



Teaching the daily mathematics
lesson to children with severe
or profound and multiple
learning difficulties: Training File

**Mathematics
coordinators in
settings where there
are children with
severe or profound
and multiple learning
difficulties**

Status: Recommended

Date of issue: 01/03

Ref: DfES 0032/2003

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The National
Numeracy *Strategy*

Teaching the daily mathematics lesson to children with severe or profound and multiple learning difficulties

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Introduction

Purpose of the materials

These materials consist of a booklet and an accompanying video (Ref: DfES 0033/2003). They are intended as a training resource to help staff in primary settings where there are children with severe or profound and multiple learning difficulties to develop further their mathematical subject knowledge and range of teaching strategies for the daily mathematics lesson.

How to use the materials

The materials are designed for use by National Numeracy Strategy numeracy consultants and the school's mathematics coordinator. They consist of five core sessions of between 60 and 75 minutes. Some sessions have additional optional activities which, if used, would take the session to a maximum of 90 minutes. Each session is accompanied by a video sequence, showing aspects of teaching the daily mathematics lesson in settings for children with severe, profound and multiple learning difficulties. The sessions on problem solving and data handling draw on a single video example, used in both sessions.

The sessions can be used:

- as the basis for a series of staff meetings;
- to put together an inservice training day for one school;
- to put together an inservice training day for several schools across an LEA or region.

The sessions and their timings are shown below.

Session	Timing
Numbers and the number system	75 minutes plus optional 15 minutes
Calculation	60 minutes plus optional 30 minutes
Problem solving	75 minutes plus optional 15 minutes
Handling data	60 minutes plus optional 15 minutes
Shape and space	75 minutes

The materials are designed so that schools can plan their own programme, using those sessions which are most relevant to addressing the issues they have identified in their own action plans for mathematics.

How to choose which sessions to use

The five sessions each cover one strand of the mathematics curriculum. Additionally, they cover a range of issues in teaching the daily mathematics lesson, as follows.

Session	Strand	Issue
1	Numbers and the number system	Managing the plenary
2	Calculation	Exploiting mathematical opportunities throughout the school day
3	Problem solving	Whole-class teaching; Role of additional adults (optional activity)
4	Handling data	Questioning (optional activity)
5	Shape and space	Planning for lateral progression

Decisions about which sessions to use will depend in part on which strands of the mathematics curriculum are most important for the school or schools involved in the training to consider, and in part on which issues are most relevant in terms of staff development.

The sessions can be used in any order, though it is advisable to plan the session on problem solving before the session on handling data, so that the video sequence will already be familiar to participants when they engage with it from a data-handling perspective. Similarly, it is advisable to plan the session on numbers and the number system before the session on calculation, so that staff can consider how their teaching of the two strands overlaps, and how it differs.

Session objectives

One objective runs through all five sessions:

- to consider strategies for teaching classes with a wide range of abilities

Other objectives are session-specific.

Session 1 Numbers and the number system page 7

- to consider progression in developing knowledge of numbers and the number system for children with severe or profound and multiple learning difficulties
- to explore the use of mathematical vocabulary associated with numbers and the number system
- to consider the role and management of the plenary in the daily mathematics lesson

Session 2 Calculation page 43

- to demonstrate the relevance of calculation for children who are working towards level 1 of the National Curriculum in mathematics

- to explore the early stages of learning about calculation
- to identify opportunities to work on calculation in the daily mathematics lesson and throughout the school day

Session 3 Problem solving page 69

- to consider approaches to problem solving for children with severe or profound and multiple learning difficulties
- to identify opportunities to work on problem solving in the daily mathematics lesson and throughout the school day
- to consider the respective benefits of whole-class teaching and individual or group work
- to consider the role of additional adults in supporting children's mathematical learning (optional)

Session 4 Handling data page 95

- to consider the range of opportunities for teaching data handling
- to outline the data-handling cycle
- to explore the links between data handling and P level exemplification
- to consider the role of questioning in supporting children's learning (optional)

Session 5 Shape and space page 119

- to review the breadth of curriculum content in the school's work on shape and space
- to consider progression in shape and space for children with severe or profound and multiple learning difficulties

Using the materials in all-age special schools

These materials focus on the primary mathematics curriculum. Aspects are likely to be relevant to staff working in Key Stage 3, however, in all-age settings. Where ideas for progression in the curriculum are given – for example, in the shape and space session – the progression to Key Stage 3 has been included alongside that from the Foundation Stage to Key Stages 1 and 2.

