Playing with maths:
Does implementation dosage affect children's learning outcomes?

Presenters:

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Key points of presentation

- Introduction
- Implementation studies in early childhood settings
- Measuring children's learning outcomes
- Preliminary results and discussion
- Lessons learnt

Introduction

- Declining number of STEM students in OECD countries over the last 20 years – implications for research, development and innovation (Ainley, Kos & Nicholas, 2008).
- Mathematical proficiency of children at age 4 in Asian countries ahead of children in the US; gap increases as children progress into formal education (Lee & Ginsburg, 2007).
- Early Years Learning Framework for Australia (DEECD, 2009) and National Quality Standard for Australia (DEEWR, 2011) require (i) intentional teaching, (2) numeracy skills.

Rationale for the study

- Children's understanding of mathematical ideas varies greatly (Klibanoff, Levine et al, 2006).
- Middle-class background – more opportunities changes children's learning trajectories (Jordan, Glutting & Ramineni, 2010).
- Educator's self-reported uncertainty (Lee & Ginsburg, 2009; Pearn, Hunting & Robbins, 2009; Perry, 2009).
- Minimal pre-service/post-qualification PD for early childhood educators.

Research design

- Six early childhood educators consented to participate.
- Packaged suite of play-based mathematics activities provided.
- Each educator agreed to present one small group activity each day and record on an implementation log.
- Interviews with educators at the start, mid-way and the end of the implementation phase.
- Pre- and post-implementation assessment of children's cognitive abilities Woodcock-Johnson III (WJIII; Mather & Woodcock, 2001a, 2001b; McGrew et al, 2001).
- Pedagogical quality assessment at group level (CLASS; Pianta, Hamre & La Paro, 2008).

Research design

Number

Number clothesline

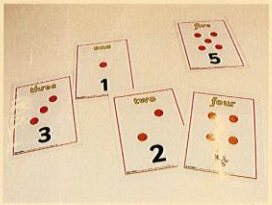
What? The child identifies the numeral on a card and hangs it on the washing line in the correct numerical sequence.

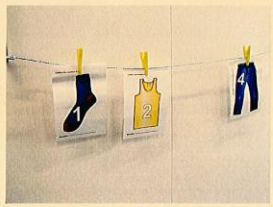
Why? There is a difference between knowing the number word sequence (the poetry of the words) and associating a number word with a numeral, and being able to count.

(Counting is dealt with in the Toy Box activity.)

How? Cards are placed face down on the floor in the middle of the semi-circle. The child chooses a card.

Say, "Please tell me the number on the card, and then hang it on the clothesline!"





You need:

- Numeral cards
- Clothes line and pegs

Extend the activity:

Children use number cards to work out their order in a line

Shorter or longer numeral sequences

Sample question:

Is it before or after this number...?

