



Centre for Early  
Mathematics  
Learning

# Maths is Everywhere?

Practitioner approaches to creating  
mathematics learning opportunities in early  
years settings – and what this might mean for  
motivation

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Centre for Early Mathematics Learning



Background

Data and Method

How do early years practitioners design spaces for mathematics learning?

How do practitioners reflect on desired outcomes ?

What might be some implications for children's motivation and learning?

Conclusion

# Early Years Mathematics – motivation, variation, quality

Background



# Early Years Mathematics

- Children's mathematics learning outcomes vary due to the quality of early years education that they experience before starting formal schooling (Melhuish et al., 2013)
- Some recent evidence showing measures of quality of mathematics instruction in early years are predictive of outcomes (Pohle et al., 2022)
- There is wide variance in outcomes among children – and more variance between settings than within (Melhuish et al., 2013, Pohle et al., 2022)



# Motivation in mathematics

- Evidence of sharp declines in enjoyment of mathematics through primary and secondary school (Noyes et al., 2012)
- Enjoyment and motivation in mathematical learning strongly related throughout school experience (Schukajlow, 2023)
- Motivation matters for learning outcomes. Intrinsic motivation predicts growth in arithmetic fluency in primary school (Baten et al. 2026)
- Evidence from studies with older children that a more student-centred pedagogical approach might promote higher levels of engagement and motivation (Pampaka et al., 2011; Noyes et al., 2012)

# Environment Design

- In South Korean and English settings, maths tables and areas with materials for mathematics activities were present in both countries (Siraj-Blatchford and Nah, 2014)
  - In South Korean settings, there were science materials near the mathematics materials due to their proximity in the national curriculum
  - In English settings, practitioners spoke of the ways in which mathematical thinking and learning also took place in areas other than the ‘maths area’
- Maths tables/areas are sometimes associated with specific tasks;
  - ‘sorting and counting’ (Cohrssen et al., 2015),
  - ‘sand and water equipment [...] emphasizing capacity, conservation, size, grading’ (West & Verlaam, 1991: 111)

# Practitioners' Intentions

- It has been questioned whether it is appropriate for ECE practitioners to have deliberate, explicit intentions for their learners (Grieshaber et al., 2021)
- Many practitioners are hesitant to engage in intentional teaching of mathematics specifically (Cohrssen et al., 2013) and prefer to address mathematics through everyday classroom routines (Lee & Ginsburg, 2009)
- Wary of the risk of learning intentions ‘hijacking’ play (Pyle & Danniels, 2017)
- Learning intentions are valuable through all modes of learning from ‘free play’ to ‘structured’ (Chigeza & Sorin, 2016)
- Practitioners can plan learning experiences in advance “with specific outcomes or goals in mind for children’s development and learning”, while also being sensitive to recognise and take opportunities that arise (Epstein, 2007, p. 1)

# Research Questions

**How do Early Years practitioners create environments for mathematics learning for 3–4-year-old children?**

**How do Early Childhood Education practitioners reflect on their intended outcomes for 3-4-year-old children's mathematics learning?**

**How do these decisions position motivation and learning?**

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# The Interviews and Thematic Analysis

Data and Method



# Interviews and Observations

## Visit 1

- 30-minute interview: how do you create opportunities for mathematics thinking & learning
- 1-hour+ observation: noting features of the environment, main areas of activity, practitioner roles
- 30-minute interview: reflecting on the observed session

## Visit 2

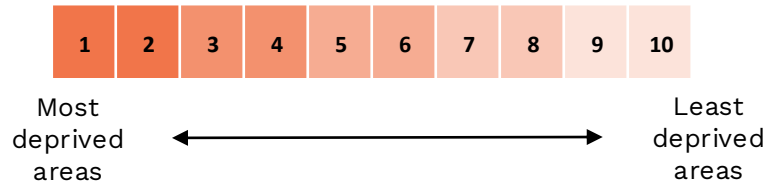
- 30-minute interview: Focus on training, development, access to resources