The video

The video contains four sequences:

Video sequence 1: *Numbers and the number system*

Kim is teaching a **Key Stage 2** class of 9 children in Merton

Video sequence 2: *Calculation*

Denise is teaching a **Key Stages 1 and 2** class of 7 children in Kirklees

Video sequence 3: *Problem solving and data handling*

Rosie is teaching a **Key Stages 1 and 2** class of 8 children in Liverpool

Video sequence 4: *Shape and space*

Diane is teaching a **Foundation Stage and Key Stage 1** class of 8 children in Lancashire

We are very grateful to the staff and children of the schools for children with severe learning difficulties which are featured in this video. The schools are:

School	LEA	Number on roll	FSM
St Ann's School, Morden	Merton	87	26%
Turnshaws School, Huddersfield	Kirklees	49	39%
Millstead Primary School, Liverpool	Liverpool	57	50%
Townhouse School, Nelson	Lancashire	42	50%

Numbers and the number system

Objectives

- To consider progression in developing knowledge of numbers and the number system for children with severe or profound and multiple learning difficulties
- To explore the use of mathematical vocabulary associated with numbers and the number system
- To consider strategies for teaching classes with a wide range of abilities about numbers and the number system
- To consider the role and management of the plenary in the daily mathematics lesson

Resources

- OHTs 1.1–1.6
- Video sequence 1: *Numbers and the number system*
- Handouts 1.1–1.6 for each participant, with handout 1.1 enlarged to A3 size
- Resource sheets 1.1 and 1.2 for each pair of participants (optional)
- Several pairs of scissors (optional)
- A set of Japanese numeral cards for the presenter, made by cutting up Resource sheet 1.2 (optional)
- A number line for the presenter, which uses the Japanese numerals (made from Resource sheet 1.2) (optional)
- A box of small objects for counting
- Ten counters for use on the overhead projector
- A highlighter pen for each participant

- Reference copy for presenter of *Towards the National Curriculum for Mathematics: examples of what pupils with special educational needs should be able to do at each P level* (DfES 0637/2001) and the *National Numeracy Strategy Framework for teaching mathematics: Reception to Year 6* (DfES NNFT 1999)

Outline of the session		
Introduction Objectives for the session	Talk	5 minutes
Developing knowledge about number Developing a sense of number; progression in number skills	Talk Discussion	10 minutes
Using appropriate vocabulary The consistent use of appropriate mathematical language	Activity Discussion	10 minutes
Learning to count Optional activity to allow participants to experience the early stages of counting in a different language	Activity Discussion	15 minutes (optional)
The principles of counting The stages in learning to count	Talk Demonstration Discussion	10 minutes
Teaching a class with a wide range of levels of attainment A lesson on numbers and the number system	Talk Video Discussion	20 minutes
Managing the plenary Purpose and organisation of the plenary	Talk Video Discussion	15 minutes
Conclusion Key points from the session	Paired work Talk	5 minutes

Introduction

5 minutes

OHT 1.1

Objectives

- to consider progression in developing knowledge of numbers and the number system for children with severe or profound and multiple learning difficulties
- to explore the use of mathematical vocabulary associated with numbers and the number system
- to consider strategies for teaching classes with a wide range of abilities about numbers and the number system
- to consider the role and management of the plenary in the daily mathematics lesson

Show **OHT 1.1**. Explain that the session is about the numbers and the number system strand of the mathematics curriculum, with a focus on developing the skills of counting and the comparison of quantities. Teachers working in settings where there are children with severe or profound and multiple learning difficulties will plan to work on these skills in the daily mathematics lesson, but there will also be opportunities to model the use of counting and comparison at other points during the school day; for some children these other opportunities may be the most effective in developing understanding and the application of these skills.

Developing knowledge about number

10 minutes

Explain that the session begins with a look at the stages in which children learn about number. Awareness of number starts surprisingly early. Infants have an intrinsic sense of number – babies will react to changes in quantity in their environment. The sense of number develops through a range of experiences which for most children take place at an early stage, and so naturally that they are hardly referred to in the National Curriculum.

From an early age, children are able to recognise how many there are in small groups of objects by subitising. This is the ability to know how many there are without needing to count. Demonstrate this by placing five counters on the switched-off OHP and then switching on and off without giving time to count. Most children and adults would be able to recognise that there were five objects without needing to count. Some children with severe or profound and multiple learning difficulties will be able to subitise quantities and communicate the quantity if they are supported in making a connection to the number name, its numeral or an alternative representation of the quantity: for example, a dice pattern.

Very young children are also able to make rudimentary comparisons between small groups of objects, select the larger of two groups, and even have a sense of their order by size, usually with a range of up to three only, but with an awareness of 'more than three'. We are building on this when we teach our children to make comparisons, to communicate whether a set contains more or less than another set, and to begin to work with classroom number lines.

