The Development of Problem Solving, Reasoning and Numeracy
0 – 6 yrs

This section focuses on the development of one aspect of number: "Numbers as Labels and for Counting". It explores the development of children's mathematical understanding across the Birth to Six age range. The children attend a variety of early years settings and are supported in their learning by a range of practitioners.

Meet the Children

Thomas – 13 months

Thomas has attended a day nursery close to mum's workplace for three days a week since he was three months old. On the other two days he is at home with mum and sister Sophie. Sophie also attends the nursery and is currently in the pre-school room. Thomas's key person, Teresa, supports him in the baby room.

Bradley – 4 years

Bradley attends a Foundation Stage unit in a Children's Centre. He currently attends five morning sessions a week. Teachers, nursery nurses and teaching assistants staff the unit. His key person, Marie, supports Bradley in group sessions.

Keeley – 2 years

Keeley is cared for on a full-time basis by her childminder Sarah. Her older brother, Jake, is at school. Keeley and Sarah collect him at the end of the day. During the week they attend two sessions of the local Stay and Play at the Children's Centre and also use the local environment.

Saba – 5 years

Saba attends a large reception unit within a primary school in an urban area. Three teachers and three teaching assistants staff the unit. Saba is bilingual. Before starting school she attended a local playgroup for three sessions a week.

Sophie – 3 years

For the past two months Sophie has been attending the morning sessions at the local pre-school in the church hall with 23 other children. Her key person, Sue, supports eight children. In the afternoon she stays at home with mum or grandad. Sophie has a new baby brother called Michael.

Miles – 6 years

Miles attends a rural village school where he is in a mixed Reception and Year 1 class. One full-time teacher and one full-time teaching assistant staff the class. Before starting school, Miles attended the pre-school situated on the school site.

"Mathematical Development depends on becoming confident and competent in learning and using key skills."

"Mathematical understanding should be developed through stories, songs, games and imaginative play, so that children enjoy using and experimenting with numbers."

(*Curriculum Guidance for the Foundation Stage*, 2000, QCA)

Children's daily experiences in the setting are full of problem solving opportunities and numbers. Children have a natural curiosity to resolve difficulties, use numbers and find out about them. Whether sharing out snacks at cafe time, counting to see if there is enough room for them to join in an activity, cooking, building with blocks or singing number rhymes, they are involved in not just counting, but developing understanding about how numbers work. Practitioners need to make time to talk with children, using a rich mathematical vocabulary as they intervene in play, as part of these daily activities.

Asking questions, as well as engaging in discussion with children during mathematical activities, helps them to organise their ideas and explain what they have done. It also allows practitioners to build on the things that children understand correctly, and to amend any misunderstandings.

Children's mathematical development is enriched by a well planned and carefully resourced learning environment, outdoors as well as indoors. Practitioners should aim to offer experiences which are relevant to children's prior experiences and embedded in real life activities.

Mathematical learning is often placed under different headings: problem solving, reasoning, numbers as labels for counting, calculating, shape, space and measures. It is important to realise that children's learning is not compartmentalised like this and many activities offer opportunities to develop all areas of mathematics and can be found in all areas of the learning environment.

Context for learning:
Counting rhymes with key person
Thomas: 13 months

What did Thomas do?

Thomas is enjoying some quiet time with Teresa, his key person, after a busy morning at nursery. She sits with Thomas and chants a favourite rhyme: "Teddy on the table, monkey in the tree, all jump down with a one, two, three." Teresa taps the carpet in time as she chants. At the end of the rhyme Teresa asks: "Again?" She waits for a gesture from Thomas. He smiles and waves his arms. Teresa repeats the rhyme, clapping her hands to vary the experience. Thomas maintains eye contact and bangs his hands on the floor throughout. Once more Teresa asks: "Again?" Thomas repeats the arm gestures and vocalises by babbling. Teresa picks up a teddy and a toy monkey and mimics them jumping down for the third rendition. Thomas's body language indicates his continued interest. Teresa hands him the monkey. Thomas holds it up and then drops it, mimicking Teresa's actions. As Teresa passes the monkey back to Thomas she says: "All fall down", and a new game begins.

Links to Early Years Foundation Stage

Personal, Social and Emotional Development

Sense of Community

- Learn that their voice and actions have effects on others.

Communication, Language and Literacy

Language for Thinking

- Understand and respond to the different things said to them when in a familiar context with a special person.

Problem Solving, Reasoning and Numeracy

Numbers as Labels and for Counting

- Develop an awareness of number names through their enjoyment of action rhymes and songs that relate to their experience of numbers.

How did the adult support Thomas's learning?