Record of implementation

Number Clothesline

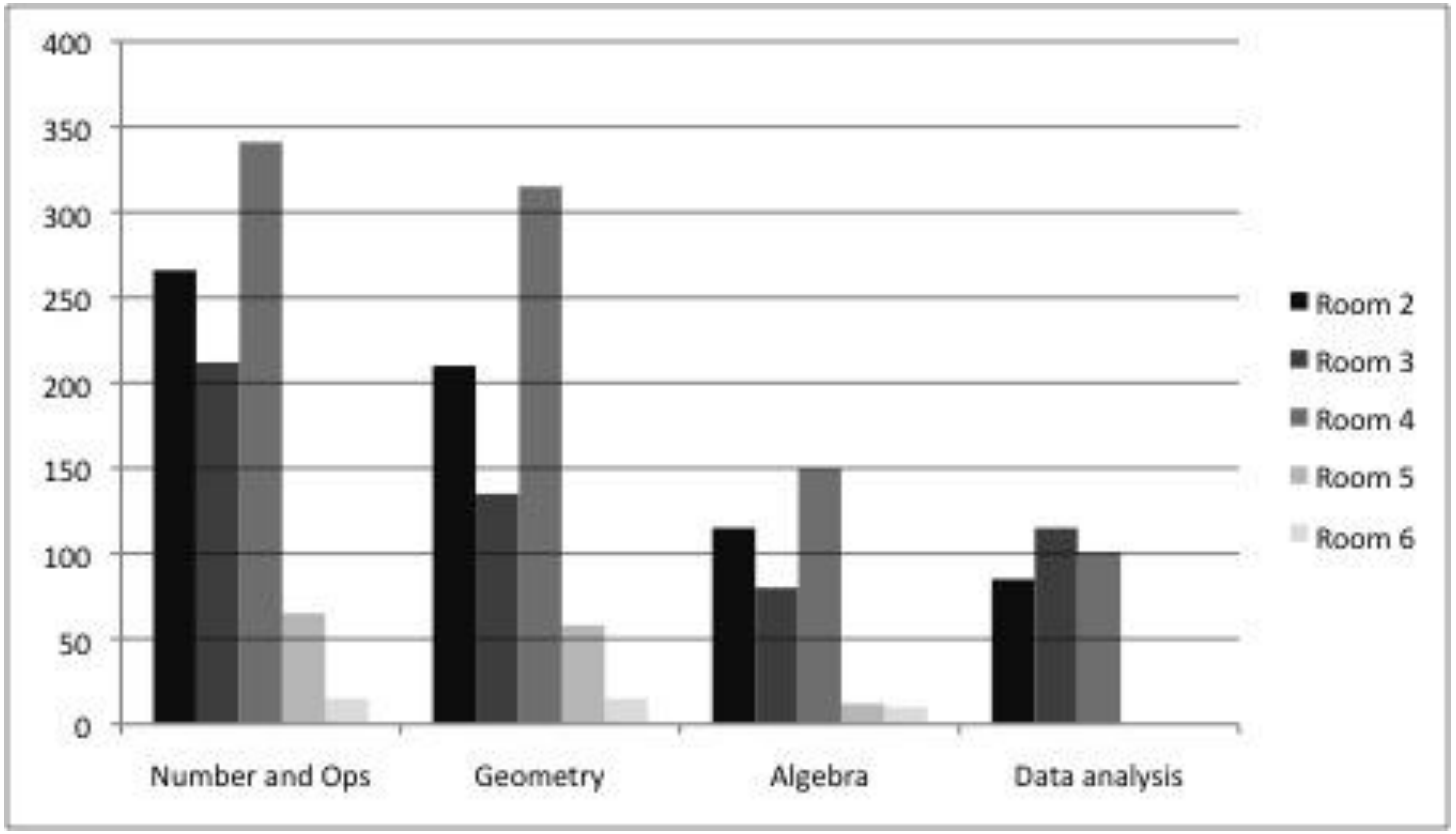
Date	No. of children	How long did the activity last? *(Minutes)*	Did children engage with the activity? *(Please circle the answer)*	Did you change the activity? *(Please circle the answer)*	If yes, describe the changes you made.
7/10	1 girls ... boys	5min	1 2 3 4 (5) (no) (somewhat) (very much)	(Yes) No	Gave ch number cards w/o dots + asked her to put on line.
31/10	3 girls 2 boys	10mins	1 2 3 (4) 5 (no) (somewhat) (very much)	Yes (No)	
3/11	2 girls 2 boys	5mins	1 2 3 (4) 5 (no) (somewhat) (very much)	(Yes) No	11 → 20
4/11	3 girls ... boys	5mins	1 2 (3) 4 5 (no) (somewhat) (very much)	(Yes) No	Did 10 to 1
7/11	6 girls 7 boys	10mins	1 2 3 4 (5) (no) (somewhat) (very much)	(Yes) No	Put numbers on floor and asked each to show me a particular number

Research design

	Number of implementations	Rank		Number of minutes	Rank
Room 1:	*Withdrew*	-	Room 1:	*Withdrew*	-
Room 2:	64	2	Room 2:	676	2
Room 3:	57	3	Room 3:	542	3
Room 4:	78	1	Room 4:	907	1
Room 5:	15	4	Room 5:	135	4
Room 6:	6	5	Room 6:	40	5

- Dosage ranked by number of implementations and total minutes – same ranking on both measures.
- Rooms ranked 1, 2 and 3 grouped “high”; rooms ranked 4, 5 grouped “other”.