Many of the responses referred to in P levels 1–3 belong to this early stage of knowing about number. We can call this stage **learning to appreciate quantity and communicate about quantities** (show OHT 1.2).

OHT 1.2

Learning to appreciate quantity and communicate about quantities

- responding to a pleasurable stimulus (e.g. items of food or drum beats) by indicating a desire for 'more' and hearing adults use those terms
- becoming aware of sequences, and looking towards the next event in a sequence, e.g. the next light to come on along a rope of brightly coloured lights
- exploring and holding sets with different numbers of objects
- choosing between sets with different numbers of objects
- anticipating numbers, e.g. anticipating the appearance of a second object when two have been hidden while the child watches, and one has already appeared or been found

Give out copies of **handout 1.1**, which sets out a progression in developing a sense of number at the next stage, which at P levels 4–7 we can call **learning about numbers and how they describe quantities**. The handout is based on the National Numeracy Strategy *Framework for teaching mathematics: Reception to Year 6* and the National Numeracy Strategy publication *Towards the National Curriculum for Mathematics: examples of what pupils with special educational needs should be able to do at each P level*.

Point out that the progression chart from P4 onwards refers to the development of understanding in four aspects of number:

- the sequence of numbers used for counting;
- counting to find a quantity;
- recognition of numerals;
- comparing and ordering numbers and quantities.

Allow a few minutes for participants to familiarise themselves with these stages in the progression. Ask them to discuss how the progression indicated on the chart relates to the work that they do with children in their classes. Take brief feedback.

Using appropriate vocabulary

10 minutes

Explain that the National Numeracy Strategy has placed a particular emphasis on the use of key vocabulary to help develop children's thinking, and that this is the focus of the next part of the session.



Activity

Give out **handout 1.2**. Ask participants to take **2 or 3 minutes** to:

- tick the mathematical terms which they regularly use on an **informal** basis in their classrooms;
- use a highlighter pen to highlight any terms which they have used on a **planned** basis, i.e. where they have explicitly built teaching the vocabulary into their lesson planning and assessment.

Take feedback, asking whether there are any terms which tend to be under-used, and discussing any reasons for this. Establish whether explicit teaching is regularly built into planning.

Say that you are now going to choose one mathematical term from the list on the handout – 'compare' – and think about how it might be explicitly taught. Ask participants to suggest activities which could be used with children to develop their understanding of the term. What other mathematical vocabulary would also be used? What might be the sensory learning for pre-verbal children who take part in these activities alongside their peers?

Take feedback and emphasise the following points.

- The consistent use of appropriate mathematical language is very important to help children in severe or profound and multiple learning difficulty settings to form concepts of number.
- Explicit teaching of core vocabulary needs to be built into lesson planning.
- The use of appropriate vocabulary is especially important for developing concepts of comparison.

Learning to count (optional activity)

15 minutes



Activity

Explain that the next activity is designed to allow participants an opportunity to put themselves in the position of the early stages of learning about number. They will work in pairs with one being the teacher and the other being the learner. The activity involves learning Japanese numbers and any participants who are familiar with the Japanese number system should take the teacher role.

Give out copies of **Resource sheets 1.1** and **1.2** to those who are going to take the role of teacher.

Put up **OHT 1.3**, which shows the learning objectives, referenced to the P levels and the *Framework for teaching mathematics: Reception to Year 6*, which the 'teacher' will focus on – according to the progress made by their 'pupil'.

OHT **1.3**

Counting in Japanese

- join in with rote counting to 10 (P7)
- count at least five objects reliably (P7)
- begin to recognise numerals from 1 to 5 and to understand that each represents a constant number or amount (P7)

Extension:

- continue the rote count onwards from a given small number (P8)
- count reliably up to 10 everyday objects (Year R)

Explain that the 'teacher' should help the 'pupil' achieve these objectives by teaching them how to count objects and recognise numerals. All communication must be done using the Japanese number names and symbols. Objects and a number line may be used to support the learning process. Try to discourage participants from learning a direct translation from English to Japanese – this is not helpful to this exercise and is likely to increase difficulty as it requires substantial memory capacity.

After about **5 minutes**, bring the whole group together and say that you are going to assess the learning of some of the 'pupils'. First count in Japanese to *juu* with the whole group, along a number line you have made using a copy of Resource sheet 1.2. Then assess individuals by asking them to:

- count the number of objects in a set of three or four which you give them, either aloud or silently;

- find the Japanese numeral card (from the set you have made by cutting up another copy of Resource sheet 1.2) that matches the number of objects;
- count out a different number of objects, saying aloud the number names as they do so.