- By sitting opposite Thomas so he can see Teresa's face and actions clearly.
- By allowing Thomas time to respond (non-verbally) to her prompts of *"Again?"*
- By responding affirmatively to Thomas's communication.

Next steps

- Provide the rhyme and props in a story bag for parents to borrow.
- Repeating the rhyme regularly and introducing Thomas to a new one.
- Playing peek-a-boo with monkey and teddy, hiding them after a count of one, two, three.

Context for learning:
Making cakes
Keeley: 2 years

What did Keeley do?

Keeley is excited because she is going out to the shops with Sarah to buy the ingredients to make cakes and to buy a birthday card for Keeley's brother Jake. Keeley tells Sarah that Jake is a "bigger boy" than her. "Do you mean Jake is older than you?" asks Sarah. As Sarah and Keeley look at the cards Keeley spots a number 2 badge. "Two, two, two, I am two," she says. "That's right," says Sarah. "You are two." Keeley recognises the number on several cards and relates it to her own age. Back at home Sarah supports Keeley's interest in the number by counting out 1, 2, as she puts out two mixing bowls, two jugs and two spoons to encourage understanding of 'two-ness'. The pair make the cakes and after they have shared some lunch Sarah smiles and offers Keeley a cake, asking: "Do you want two?" Keeley nods but takes just one cake, suggesting that although she recognises the numeral 2 because it has personal significance for her, she is not yet able to understand the one-to-one principle of one item, one number.

Links to Early Years Foundation Stage

Problem Solving, Reasoning and Numeracy

Numbers as Labels and for Counting

- Gain awareness of one-to-one correspondence through categorising belongings.
- Have some understanding of 1 and 2, especially when the number is important to them.

Physical Development

Using Equipment and Materials

- Use tools and materials for particular purposes.

How did the adult support Keeley's learning?

- By acknowledging Keeley's recognition of a special number.
- By encouraging the development of Keeley's understanding in a practical way based upon a real experience.
- By modelling counting as she places utensils for cooking on the table.

Next steps

- Play hide and seek with two items at a time.
- Point out and count pairs of objects on the walk to school to collect Jake.
- Introduce Keeley to pairs by playing a matching game with coloured or patterned socks.
- Use rhymes which focus on two, for example 'Two Little Dicky Birds'.

Context for learning: Child-initiated play in the role play area
Sophie: 3 years

What did Sophie do?

Sophie is playing with a small world scenario based upon the rhyme 'Five Little Speckled Frogs'. Practitioners have incorporated resources for developing counting forwards from 1 to 5 and backwards from 5 to 1. Sue, Sophie's key person, observes Sophie as she puts on a frog finger puppet and then jumps it off the log and into the pond. "Splash," says Sophie, and turns to repeat the action with another puppet. "That looks fun," says Sue. "Can I have a frog?" Sophie passes Sue a frog and they both play jumping the frogs into the pond until all five are sitting in the pretend pool. Sophie looks at the frogs and tells Sue: "I have lots, a mummy, a daddy and baby frogs." "How many are babies?" asks Sue. "This one and this one and this one," replies Sophie, and then she counts them: "1, 2, 3. Can we do it again?" Sue helps Sophie to sit the frogs back on the log, counting them out as she goes: "1, 2, 3, 4, 5." As they begin to play again, Sue sings the rhyme to model counting down from 5 to 1.

Links to Early Years Foundation Stage

Personal, Social and Emotional Development

Sense of Community

- Learn social skills, and enjoy being with and talking to adults and other children.

Problem Solving, Reasoning and Numeracy

Numbers as Labels and for Counting

- Recites some number names in sequence.
- Use some number names accurately in play.

How did the adult support Sophie's learning?

- By asking questions to extend Sophie's play.
- By becoming involved in Sophie's play and following her lead.
- By using numbers as labels for Sophie's counting and extending counting to five.
- By modelling counting up and back down a number series.

Next steps

- Provide opportunities for Sophie to use numbers in real situations, for example, counting out pieces of fruit at the snack bar.
- Make collections of resources that interest Sophie that she can count in play situations across the learning environment.
- Use stories and rhymes, which include number, to further develop her understanding.

Context for learning: Games to encourage recognition and counting to 5
Bradley: 4 years

What did Bradley do?

The practitioner places number cards (1 to 5) face down on the floor. The children take it in turns to pick up a card. The practitioner encourages all children to read the number and then asks them to do that number of jumps, hops, twirls or claps. Bradley is very enthusiastic about this activity and is able to recognise all the numbers from 1 to 5 and do the correct number of actions.

