and the Concept Maps.
- Hold up the picture of the world map and say, *A picture of the world around us is called a map. Some maps show pictures of big places, like the whole world on this world map. This is a map. Say map.* Have students say *map* while pointing to the world map.
- Then show the Concept Map and say, *This is the word map. Say map.* Have students say *map* while pointing to the word *map*.
- Introduce the term *point* by saying, *Maps have a special name for a place, called a point. A point is a place, or a location on a map.*
- Then using the Concept Map for point, touch the point while saying, *This is a picture of a point. Say point.* Have students touch and say *point*.
- Then say, *This is the word point. Say point again.* Have students say *point* while touching the word *point*.
- Touch the capital D and say, *Sometimes a point is named by a capital letter. This is point D.*
- Using the Concept Map for line segment say, *Sometimes, we go from one point to another. The line that goes from one point to another is called a line segment.* Have students say *line segment* while pointing to the picture for line segment.

Make Sets 1-3



Identify the ABAB Pattern



Response options provided in the Student Response book.



We recreated the ABAB pattern response options using objects, Velcro™, and foam board.

Calendar

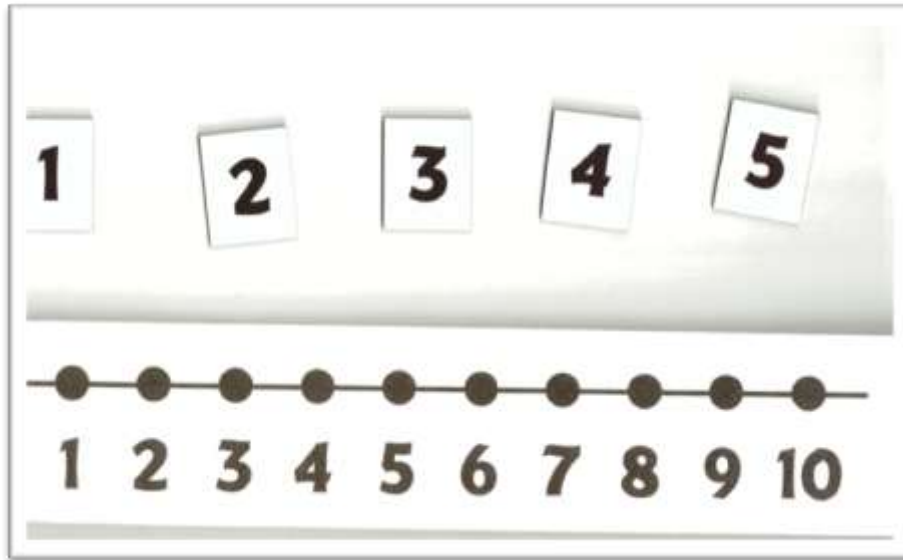
Kit provided paper monthly calendar.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

We recreated one week and made tactile.



Numerals 1-5



individual magnetic boards with small numbers and paper number line.

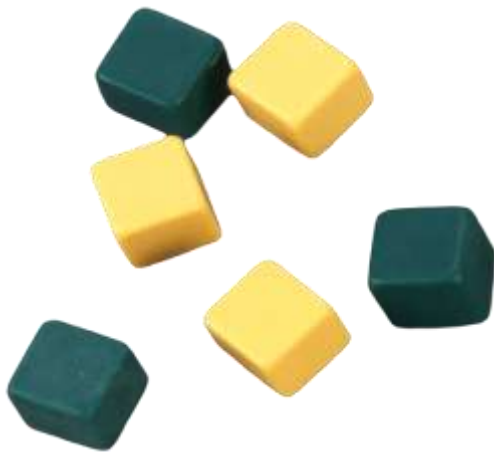


large plastic numbers (e.g., mailbox numbers), Velcro™, and foam board.

Example

Mainstream Math Lesson : Grade Aligned Expectations

- Using sets to develop understanding of multiplication or division
 - Creating 3 sets of 4
 - Dividing 12 into 3 sets



Embedded instruction

- Create sets up to 5 (skill learning in Early Numeracy instruction)
 - Generalized to general education math materials for creating sets
 - Extended to multiplication
- Can select number from number line to label sets
 - Using number line from Early Numeracy instruction in general education math classroom
- May be able to count to find multiplication answer