The task could be extended by asking participants to count aloud, and then silently, a small number of claps or drumbeats. Relate this to touch by tapping on the palm of their hand or on their shoulder.

Discussion

How do you think the teaching and learning experience relates to the way in which your children learn about number?

To what extent did 'teachers' use the progression outlined in the P levels to develop the learning?

What did the teachers do that was helpful?

Bring out the following key points.

- Learning the sequence of number names is helpful although the amount that can be learned at one time is limited – it is unlikely that anyone attained level P7 by counting to 10 in the activity. Most would probably have got as far as levels P5 or P6: rote counting up to 5. The 'teachers' probably helped by ensuring that a sequence of two or three numbers was learned before introducing more.
- The use of a number line, even if children cannot remember the symbols, supports the counting process and the idea that the unfamiliar words being spoken form a particular sequence.
- Matching an unfamiliar number name to a quantity is difficult; knowing the counting sequence supports the identification of the correct name through counting the objects, or a corresponding number of fingers, or making the equivalent number of jumps along a number line.
- The skills involved in learning to count are complex; the learning depends on a number of important principles which will be outlined in the next part of the session.

The principles of counting

10 minutes

Note: If you did not use the optional activity, ignore the references to counting in Japanese.

Counting is a key aspect of our understanding of number. The National Numeracy Strategy has promoted progression in counting skills as a means of extending children's experience of the number system and the ways in which numbers relate to one another.

Ask participants what skills and knowledge need to be secured as children learn to count objects. If you did the optional activity, ask them to draw on their experience of learning to count in Japanese.

Explain that the ability to count objects relies on five principles. Show **OHT 1.4** and talk through the principles. Say that these are established early and quickly for many children and, as such, are not highlighted in the National Curriculum or even in the P levels. For children with severe or profound and multiple learning difficulties, however, these principles will form the basis of their early work with number and must be established if the children are to develop number skills which will be useful in everyday life.

OHT 1.4**Five principles of counting**

- **The stable order principle:** understanding that the number names must be used in that particular order when counting
- **The one-to-one principle:** understanding and ensuring that the next item in a count corresponds to the next number
- **The cardinal principle:** knowing that the final number represents the size of the set
- **The abstract principle:** knowing that counting can be applied to any collection, real or imagined
- **The order irrelevance principle:** knowing that the order in which the items are counted is not relevant to the total value

Say that when learning to count in Japanese, those taking the role of learner were applying these principles, perhaps implicitly. They only had to learn new number names and symbols. The children that they work with, however, are learning number names and symbols **at the same time as** they are developing the five principles of counting – a much harder task.

Give out **handout 1.3** and say that you are now going to demonstrate these five principles, which are summarised in the handout.

Talk through the handout, drawing out the following points by demonstrating typical errors and effective teaching strategies with a set of small objects.

- **Demonstrate counting out your set of objects, saying the numbers in the wrong order, and missing out some numbers.** Say that by learning the string of Japanese number names in ascending order, and using this sequence when counting objects, participants demonstrated their awareness of the **stable order principle**. They may have used the strategy of learning shorter strings by pausing after a small number or by emphasising particular 'landmark' numbers. Trying to learn all of the numbers to 10 in one attempt before consolidating counting to a smaller number leads to mistakes in recall. In the classroom, the order of numbers can be reinforced for children through rote counting, 'counting up' number rhymes and songs, and visually through the use of a number line. Teachers and supporting adults can model the use of the number line by taking opportunities as they arise to count objects or events.