# The Data

Setting Type	Number of Settings	IMD
Private	6	2, 4, 6, 8, 9, 10
School	6	1, 5, 5, 5, 5, 7
Playgroup	3	2, 8, 10
Private on school grounds	2	6, 10

- IMD measures seven domains of deprivation to give a rank and a decile (1 being most deprived areas and 10 being the least deprived)
- Based on the postcode of the setting



# Thematic Analysis

- To identify repeated patterns of meaning across a data set (Braun & Clarke, 2006: 86)
- Patterns are developed from a process of:
  - data familiarization
  - data coding
  - theme creation
  - revision
- Thematic Analysis is an overarching term rather than a single method (Braun & Clarke, 2019)



Coding Reliability  
Thematic Analysis



Codebook  
Thematic Analysis



Reflexive Thematic  
Analysis

Background

Data and Method

How do early years practitioners design spaces for mathematics learning?

How do early years practitioners enable a 'maths everywhere' approach?

What are practitioners' reflections for pedagogy and practitioner skills?

Conclusion

# How do early years practitioners design spaces for mathematics learning?

Analysis and Discussion



# Settings with a maths table/area

Setting type	Maths Table	IMD
Private	1	4
School	5	1, 5, 5, 5, 5
Playgroup	2	2, 10
Private attached to school	1	10
<b>Total:</b>	<b>9</b>	



# Engagement with maths tables/areas

- Children with ‘positive attitude’ towards maths engage well
- Children’s interests are often captured by other aspects of the provision
- Some children need “a push” to engage with the maths table/area

So, one of the little boys, he loves maths, he always participates in all the lessons and then out of the un – out of the, the classroom in continuous provision you’ll often see him within the maths area.

(MT-School-IMD1)

A few will need a little bit more of a – a push to go over and look at the maths area.

(MT-School-IMD5c)



## Settings without a Maths Table/Area

Setting type	No Maths Table	IMD
Private	5	2, 6, 8, 9, 10
School	1	7
Playgroup	1	8
Private attached to school	1	6
<b>Total:</b>	<b>8</b>	

# Reasons not to have a maths table/area

- Some settings noted that they had previously had a maths table and removed them for the following reasons:
  - Mathematics was already being incorporated in everyday routines and play, so the maths table/area became redundant
  - Children only accessed when an adult was present at the table/area

So, we used to have a set area, and it would be a kind of maths area and it would have resources there to teach maths and over the last few years, we've changed that to make sure that it's incorporated in all the things we do, because it is. [...] We don't need an area, we don't need a certain time to be able to teach maths, it's there throughout the day.

(NMT-Private-IMD10)

We used to have a formal maths table, which was recommended, but it wasn't really accessed because I think, unless an adult was there all day

(NMT-Playgroup-IMD8)

# What is ‘Maths Everywhere’?

- The term ‘maths everywhere’ is one that has come out of the data
  - Other variations were also used
  - Not only tied to settings without a maths table
- Practitioners sometimes acknowledge their lack of a maths table and describe ‘maths everywhere’ as being an alternative
- Other settings mix these approaches and whilst having a maths table, recognise that ‘maths is everywhere’

I think as a setting, for us, I’d say maths is always there in the background.

(NMT-Private-IMD10)

Maths is absolutely everywhere in our setting.

(MT-School-IMD5d)

We do have one like a writing station where they do their writing, but we don’t have a maths station per se. So, we have maths everywhere.

(NMT-Private-IMD2)

# Not realising that you're doing maths

- Practitioners recognise that mathematics learning is happening for the children, but without them recognising it
- Practitioners note that they consciously don't use the word "maths" to describe activities as a way of incorporating mathematical thinking into a variety of activities

So, the way we're doing it in their play, in that moment, they almost don't even realise they're doing it. And we're not forcing them to do something that they don't want to do.

(NMT- Private/School-Grounds-IMD6)

I think they don't know that we do maths. We don't use the word, like, "Oh, we're doing maths now".