Research design

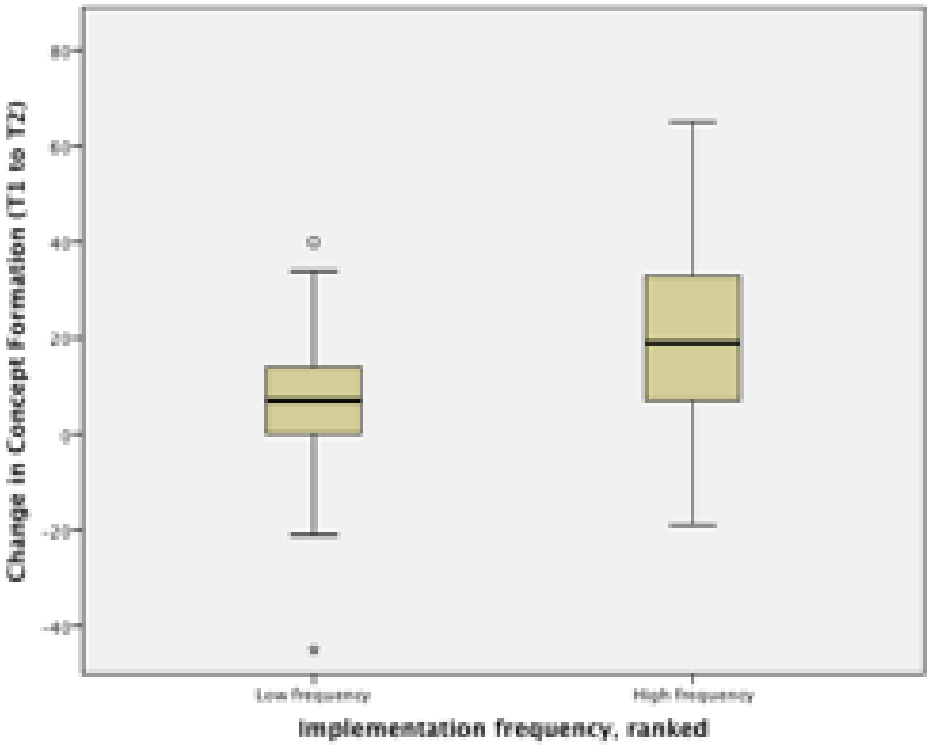


Minutes of implementation by mathematics strand across implementation period (April to Nov).

Measuring children's learning outcomes

- Concept Formation test from the Woodcock-Johnson III (Mather & Woodcock, 2001a, 2001b; McGrew et al, 2001) explored whether exposure to the mathematics activities was associated with a change in the mathematics achievement of the children in each setting.
- Avoided evaluator bias in educators' reports of children's achievement.
- Accordingly, inferences may be drawn.

Preliminary results and discussion



- Data from Room 6 excluded due to incompleteness.
- Average change in CF greater in the higher dosage room than low dosage room.

Lessons learnt

- Results demonstrate an association between children's Concept Formation scores and "high" dosage of the mathematics activities.
- Limitations:

  (i) selection effects (such as attributes of children and their families that cause differences in Concept Formation scores may also be associated with the choice of EC program), and

  (ii) missing or incomplete data around implementation.

Lessons learnt: Recommendations for future implementation assessment in EC settings

- Use an experimental or quasi-experimental design to isolate the treatment condition;
- Conduct more detailed observation throughout the duration of the study; and
- Use more nuanced child-level measures.

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