- **Demonstrate counting your objects, touching and counting one of the objects twice.** Say that when counting objects using Japanese number names, participants would have used their understanding of the **one-to-one principle**, that the next item in a count corresponds to the next number. They may have demonstrated strategies for ensuring this, perhaps by moving objects to one side as they are counted. Children should be encouraged to organise their counting in this way since, in addition to keeping track of the items that they have counted, the concept of matching one number name to one object is emphasised through the physical contact and movement associated with saying the number as the item is counted. Moving the items into a line as they count will also provide a helpful structure for checking. Teachers often develop ideas of one-to-one matching through making sure that there is one cup and one plate for each child at snack time. This can be developed for some children by giving tasks such as ‘We have counted that there are five people here. Can you find five cups for their drinks?’
- **Ask a colleague to play the teacher. Count your set of objects, but give no answer when s/he asks you the question ‘How many are there?’ after you have counted.** Suggest that when counting in Japanese, participants used their understanding of the **cardinal principle** as they knew that the last number that they said represented the total quantity of objects. However, this is a concept that may take time to develop for children with severe or profound and multiple learning difficulties. There is evidence that it develops in four stages.
 - 1 Being aware that the last number said in the count is the response expected by the adult without recognising that it represents the quantity.
 - 2 Knowing that the last number in the count indicates the quantity. The transition between these first two stages can be developed through the use of particular intonation on the last number in the count and by repeating, for example, ‘There are **five** elephants’ after the count.
 - 3 Recognising that if a count is interrupted they can say how many they have counted so far and continue with the remainder of the set to find the total. Children should have opportunities to pause and then continue counting – this can be developed later to a more abstract level by placing the items already counted out of sight before continuing the count.
 - 4 Awareness that numbers, once assigned to sets, can be compared. Without this principle, children are not able to compare the sizes of two sets represented by numbers.
- Having learned the Japanese number names, participants would be able to use them in applying the **abstraction principle**, that is, to count something that wasn’t present, for example the number of windows in their classroom. Ask participants to make this abstract count and to explain how they did it. Children’s early experiences of counting are generally with real objects. Often these are related to sorting activities where they need to consider items which are included or excluded from a particular count. As children develop their counting skills they need to begin to count objects that they cannot see, for example how many people live in their home, and events as they happen, for example how many times the teacher bangs on a drum, leading to counting events that happen somewhere else.

- **With a colleague, model counting a set of objects arranged in a row when asked to start at one end, and then being unable to do so when asked to start with an object in the middle.** Say that in the early stages of counting, children are not able to recognise that the order in which they count objects does not affect the cardinal value – the **order irrelevance principle**. They need to understand that the name tags given to items as they count are not related to the properties of the item but are given temporarily to enable the number of items in the set to be found. Children need to have experience of counting and recounting objects in different orders to establish that the cardinal value remains the same. The same principle applies to the way in which objects are arranged, and opportunities to count objects that are arranged close together and then further apart should be offered to help develop an understanding of the conservation of number.

Teaching a class with a wide range of levels of attainment

20 minutes

Say that the session so far will have demonstrated that the stages children go through in learning about number are complex – so it is not surprising that many children with severe or profound and multiple learning difficulties take a long time to master them. This is one reason why everyone will have in their class children who are at different stages in the process and working at a variety of levels.

Explain that you are now going to show a video extract which illustrates how one teacher manages a class where there are children working at P levels 1–8. The class is a mixed group containing Key Stage 2 children with severe or profound and multiple learning difficulties and autistic spectrum disorder. The teacher, Kim, plans activities and key lines of questioning and dialogue for her children to work at an appropriate level and prepares a box of activities that are suited to their interests. The adults working with the children are briefed on the intended outcomes and appropriate lines of questioning and dialogue. They select activities for the session based on work they have been doing previously and on what they feel the next steps are for the children.

Give out **handouts 1.4, 1.5 and 1.6** and explain that this is the format Kim uses to brief each of the adults who will be working with one of her four 'groups' on the children's targets and related activities for the half-term. Say that on the video they will see Kim and her teaching assistants work on some of those activities during the main part of the lesson. They will also see the mental/oral starter: a shape song involving counting and recognition of numerals.

Allow time for participants to look through the briefing notes.

Show the video, asking participants to note the stage at which each 'group' of children is working in their understanding of number and the strategies that are used to engage all the children in the lesson.

After the video, take feedback, drawing out the following points.

- Some children are at the stage of experiencing and appreciating quantity. Others are learning to communicate about quantity. Josephine and Chloe are working on some of the five principles of counting, including the one-to-one principle and the cardinal principle.
- Strategies used to keep all children engaged in the mental/oral starter and the plenary include a variety of sensory experiences, close interaction between the teacher and each child in turn, and the use of prepared resources such as 'show me' numeral cards set out on a Velcro board. More able children are asked to use reasoning skills to predict the shapes which might be next out of the bag.
- Strategies used to keep children engaged in the main part of the lesson include focused adult support, the planned use of activities which have become familiar to the children and purposeful 'holding' activities while the adult engages with an individual in the group.

Managing the plenary

15 minutes

Ask the group of participants to list the advantages of bringing children together for a plenary, as on the video, and some of the disadvantages and difficulties which they may have experienced in their own classrooms.

The points raised are likely to include the following.

- The children are tired and aware that the lesson is nearly over.
- Some children will require more time to feed back than others, who may lose interest unless adults take care to involve them.
- The teacher may need to stop children and gain their attention before they have completed the work set, when it would be easier to let them continue.
- Some or all children may be in wheelchairs, standing frames or other pieces of equipment, which then creates a problem with the task of physically moving them back together, and takes up valuable teaching time.