(NMT-Private-IMD2)

# Maths Everywhere

It can be a challenge for children to engage in mathematics if they don't know how to play

“Sometimes you get a cohort and [...] they don't know how to play. They don't know what numbers are so then they can't use that in the play. Then you've got to teach them and then you've got to teach them how to use it in play”

(MT-School-IMD5a)

Adults have to 'realise' the opportunities around them and expand on them

“I think sometimes it take as specific adults to realise that that is actually maths, and it's not just they're playing, it's actually there is an interest there, let's expand it.”

(NMT-Private/School-Grounds-IMD6)

Maths is more than numeracy

“If they've painted something [...] like the different sizes and things like that and that was a big stroke [...] I think a lot of the time they focus on number.”

(NMT-Private-IMD8)

Keeping track of children's learning

“We're doing observations on the children, [...]. So, we'd sort of been in [...] just naturally through the children's play and sort of making – taking a wee note of those things.”

(MT-School-IMD7)

# Maths Tables/Areas

Showing children how to access the maths tables/areas

“We take him over and if you sit him down and engage him and line things up and play and show him, he will sit and sort of do it with you, but he needs the encouragement to come over.”

(MT-School-IMD5c)

Adults being present at the maths table/area

“We used to have a formal maths table, which was recommended, but it wasn't really accessed because I think, unless an adult was there all day.”

(NMT-Playgroup-IMD8)

Encouraging children to engage with the space

“A few will need a little bit more of a – a push to go over and look at the maths area.”

(MT-School-IMD5c)

Consolidation and identifying gaps

“[...] he's also getting really good at putting those numbers together now [...] through that and through directed maths teaching as well we can identify more of the gaps really.”

(MT-School-IMD5a)

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Data and Method

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How do practitioners reflect on desired outcomes?

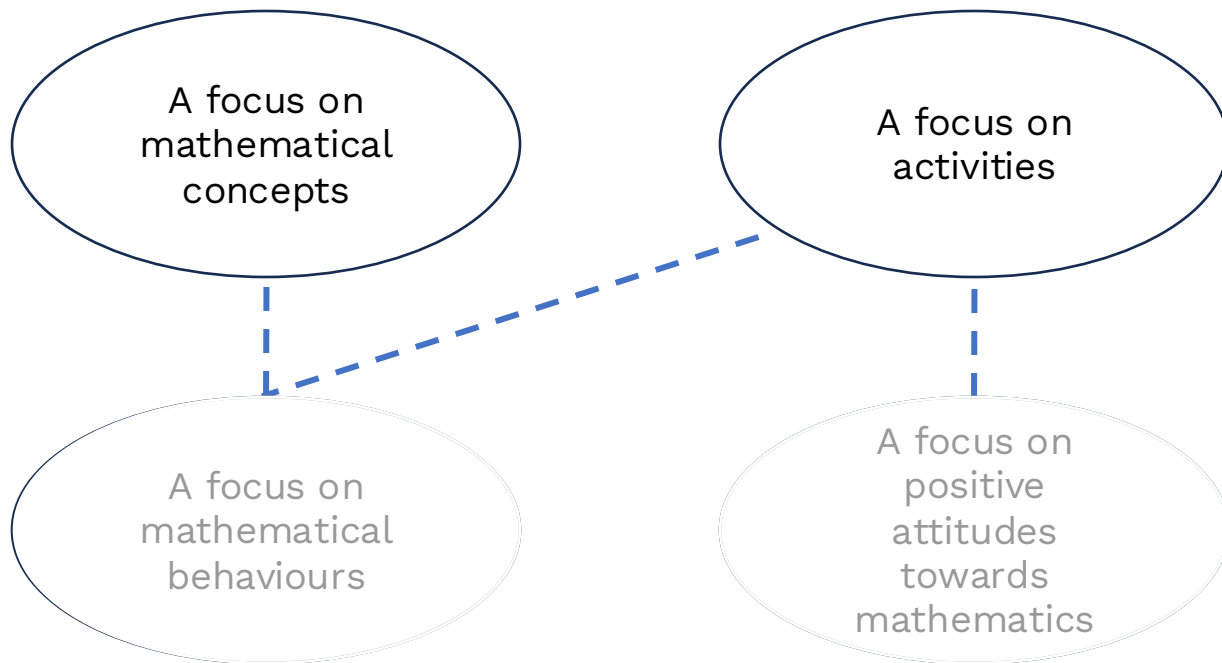
What might be some implications for children's motivation and learning?