The activity has finished and Bradley asks the practitioner if he can play with the number cards. He places them face down on the floor and picks them up, saying the number each time. The practitioner asks Bradley if he can peg the numbers on the number line. Bradley pegs the numbers 1 to 5 in the correct order, but going from right to left on the number line instead of left to right. The practitioner takes this opportunity to count from 1 to 5 and from 5 to 1 with Bradley. She also reminds him of one of his favourite action rhymes, 'Five Little Spacemen', and consolidates this by using the rhyme at group time.

Links to Early Years Foundation Stage

Problem Solving, Reasoning and Numeracy

Numbers as Labels and for Counting

- Use some number names accurately in play.
- Recognise numerals 1 to 5.
- Count actions or objects that cannot be moved.

How did the adult support Bradley's learning?

- Allowed Bradley to continue to play with the numbers after the initial activity had finished.
- Extended Bradley's play and gave it a purpose.
- Stood back and observed Bradley to allow her to assess his understanding.

Next steps

- Encourage Bradley to look at number lines and notice how they go from left to right.
- Provide Bradley with more opportunities to make his own number lines.
- Encourage Bradley to start his number line from the left.

Context for learning: Role play set up as a baker's shop
Saba: 5 years

What did Saba do?

The children have recently been visiting the local shops in small groups. They have worked with their teacher to set up a baker's shop for their role play area.
Saba and Misha are playing in the baker's shop, whichhas been stocked with biscuits in different shapes, sandwiches and cakes made by the children, a calculator and a till with a lot of real 1p coins. Paper, pencils, masking tape and clipboards are available and the children have written their own price tags and signs. The practitioner asks, "Is the shop open?" as she joins them. Saba asks: "What do you want?" "A round biscuit and a square biscuit, please." The practitioner thanks Saba and asks how much they will cost. Saba refers to the handwritten price list, points to the round shape and says, "That costs 3p and the square biscuit is 1p." The practitioner then poses the question, "I wonder how we could work out how many pennies I would need altogether?" Saba replies, "I think it's 4p because it's one more than 3." The practitioner and the children check the answer by counting the coins.

Links to Early Years Foundation Stage

Problem Solving, Reasoning and Numeracy

Numbers as Labels and for Counting

- Use language such as 'more' or 'less' to compare two numbers.
- Use developing mathematical ideas and methods to solve practical problems.

Calculating

- State the number that is one more than a given number.

How did the adult support Saba's learning?

- By joining in with the children's play.
- By asking Saba to explain her thinking.
- By setting up a role play scenario related to the children's prior experiences.

Next steps

- Give Saba opportunities to record her answers.
- Use songs and rhymes that involve counting forward and back 0–10.
- Provide further opportunities to identify and name shapes in the indoor and outdoor learning environments.

Context for learning:
Active maths session – finding the difference
Miles: 6 years

What did Miles do?

Miles watches carefully as the practitioner models several activities during the whole class input at the beginning of the session. He quickly chooses one activity as soon as group time is over. To start the activity he picks a number card from a selection of numbers 9 to 20. Miles has number 13. He counts out and places 13 beanbags in a line on the floor. The next step is to pick up and roll a large dice. Miles rolls a 4. He hesitates for a second or two but before the practitioner intervenes he picks up another four beanbags and places these underneath beanbags 1, 2, 3 and 4 in his original line. The practitioner asks Miles: "How many more are in the first line of beanbags?" Miles quickly counts the difference using his finger to point to each beanbag in turn. "Nine," he replies. Miles decides to record his answer on a whiteboard by making a number sentence. The practitioner is interested in Miles's understanding of the concept. She asks Miles if he can explain to her how he has found the difference between the two numbers. Miles replies: "I matched the beanbags and then counted to see how many were left."

Links to Early Years Foundation Stage

Problem Solving, Reasoning and Numeracy

Calculating

- In practical activities and discussion begin to use the vocabulary involved in adding and subtracting.

Links to Primary framework for literacy and mathematics

Year 1 Calculating

- Learning objective: Understand subtraction as 'take away' and find a 'difference' by counting up; use practical and informal written methods to support the subtraction of a one-digit number from a one digit or two-digit number and a multiple of 10 from a two-digit number.

How did the adult support Miles's learning?

- By working on the problem in a practical situation.
- By modelling the activity first and clearly explaining learning intentions.
- By asking Miles to explain how he had arrived at his answer.
- By not intervening too soon when Miles hesitated.

Next steps

- Plan a variety of different experiences for Miles to consolidate his understanding, for example a role play shopping activity.
- Repeat the activity with a partner picking the card or rolling the dice and use an interactive whiteboard to record the process.