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OHT 1.5

Purposes of the plenary

- To assess informally the work of any group(s) of children that the teacher has not been working with in a focused way. These children may have been working on their own or with help from a support assistant
- To address any common difficulties or misunderstandings
- To review the main teaching points and to summarise key facts, ideas and vocabulary
- To make links with other work, in mathematics and other subjects, to explain what the class will go on to do next, and to describe anything which has to be done in the interim
- To signal a definite conclusion to the lesson and ensure that children go away positive about what they have achieved and what they are going to do next

Show **OHT 1.5**. Ask participants which of these listed purposes they were able to observe in Kim's lesson. You may want to show the video of the plenary again at this point. They should mention:

- the teacher making informal assessments of children's progress;
- addressing misconceptions (returning to Chloe's error of getting a number the wrong way round);
- learning being reinforced through questioning in the whole group;
- the teacher signalling a definitive and positive end to the lesson.

Ask participants to share examples of solutions they have found to some of the practical problems involved in organising the plenary. Show **OHT 1.6** for further ideas.

OHT 1.6

Managing the plenary

- Plan time for the plenary
- Have a clear idea of what you want to achieve
- Plan a variety of activities - not just children reporting back on what they have done
- Have strategies for deploying adult support and maintaining children's engagement
- It may be appropriate, where there are physical problems with bringing children back together, to have a plenary with the children remaining in their small groups on 2 or 3 days each week
- The plenary can vary in length; some days it may be 4 or 5 minutes, on other occasions it may be 20 minutes
- One day each week, plan the lesson differently with a longer plenary time. Use this to complete some 'assess and review' activities and to look at what the children have learned during the week

Conclusion**5 minutes**

Ask participants to talk to a partner about one change they may want to make to their teaching as a result of the session, or a point they want to remember.

Finish the session by emphasising key points.

- Children need to go through a series of stages in learning about numbers and counting; it will help us to move their learning on if we are aware of these stages.
- Planning how we will teach and reinforce key vocabulary is essential.
- Our planning almost always needs to cover a wide range of levels, and involve strategies for keeping all children engaged.
- Much useful learning can take place in the plenary, and though it is not always easy to organise, it is very important.

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Resource sheet 1.1

Counting in Japanese: Teacher information

1	ichi	一
2	ni	二
3	san	三
4	shi	四
5	go	五
6	roku	六
7	shichi	七
8	haachi	八
9	kyuu	九
10	juu	十

Resource sheet 1.2

Japanese number cards

一	二	三	四	五	十
六	七	八	九		



Objectives

- to consider progression in developing knowledge of numbers and the number system for children with severe or profound and multiple learning difficulties
- to explore the use of mathematical vocabulary associated with numbers and the number system
- to consider strategies for teaching classes with a wide range of abilities about numbers and the number system
- to consider the role and management of the plenary in the daily mathematics lesson



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Learning to appreciate quantity and communicate about quantities

- responding to a pleasurable stimulus (e.g. items of food or drum beats) by indicating a desire for 'more' and hearing adults use those terms
- becoming aware of sequences, and looking towards the next event in a sequence, e.g. the next light to come on along a rope of brightly coloured lights
- exploring and holding sets with different numbers of objects
- choosing between sets with different numbers of objects
- anticipating numbers, e.g. anticipating the appearance of a second object when two have been hidden while the child watches, and one has already appeared or been found



Counting in Japanese

- join in with rote counting to 10 (P7)
- count at least five objects reliably (P7)
- begin to recognise numerals from 1 to 5 and to understand that each represents a constant number or amount (P7)

Extension:

- continue the rote count onwards from a given small number (P8)
- count reliably up to 10 everyday objects (Year R)



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Five principles of counting

- **The stable order principle:** understanding that the number names must be used in that particular order when counting
- **The one-to-one principle:** understanding and ensuring that the next item in a count corresponds to the next number
- **The cardinal principle:** knowing that the final number represents the size of the set
- **The abstraction principle:** knowing that counting can be applied to any collection, real or imagined
- **The order irrelevance principle:** knowing that the order in which the items are counted is not relevant to the total value

OHT 1.5

Purposes of the plenary

- To assess informally the work of any group(s) of children that the teacher has not been working with in a focused way. These children may have been working on their own or with help from a support assistant
 - To address any common difficulties or misunderstandings
 - To review the main teaching points and to summarise key facts, ideas and vocabulary
 - To make links with other work, in mathematics and other subjects, to explain what the class will go on to do next, and to describe anything which has to be done in the interim
 - To signal a definite conclusion to the lesson and ensure that children go away positive about what they have achieved and what they are going to do next
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Managing the plenary