Conclusion

# How do practitioners reflect on desired outcomes for children's mathematics learning?

Analysis and Discussion

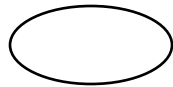
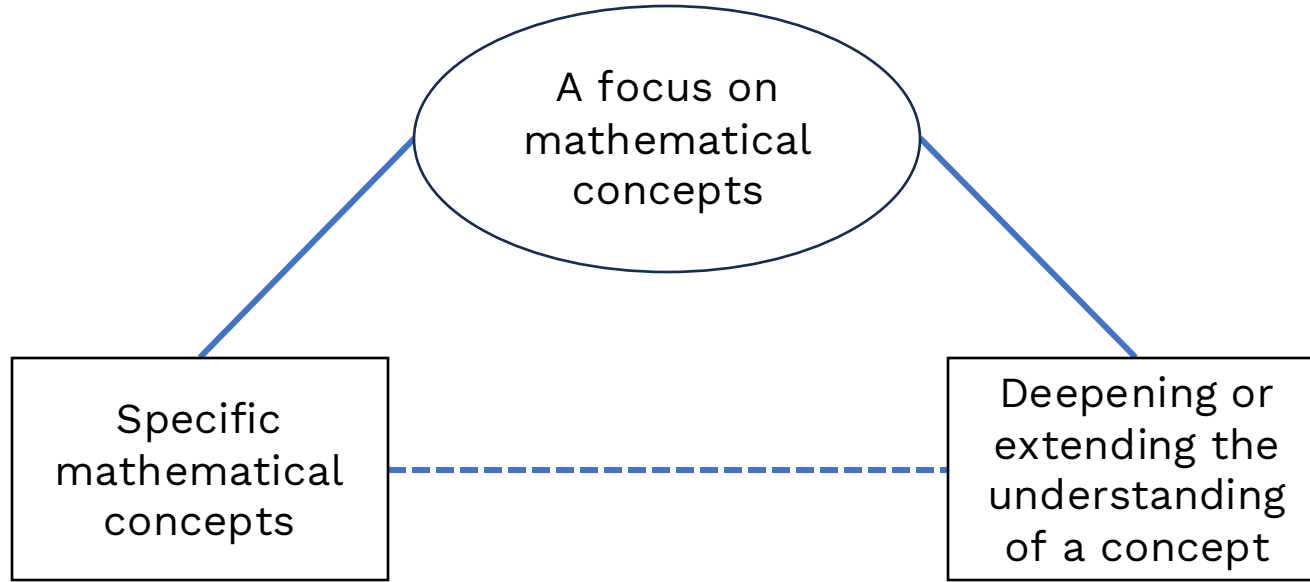




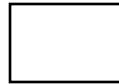
Theme



Relationship  
between themes



Theme



Sub-theme



Relationship  
between  
sub-themes



Link to sub-theme

# Sub-Theme 1a: Specific mathematical concepts

- Outcomes that are driven by a central mathematical concept that the practitioner wants the children to learn about
- Planned learning activities conducive to the achievement of these outcomes
- Whole class, adult-led mathematics sessions
  - Carefully structured around the intended concept-driven outcome

I've got some real life patterns, for them to look at first, because [...] I try to bring it back more to real life, so it's, so it's relevant really, because otherwise if it's not relevant it doesn't mean anything, does it? And then we've got some cubes, so that they can continue a pattern with cubes [...] and then [...] having the challenge of doing the stockings afterwards, then that's an extra, so that they're kind of applying what they're doing. (School-IDACI-6a)

