



National Day Nurseries Association



Maths
Champions

Developing Mathematical Confidence in the Early Years: The Big Ideas of Number Sense

Course Summary



Module 1 - Mathematical Learning Through Play

As a practitioner, it is important to be able to identify maths in children's play, to assess progress and decide what to support next, either in the moment or later.

ACTIVITY: Choose an observation of a child and discuss the potential learning about:

- Number
- Pattern
- Measures
- Shapes
- Spatial awareness.

Number, pattern and spatial reasoning all support later maths success. Children benefit when adults recognise and build on these ideas during play.

When adults introduce and implement mathematical language, children's maths outcomes are improved. In addition, children with good mathematical language skills do better in maths overall. This evidence is strongest when maths language is embedded into regular activities and children's natural play and exploration.

TOP TIP: Download the '**Facilitating Mathematical Language**' handout from **Module 1** of the course to support with this activity.

What predicts maths success in the early years?

- **Parents' education and home learning:** The home learning environment has been found to have the greatest impact on children's learning outcomes, above the socio-economic status of the family. Put simply, "What parents do is more important than who parents are." (EPPE, 2004).
- **Partnership with families:** Share children's maths learning with families and offer simple ideas they can use at home.
- **Adult and child-led learning:** Children need adults to introduce number ideas, then space to explore, practise and develop them through play.

What research tells us

- **Adults' confidence matters** - Maths anxiety can affect how adults support children. . Female teachers who are anxious about maths produce anxious female pupils (the boys do not seem to be affected in the same way!) (Beilock et al, 2010). Building staff confidence helps make maths playful and positive.
- **Early support is vital** - Children who start behind in maths can fall further behind. Pre-school is a key time to build confidence and understanding.

ACTIVITY: Think back to your own time at school and your experience of being taught maths. Are they positive and empowering memories, or can you relate more to the maths anxiety discussed above?

TOP TIP: Use the **Staff Confidence Audit** in **Step 5** of the Maths Champions programme to open up conversations about potential maths anxieties. Together you can work on strengthening knowledge and confidence so that maths becomes a teaching strength.

TOP TIP: Use the **Children's Observational Assessment Tool** in **Step 4** of the Maths Champions programme to help you identify the baseline skills children have. Use this to develop a rich maths curriculum which provides quality experiences that all children, including disadvantaged children will benefit from.

Module 2 - Developing Number Sense

Number sense means understanding numbers, how they relate to each other, and how they are used. It includes subitising, counting, cardinality, comparison and composition.

Young children are learning four 'Big Ideas' of number sense:

- **Counting:** saying the number sequence, counting objects, and knowing how many there are
- **Cardinality:** understanding the meaning of each number, the 'threeness' of three or 'eightness' of eight
- **Comparison:** having a feel for the relative size of numbers e.g. five is more than two, but 20 is a lot more than three
- **Composition:** understanding that numbers are made up of other numbers e.g. seeing six as three and three.

Counting

Counting takes time to develop. Children learn the number sequence, how to count objects, and that the last number tells how many there are.

Very young children recognise counting as an activity linked to the number of objects. They begin by imitating counting-like behaviour by saying some number words and pointing. Even

very young children notice that counting relates to quantity. They may not understand every number word yet, but counting helps them focus on “how many”.

Children often learn number words before they fully understand their meaning. Most children start learning number words at two-years-old and many six-year-olds still miss out ‘13’ when counting as they need to memorise 20 random words. Only after that do they tend to recognise the pattern of sixteen, seventeen, eighteen, nineteen and spot the links to thirteen, fourteen, fifteen.

Repetition, songs and everyday counting help them become familiar with the number sequence. Counting to larger numbers is still valuable, even before children understand every number. It builds familiarity and confidence.

— 1 & 2 Year Olds

- Say some number words, maybe in order
- Say numbers while pointing to objects.

— 3 & 4 Year Olds

- Say numbers to five or 10 in order
- Begin to count objects, actions and sounds
- Tag one number to each item, but sometimes skip one or tag one twice
- May count out three or four things from a larger group.

Progressing to:

- Say numbers to 20 or beyond (but often miss out 13)
- May count out five or more things
- Begin to count things arranged irregularly, which cannot be moved.

Practitioners can do all of the activities for younger children, plus:

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- **Music time**
 - Act out number rhymes and songs with props
 - Count forwards and backwards to and from 10 and beyond, with actions and sounds such as claps, jumps or drum beats
- **Snack and meal times**
 - Ask children to give you four pieces of apple or get four spoons
 - Encourage children to count resources and snack items to see if there are enough
- **Tidy up time**
 - Count to check that nothing has gone missing
- **Challenge activities** e.g. treasure hunts: How many:
 - Shells can you find in the sand?
 - ‘Fish’ can you catch with the net?
 - Peas can you pick up with the tweezers?
 - Conkers can you collect?