- Plan time for the plenary
- Have a clear idea of what you want to achieve
- Plan a variety of activities - not just children reporting back on what they have done
- Have strategies for deploying adult support and maintaining children's engagement
- It may be appropriate, where there are physical problems with bringing children back together, to have a plenary with the children remaining in their small groups on 2 or 3 days each week
- The plenary can vary in length; some days it may be 4 or 5 minutes, on other occasions it may be 20 minutes
- One day each week, plan the lesson differently with a longer plenary time. Use this to complete some 'assess and review' activities and to look at what the children have learned during the week

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Handout 1.1

Learning about numbers and how they describe quantities: progression from level P4 to Year 2 Key Objectives

	P4	P5	P6	P7	P8	Reception Key Objectives	Year 1 Key Objectives	Year 2 Key Objectives
The sequence of numbers used for counting	Show an interest in number activities and counting	Respond to and join in with familiar number rhymes, stories, songs and games	Join in with new number rhymes, songs, stories and games with some assistance or encouragement Join in rote counting up to 5 and use numbers to 5 in familiar activities and games	Join in with rote counting to 10	Join in with rote counting to beyond 10 Continue the rote count onwards from a given small number	Say and use number names in order in familiar contexts	Count on and back in ones from any small number, and in tens from and back to zero	Describe and extend simple number sequences (including odd/even numbers, counting on or back in ones or tens from any two-digit number, and so on)
Counting to find a quantity	Show an interest in number activities and counting	Indicate one or two	Demonstrate an understanding of one-to-one correspondence in a range of contexts Count reliably to 3 and make sets of up to three objects	Count at least five objects reliably	Begin to count up to ten objects Estimate a small number and check by counting	Count reliably up to ten everyday objects	Count reliably at least 20 objects	
Recognition of numerals				Begin to recognise numerals from 1 to 5 and to understand that each represents a constant number or amount	Begin to recognise numerals from 1 to 9 and relate them to sets of objects	Place value and ordering		
Comparing and ordering numbers and quantities	Show an interest in number activities and counting	Demonstrate awareness of contrasting quantities by making groups of objects with help	Demonstrate an understanding of the concept of more/fewer Demonstrate an understanding of one-to-one correspondence in a range of contexts	Begin to recognise differences in quantity	Compare two given numbers of objects, saying which is more and which is less Begin to use ordinal numbers (first, second or third) when describing the position of objects, people or events	Recognise numerals 1 to 9 (consistently and with confidence) then 0 to 10 Use language such as 'more' or 'less', 'greater' or 'smaller', to compare two numbers	Read, write and order numbers from 0 to at least 20 Understand and use the vocabulary of comparing and ordering numbers Within the range 0 to 30, say the number that is 1 or 10 more or less than any given number	Count, read, write and order whole numbers from 0 to at least 100; know what each digit represents (including 0 as a place holder)

Handout 1.2

Mathematical vocabulary: counting and recognising numbers

Taken from the NNS booklet *Mathematical vocabulary* (DfES 0313/2000): Reception list

Words that also appear in the NNS publication *Core Vocabulary to support mathematics lessons in special schools and units with Key Stage 3 pupils* (DfES 2002) are highlighted in bold.

Counting

number

zero, one, two, three ... to twenty and beyond

zero, ten, twenty ... **one hundred**

none

how many ... ?

count, count (up) to

count on (from, to)

count back (from, to)

count in ones, twos ... tens ...

more, less, many, few

odd, even

every other

how many times?

pattern, pair

guess how many, estimate

nearly, close to, about the same as

just over, just under

Comparing and ordering numbers

the same number as, as many as

Of two objects/amounts:

greater, **more**, larger, **bigger**

less, fewer, **smaller**

Of three or more objects/amounts:

greatest, **most**, **biggest**, largest

least, fewest, **smallest**

one more, ten more

one less, ten less

compare

order

size

first, second, third ... tenth

last, last but one

before, after

next, between, above, below

Handout 1.3 page 1 of 2

Five principles of counting

The stable order principle

This means understanding that the number names must be used in a particular order when counting. We help children to learn the order by practising counting in shorter strings to start with, and by emphasising particular 'landmark' numbers such as two, five and ten. The order of numbers can be reinforced through rote counting, 'counting up', number rhymes and songs, and visually through the use of a number line. Teachers and supporting adults model the count by taking opportunities as they arise to count objects or events.