# Sub-Theme 1a: Specific mathematical concepts

- Whole class, adult-led sessions with an entirely mathematical focus
  - Concept-driven outcomes were the intended result of a section of the session
- Planned activities in the continuous provision
  - Intention of the children engaging with resources in an expected way that was related to the concept-driven outcome

We always have a bit of a welcome time and we go through like the days of the week, and again we talk about how many days are there in a week and we – we go through our little preschool rules and we do sort of a maths thing with our preschool rules. We have five and – and then I – then I’ll say, “I’ve got five. I’ve – I’ve put one on the board. How many have I got left in my hand?” and they all engage in that every morning. (Private-IDACI-8)

We’ve got the coloured objects with the number and the bowl, so our intentions are for them to match the quantity to the numeral. (Voluntary-IDACI-1)

# Sub-Theme 1b: Deepening or extending the understanding of a concept

- Concept-driven outcomes based the children having a better developed or more secure understanding of a learned concept
  - Forming connections between concepts
  - Challenging the children to think critically about a concept

So, because I know this, therefore I know that. So if I know that you give me a high five, that's five. So therefore I don't need to count one, two, three, four, five. Because I know this, therefore I know that that's six. And then they can count on. (Private-IDACI-2)

So there's a sorting activity [...] but we – we want them thinking a bit more critically. So they can sort, but like say into blue and red, but we want them – so we've got buttons out today so we want them to be seeing like four – four holes and two, so just looking a bit more in depth. (School-IDACI-6b)

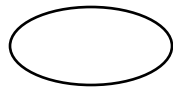
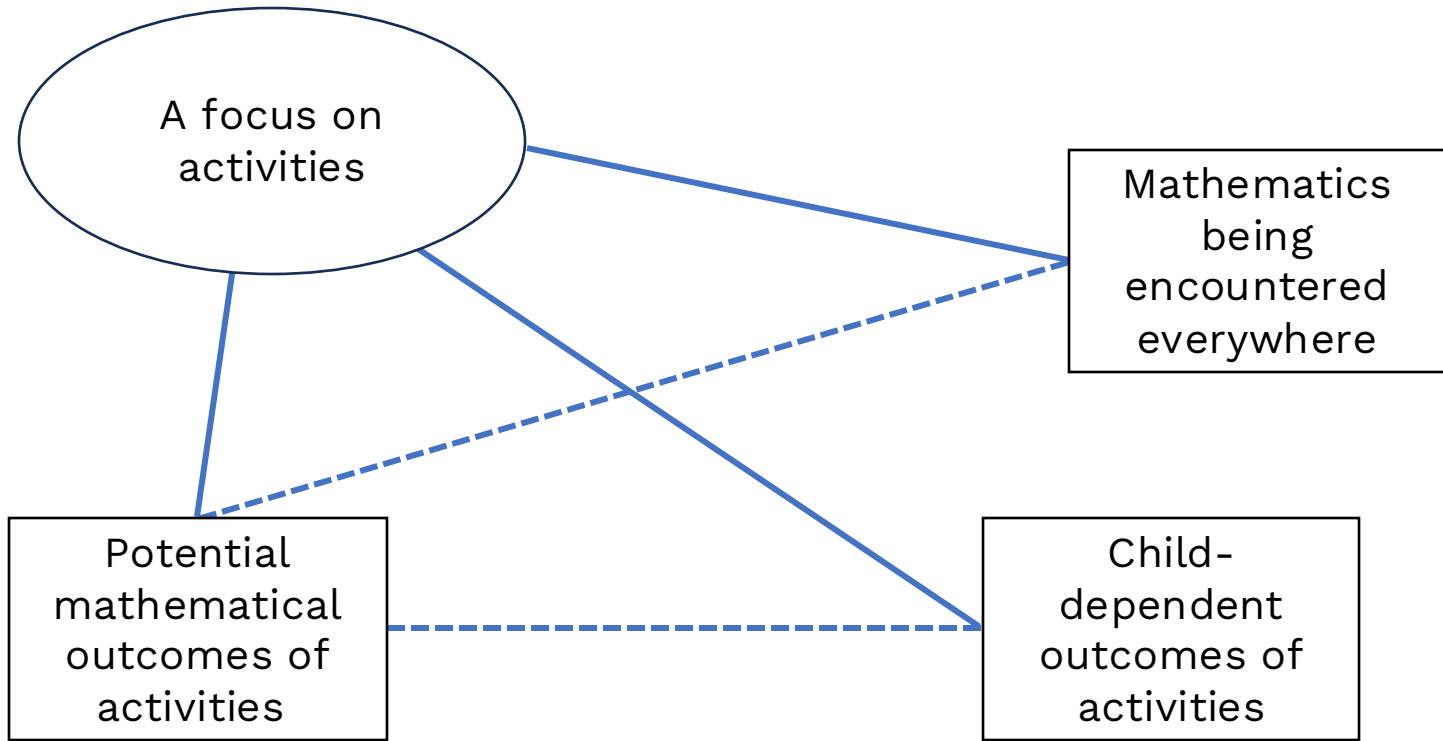
# Sub-Theme 1b: Deepening or extending the understanding of a concept