Key assessment: Counting out a number from a larger group

A useful assessment is asking a child to give a set number of objects from a larger group. This shows whether they understand when to stop counting and that the final number gives the total.

If you ask very young children to give you a number of things, they will probably just grab a handful. Two-year-olds can give one thing, but may not be able to give two, for example. However, four-year-olds are able to use counting to give bigger numbers of four or more. This shows they understand that the last number said is the number of the group, the cardinal counting principle.

Giving a number' is the best assessment of this: if you ask a child to count a group of just five objects, they may say there are five because they have learnt to repeat the last number and they have run out of things to count. Counting out a number of things from a larger group of objects therefore shows they understand the significance of the 'stopping number', as well as knowing the counting sequence and being able to tag - the process of counting one object for every number counted, such as putting fingers up to count out, or move items as they count their amount to the stopping number.

Module 3 - Cardinality and Comparison

Cardinality

Cardinality means understanding how many a number represents, such as the "threeness" of 3. This is different from using numbers as labels, such as house numbers or page numbers.

Children usually progress in learning the cardinal meaning of numbers in overlapping stages:

- Children usually learn the meaning of small numbers first, such as one, two and three.
- They may count higher than the numbers they understand.
- Over time, counting and number meaning begin to connect.

Adults can help by using specific number words often, such as "two mittens" or "three apples".

What is involved in learning about cardinal numbers?

Visual images for cardinal numbers:

- Fingers
- Subitising

Understanding number symbols:

- Recognising numerals
- Linking to amounts.

Fingers

Fingers are a useful early maths tool. They help children see and feel numbers through visual and physical memory.

Some children may show the correct number with their fingers before they can say the correct number word.

‘All at once’ finger numbers are important later to help children see numbers as made up of other numbers, for instance seeing six as five and one or three and three. (Björklund, et al , 2019)

ACTIVITY: Consider how you could use fingers and encourage children to use fingers to support their number sense.

Subitising

Subitising is recognising a small number of objects without counting. Dice patterns, fingers and familiar arrangements help children link images to number words.

Playing games with large dice outdoors helps children to subitise numbers- for instance they can throw a dice and do that many star jumps or hops.

Games such as dice games, “hide and reveal”, and quick-look activities give children playful opportunities to practise subitising.

ACTIVITY: Discuss what opportunities you provide to support children’s subitising skills. What other opportunities could you provide?

Number Symbols

Children need to link numerals to amounts. Recognising the symbol 3 is not enough; they also need to understand that it represents three things.

Most numerals in the environment, e.g. door numbers, bus numbers, football shirt numbers, are just a way of labelling things or are ordinal numbers to show a place in a sequence.

Children may know they are three years old, but will not understand fully the concept of a year, although they may see three birthday candles. Prices usually do not link to anything tangible: 25p does not mean that you pay with 25 pennies. Most numerals referring to a number of things are on packaging.

As children so rarely experience symbols representing numbers of things in everyday life, it is important we help them make these links in pre-school settings.

ACTIVITY: How are numerals used in your setting? What other opportunities could you provide?

✓ 1 & 2 year olds

- Can give just one thing when asked, but not two
- May recognise some numerals.

Practitioners can

- Talk about how many things there are e.g. two shoes, three bananas
- Show finger numbers when talking about small numbers
- Talk about numerals e.g. on doors, buses, birthday cards.

✓ 3 & 4 year olds

- Know how many two, three and four are
- Recognise more numerals, but may not understand them.

Progressing to:

- Link numerals to amounts
- Link counting with number values.

Practitioners can

- Talk about how many things there are e.g. two shoes, three bananas
- Show finger numbers when talking about small numbers
- Talk about numerals e.g. on doors, buses, birthday cards.

- Snack and meal times - ask children to get two pieces of fruit, get four plates etc
- Number rhymes
 - Ask children to show fingers for the number of frogs, ducks at each stage of the song
 - Link numerals with the number of frogs, ducks at each stage
- Tidy up time - label containers with numbers, so children check how many things there are
- Games
 - Play hide and reveal games for subitising with different quantities of objects (and no objects) in boxes, under cups etc. and invite children to quickly say how many there are
 - Use large numeral dice for games outdoors and indoors
 - Target games - provide a selection of individual numerals as well as number tracks and encourage children to find the numeral to match their score
 - Provide a clipboard for children to make marks to record their score
- Story time - share number books, talk about numerals and ask children to spot numbers of things and show finger numbers
- Play shopping - make price labels for numbers of pennies or pounds, so children pay with individual (pretend) coins
- Cooking - make recipe cards with numerals and pictures e.g. 3 eggs, 4 spoonfuls.

Comparison

Comparison means understanding which numbers or groups are bigger, smaller or the same. It is an important part of number sense.

Children gradually learn that each counting number is one more than the number before.

