

## ***Developing maths pedagogy in the early years: number sense***

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### ***What predicts maths success? What research tells us in the early years:***

- parents' education and home learning
- a balance of adult and child-led activities
- early number sense

### ***at primary school:***

- mathematical reasoning
- a growth mindset
- an autumn birthday

### ***How to produce children with maths difficulties:***

**Anxiety** blocks working memory space

- acceleration rather than understanding
- anxious teachers and parents create anxiety

**Fixed mindsets** - 'no good at maths', ability grouping (Bradbury, NEU, 2017)

### ***Pre-school number knowledge- research evidence***

*Children's understanding of number during preschool is consistently associated with their mathematical achievement in primary and secondary school. Mathematical achievement in turn is consistently found to be the strongest predictor of children's overall school achievement and their success in entering the workforce.* (Early Intervention Foundation, 2018)

### ***Spatial reasoning predicts maths***

**Erikson early math collaborative**

<https://earlymath.erikson.edu/?s=spatial+relationships>

<https://www.kqed.org/mindshift/47301/five-compelling-reasons-to-teach-spatial-reasoning-to-young-children>

*Ball skills predict maths - Interceptive timing*

*The neural circuitry used to build up a child's understanding of their external environment, the way they orientate themselves spatially.. is also used to process numbers and more abstract thinking.*

Mon-Williams (2018) University of Leeds, Psychological Science

<https://www.tes.com/news/clumsy-children-need-extra-help-three-rs>

### ***Numbers Goal: not supported by research*** (Gifford, 2014)

- *Children count reliably with numbers from one to **20**, place them in order and say which number is one more or one less than a given number.*
- *Using quantities and objects, they add and subtract two single-digit numbers **and count on or back to find the answer.***
- *They solve problems, including **doubling and halving.***

### ***Number sense: a feeling for numbers***

*'Five is a number which is medium small'*

- **Counting** sequence & synchronicity
- **Cardinality** *the eightness of 8*
- **Comparison** *Which is more, 5 or 8?*
- **Composition** *numbers made up of other numbers*

<https://www.ncetm.org.uk/resources/52500>

### **Developing counting and cardinality takes a long time**

- **number sequence** forwards and backwards, to 20, patterns & crossing boundaries (Anna, DREME TE)
- **one number one object** – rhythm & synchronising
- **keeping track** – being systematic
- **cardinal principle** - last number is 'how many'

### **Key assessment: *Can you get***

Counting out a number from a larger group (Young-Loveridge, 1991)

### **When do we use counting to find '*How many*'?**

- getting a number of things
- counting to check
- counting to share and compare

### **Cardinality: the number of things represented by a number**

- fingers
- subitising
- understanding number symbols  
*When do children see everyday numerals with cardinal meanings?*
- The tricky teens: 15, 50, 51

### **Comparison: relative size**

Children need to link counting with cardinality ie the size of numbers

- comparing two numbers '*Which is bigger, 5 or 4?*' - Who has more? (Griffiths et al, *Making Numbers*, Voting Station (Nrich), track games)
- estimating '*How many's in the jar?*' Estimation station (Nrich), Handfuls
- predicting adding /taking 1 Staircase patterns, Number rhymes

### **Predictors of achievement**

- counting out a number from a group
- subitising
- **numeral meanings**
- relative number size
- predicting adding one / taking one
- number combinations
- spontaneous focusing on numerosity (SFON)
- finger gnosis!
- **pattern awareness**

### **How do young children learn number sense (See Nrich for examples)**

- routines –snacktime, tidying up
- games – collecting, tracks and targets, with scoring

- number rhymes & picture books – fingers & symbols
- playfulness- eg making mistakes
- problem solving eg sharing
- ‘sustained shared thinking’ with adults

### **Game: Ten Nice things**

Each player has ten nice things, takes it in turns to throw the dice and give that many things to the person on their right. (Play with dot dice then numeral dice)

- What might you observe and assess? (see observation sheet)
- Questioning and comments?
- How might you adapt and develop?

**For next time:** develop some games, indoors and out

- Collecting, Track, Target & Estimating games
- scoring and recording

**Bring notes and photos!**  
**Check your school’s photo policy first!**  
**Or email: [s.gifford@roehampton.ac.uk](mailto:s.gifford@roehampton.ac.uk)**

### **Websites:**

**DREME TE** Early mathematics resources for teacher educators

<http://prek-math-te.stanford.edu>

**Erikson early mathematics collaborative**

<http://earlymath.erikson.edu/>

**Making numbers animations** OUP Oxford Owl: (log in as teacher, then go to **Professional Development**, then **PD books**, then **Making numbers**)

<https://www.oxfordowl.co.uk/for-school/pd-books/making-numbers>

**NCETM: Main areas of early years maths** <https://www.ncetm.org.uk/resources/52500>

**Nrich** <http://nrich.maths.org/early-years>

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## Assessing Counting in Early Years

### *Ten nice things*

Each player has 10 small, appealing objects on a sheet of card. Throw a dice (e.g. with spots 1,1,2,2,3,3). The first player gives that number of objects to the child on their right. This child then throws the dice and gives to the child on their right. The game can proceed in this way for as long as you like, or until one child has given everything away. You can vary the level of challenge by using a dice with dots to six or numerals to five or ten. (You could provide an illustrated number line to help numeral comprehension.) You can also ask the children to predict how many they will have left after throwing the dice.

| Key Ideas   | How do you know? | Next steps |
|---|------------------|------------|
| <b>Knowledge:</b> <ul style="list-style-type: none"> <li>• number names</li> <li>• sequence</li> <li>• number symbols</li> </ul>  |                  |            |
| <b>Skills:</b> <ul style="list-style-type: none"> <li>• 1- 1 counting</li> <li>• keeping track of things counted</li> <li>• recognising numbers by visual arrangement (subitising)</li> </ul>   |                  |            |
| <b>Principles:</b> <ul style="list-style-type: none"> <li>• cardinality</li> <li>• order-irrelevance</li> </ul>   |                  |            |
| <b>Application:</b> <ul style="list-style-type: none"> <li>• counting out from a larger group</li> <li>• spontaneous counting to check</li> <li>• correcting others</li> <li>• comparing</li> </ul>   |                  |            |
| <b>Number sense:</b> <ul style="list-style-type: none"> <li>• comparison</li> <li>• estimation</li> <li>• composition</li> </ul>  |                  |            |
| <b>Difficulties and misconceptions</b>  |                  |            |
| <b>Language and explanation</b> <ul style="list-style-type: none"> <li>• comparison (more/less, adding and subtracting, take away, left )</li> <li>• Predicting result of addition or subtraction</li> <li>• One more / one less</li> </ul> |                  |            |
| <b>Attitude and confidence</b>  |                  |            |

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Number Sense. This is the ability to count accurately—first forward. Then, later in school, children will learn to count backwards. A more complex skill related to number sense is the ability to see relationships between numbers—like adding and subtracting. Ben (age 2) saw the cupcakes on the plate. He counted with his dad: “One, two, three, four, five, six!” Math skills are just one part of a larger web of skills that children are developing in the early years—including language skills, physical skills, and social skills. Each of these skill areas is dependent on and influences the others. Trina (18 months old) was stacking blocks.