- Extending a concept
- Applying concept knowledge in new ways during independent play
- Applying concept knowledge through repeating an adult-led mathematics sessions

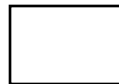
To rinse and repeat the activity [...] and maybe even extend it a little bit and with her, I know I could as well if I got numbers that went up to twenty, she would be able to do the same thing. (School-IDACI-3b)

He loves the magnetic blocks, but to go and use something else, to build where still include into maths, still got shapes, but using a different material to do that with. (School-IDACI-4)

I'm hoping [...] they'll want to come in and engage with the monkey puppet, have a go at doing that activity together on a carpet [...] the higher ability children will start the game with the lower ability ones [...] and be the teacher while the lower ability ones be the child. (School-IDACI-3b)



Theme



Sub-theme



Relationship  
between  
sub-themes



Link to sub-theme

## Sub-Theme 2a: Potential mathematical outcomes of activities

- Practitioners report the potential ways in which activities can be used as learning opportunities for multiple mathematical concepts
  - Numerous learning outcomes are possible
- Multiple opportunities 'embedded' in an activity from the outset and ready to be drawn out
  - By the practitioners and children playing together
  - By the children playing independently

Within that shop there is labels with numbers written on, we've got money and counting, we've got the till and lots of things just embedded. We write a shopping list, so we were saying, can I have two bananas and then can I have a round watermelon, can I have a big orange, and we were using mathematical concepts while we're playing (Private-IDACI-9)

We've got a hibernation tray with the hibernated animals, and we've got conkers. So we would be saying, you know, "Can you give the squirrel two conkers, three conkers?" I heard a little boy, "Oh, it's got sand in it" and he was pouring and filling and then he said, "My cup is empty, I need to fill it." (Voluntary-IDACI-7)

## Sub-Theme 2b: Child-dependent outcomes of activities

- The children have different learning opportunities from the same activity due to individual factors
  - Prior attainment
  - Age

It's not necessarily we want each child to get this out of this activity because each child is very different. So, it's about their needs and what they need to be getting from that activity [...] So, for some children, it might just be that they're learning the colours from the activity. Other children, it might be about, obviously, can we sort out the sizing of the bears in that activity? Can we sort of make a pattern? It depends upon that child's knowledge and what they're able to do, really. (School-IDACI-8)

I have got some two years old [...] so for them, this is a fun activity. They'll just take shapes out and pop it in [...] and the older ones, we would make patterns with them. Oh I'm making a pattern with one, right can you do the same? (Private-IDACI-6)

## Sub-Theme 2c: Mathematics being encountered everywhere

- A focus on activities was facilitated by practitioners' emphasis on immersing mathematics into the children's play and everyday routines
- Children encounter mathematics 'everywhere'