Comparing collections

Children often begin by comparing groups of objects and noticing “more”, “fewer” or “the same”.

Sharing activities, snack times and stories are useful ways to explore comparing amounts.

Comparing numbers

Comparing numbers is harder than comparing objects because children must understand the value of each number.

Researchers in USA found that, whereas almost all middle class five- and six-year-olds could answer abstract questions like these, most disadvantaged children could not (Gersten et al, 2005).

Some children need many practical number experiences before they can confidently compare numbers.

However, researchers have also found that playing track games helps: children come to realise that bigger numbers are further along the track (Siegler & Booth, 2004).

ACTIVITY: What resources or books do you provide that support children’s understanding of comparison?

TOP TIP: The **Core Activities** within **Step 7** of the Maths Champions programme such as ‘Outdoor Games’ can support developing number sense skills.

Knowing one more and one less

Understanding “one more” and “one less” is a key milestone. Number tracks, rhymes and stories can make this pattern visible.

This ‘one more’ pattern is common in number rhymes and traditional tales. Number rhymes usually show the ‘one less than’ pattern as ducks swim away, children fall out of bed or frogs jump off logs.

— 1 & 2 Year Olds

- Can compare collections which are very different in number
- Recognise groups which are 'more', 'less' and 'the same'.

— 3 & 4 Year Olds

- Count to compare with numbers up to 5
- Begin to predict one more and one less than numbers to 10.

Practitioners can

- Add to quantities (e.g. food items or toys) and draw attention to changes in amount, using words like more and all gone
 - Play games and sing finger rhymes which involve hiding and returning (e.g. Two little dicky birds).
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- Stories and rhymes
 - Tell stories where toys share things unfairly and invite children to help them give everyone the same
 - Read stories and sing number rhymes with increasing and decreasing number patterns, acting them out with props and encouraging children to predict the next number. Numberblocks have some number songs like this: <https://www.bbc.co.uk/cbeebies/watch/number-songs-from-numberblocks>
 - Games
 - Play collecting games and compare contrasting and increasing numbers; deliberately give one too many or too few and see if children can correct you and explain why
 - Play games with numbered tracks, indoors and out.

Module 4 - Composition

Composition means understanding that numbers are made from other numbers. For example, five can be seen as four and one, three and two, or two and two and one. This helps children begin to understand addition and subtraction visually.

Seeing a whole number and smaller numbers within it at the same time is quite a complex feat for young children. When looking at the formation above of five on a die, they need to be able to hold on to the whole number five, while simultaneously recognising four and one as parts making up the number. This ability is called 'part-whole understanding' and is a significant development in young children's mathematics. Children need lots of opportunities to subitise and to have firm understanding of cardinal number meanings before they can do this.

Children may start by spotting the 'doubles' on dot dice numbers, such as two and two inside four and three and three making six. Seeing numbers in this way helps children to understand addition and subtraction as linked operations - because four can be split into two and two, you can put the twos back together again to make four or take away two and

leave two. Later in primary school, children's knowledge of number combinations predicts maths achievement, because it enables them to solve problems without having to count.

Younger children can discuss arrangements of everyday objects and say how they see them made up of different numbers.

ACTIVITY: Discuss what you notice in this image?



Some people may see the eggs as 3 and 2, 4 and 1, 2 and 2 and 1 or 6 and 1 taken away.

Discuss what you notice in these images?



Number rhymes are also useful for demonstrating number composition, by pausing during a rhyme and asking, "How many of our frogs are in the pool now?" and "How many are still on the log?".

TOP TIP: The **Maths Champions Resources Section** contains a selection of songs and rhymes for you to use to support children's developing number sense as well as props to use for visualising amounts in the rhyme.

Finger numbers are important for feeling as well as seeing number composition, for instance with doubles, like two and two, three and three and four and four. Because numbers over five are usually shown as one hand of five fingers and the remainder on the other hand, they become familiar as 'five and a bit' numbers. As mentioned before, showing finger numbers 'all at once' is an important skill which helps number understanding. Children can also show a number like five on two hands to support understanding of composition up to five: for instance, as 'four and one' or 'three and two'. If two children are asked to show five fingers altogether in different ways, some interesting discussion will result, for instance about five and zero.

Children can be challenged to make different models with just five cubes or bricks. Checking whether children are all different gives opportunities to discuss their composition, for instance as, three and two, or two and two and one in the middle. They will also be involved in using positional language and turning shapes round to see if they are the same, which provides important spatial learning.

Making patterns with a number of objects helps children to see the composition of numbers visually, and that one number can be composed in lots of different ways.

Conclusion

The big ideas of number sense are key aspects that build the foundations for mathematical understanding through early years and beyond. This course booklet is designed to give you an overview of these key concepts and how to approach them with your children in ways that are developmentally appropriate and foster a positive attitude towards mathematical learning.