We've got playdough in the home corner so they're making cakes, making small cakes, big cakes. They put candles on them and say I'm seven or I'm four or three or anything. So it's there [...] Thomas trains have got numbers on and, in the shed, that's got corresponding numbers so they can put the number one train in the number one shed and things like that [...] And we've got a shop and we've numbers in the shops, and the packaging has got weights on. So it is everywhere, it is everywhere. (Voluntary-IDACI-7)

It's all based around play [...] they just generally engage on it on a day-to-day basis without even realising, even when they're on the water tray in there, pouring and tipping and emptying, they're learning about volume and capacity and – and different sizes and shapes. (Private-IDACI-8)

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Analysis and Discussion



# Variety of Approaches



Practitioners are often not aware of the variety across the sector



Parents are also not aware of the range of practices when making choices for their children's early years education provision



There are opportunities for learning across the early years sector

# Conclusions

- Settings in these data were also typically either more concept-driven or activity-driven – very few struck a balance between the two
- Around half of the settings used a maths table, and half did not. Pedagogical decisions around this are also almost certainly having an effect on children's understanding of mathematics and of themselves as mathematicians
- Little relationship between these 2 distinctions (!)
- Primary school-based settings more likely to have a maths table, but no relationship observed with concept-driven/activity-driven pedagogy
- More variation across the sector than was previously understood – not well communicated
- Children will enter primary schools with very different experiences of engaging with mathematics

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# Next Steps

Conclusion



# Next Steps

- We can't say which approach is 'better'. More research is required on:
  - Children's long-term outcomes
    - Children are experiencing mathematics in different ways, but we don't know how, or if, this effects their motivations and outcomes long-term
  - Which focus more adequately prepares children for learning mathematics in primary school?
    - Is a focus on concepts preparing children better for their future in formal schooling?
    - Is a focus on activities better for addressing what children need now in their early childhood?

# Next Steps

Challenges in observing or measuring motivation, attitude, and achievement at this age

Also challenges in longitudinal studies to explore long-term effects of early years experience

Few policy levers to influence practice

Urgent need for further research to better understand effects of early years education practices on children's motivation, engagement and attitudes



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# References

- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77-101.
- Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative research in sport, exercise and health*, 11(4), 589-597.
- Cohrssen, C., Tayler, C., & Cloney, D. (2015). Playing with maths: Implications for early childhood mathematics teaching from an implementation study in Melbourne, Australia. *Education 3-13*, 43(6), 641-652.
- Fisher, K. R., Hirsh-Pasek, K., Newcombe, N., & Golinkoff, R. M. (2013). Taking shape: Supporting preschoolers' acquisition of geometric knowledge through guided play. *Child development*, 84(6), 1872-1878.
- Melhuish, E. C., Sylva, K., Sammons, P., Siraj-Blatchford, I., Taggart, B., Phan, M. B., & Malin, A. (2008). Preschool influences on mathematics achievement. *Science*, 321(5893), 1161-1162.
- Noyes, A. (2012). It matters which class you are in: Student-centred teaching and the enjoyment of learning mathematics. *Research in Mathematics Education*, 14(3), 273-290.
- Pohle, L., Hosoya, G., Pohle, J., & Jenssen, L. (2022). The relationship between early childhood teachers' instructional quality and children's mathematics development. *Learning and Instruction*, 82, 101636.
- Pyle, A., & Danniels, E. (2017). A continuum of play-based learning: The role of the teacher in play-based pedagogy and the fear of hijacking play. *Early education and development*, 28(3), 274-289.
- Siraj-Blatchford, I., & Nah, K. O. (2014). A comparison of the pedagogical practices of mathematics education for young children in England and South Korea. *International Journal of Science and Mathematics Education*, 12, 145-165.
- West, A., & Varlaam, A. (1991). Educational provision for four-year-olds. *Research Papers in Education*, 6(2), 99-131.
- Wickstrom, H., Pyle, A., & DeLuca, C. (2019). Does theory translate into practice? An observational study of current mathematics pedagogies in play-based kindergarten. *Early Childhood Education Journal*, 47, 287-295.