The one-to-one principle

This means understanding and ensuring that the next item in the count corresponds to the next number. We help children with this by encouraging them, for example, to touch or move objects to one side as they are counted. Children should be encouraged to organise their counting in this way since, in addition to keeping track of the items that they have counted, the concept of matching one number name to one object is emphasised through the physical contact and movement associated with saying the number as the item is counted. Moving the items into a line as they are counted will also provide a helpful structure for checking. Teachers often develop ideas of one-to-one matching through making sure that there is one cup and one plate for each child at snack time. This can be developed for some children by giving tasks such as 'We have counted that there are five people here. Can you find five cups for them?'

The cardinal principle

This means knowing that the final number represents the size of the set. It is a concept that may take time to develop for children with severe or profound and multiple learning difficulties. There is evidence that it develops in four stages.

- 1 Being aware that the last number said in the count is the response expected by the adult without recognising that it represents the quantity.
- 2 Knowing that the last number in the count indicates the quantity. The transition between these first two stages can be developed through the use of particular intonation on the last number in the count and by repeating, for example, 'There are **five** elephants' after the count.
- 3 Recognising that if a count is interrupted they can say how many they have counted so far and continue with the remainder of the set to find the total. Children should have opportunities to pause and then continue counting – this can be developed later to a more abstract level by placing the items already counted out of sight before continuing the count.

Handout 1.3 page 2 of 2

- 4 Awareness that values, once assigned to sets, can be compared. Without this principle, children are not able to compare the sizes of two sets represented by numbers.

The abstraction principle

This means knowing that counting can be applied to any collection, either real or imagined. Children's early experiences of counting are generally with real objects. Often these are related to sorting activities where they need to consider items which are included or excluded from a particular count. As children develop their counting skills they need to begin to count objects that they cannot see, for example how many people live in their home, and events as they happen, for example how many times the teacher bangs on a drum, leading to counting events that happen somewhere else.

The order irrelevance principle

This means knowing that the order in which the items are counted is not relevant to the total value. In the early stages of counting, children are not able to recognise that the order in which they count objects does not affect the cardinal value. They need to understand that the name tags given to items as they count are not related to the properties of the item but are given temporarily to enable the number of items in the set to be found. Children need to have experience of counting and recounting objects in different orders to establish that the cardinal value remains the same. The same principle applies to the way in which objects are arranged, and opportunities to count objects that are arranged close together and then further apart should be offered to help develop an understanding of the conservation of number.

Handout 1.4

Kim's briefing notes

MATHEMATICS ACTIVITIES

Josephine and Chloe

Staff: Oliver

Targets: Chloe: To count out groups up to 12
To rote count to 20

Josephine: To recognise numerals to 10
To count out groups up to 3

Vocabulary:

number names to 20, before, after, more, less, order, how many?, none

Suggested activities

Chloe:

- Rote count to 20 with visual clue (number line)
- Count on from any given number
- Name missing/hidden number on number line
- Games: Dinner plate
Car park
Clothing on a washing line
Shopping basket

Josephine:

- Recognise numbers on a number line to 10, e.g. show me number 5
- Show correct number of fingers to 5 using her book if required
- Count out groups by placing objects on fingers on drawing of her hands
- Games: Dinner plate
Car park
Clothing on a washing line
Shopping basket

Handout 1.5

Kim's briefing notes

MATHEMATICS ACTIVITIES

Christopher, Glen and James

Staff: Kim

Targets:

Christopher: To give a number card to request a quantity of chosen objects, food or turns of an activity
To wait until requested amount is given

Glen: To give a number card to request a quantity of chosen objects, food or turns of an activity
To wait until requested amount is given

James: To listen to and respond to number stories by looking/pointing to objects as adult counts
To begin to count out groups of up to 3 through practical activities

Vocabulary:

number names and symbols to 5 (James 10), how many?, more, count

Suggested activities

Christopher and Glen:

- Make a selection from their PECS folders and receive the chosen activity/object
- Introduce a number line
- Pupil to make selection and then add number to sentence strip
- Pupil to wait as requested amount is given or show an understanding that the activity has finished once they have had requested amount of turns

James:

- Request a book using PECS
- Sit and read through book with adult
- James to point to the objects as adult counts
- Participate in a range of counting activities

Handout 1.6 page 1 of 2**Kim's briefing notes****SENSORY MATHEMATICS****1. Staff:** Jo

Targets: Luke: To cooperate with shared exploration of varying quantities of objects
 To choose between **two** objects
 To indicate 'more' through vocalisation/reaching to touch
 To develop anticipation of 1, 2, 3, GO!

Reggie: To accept and engage in coactive exploration of varying quantities of objects
 To indicate 'more' through tapping the palm of an adult's hand
 To develop anticipation of 1, 2, 3, GO!

Vocabulary:

more, which one?, one, two, three

Suggested activities

Group gel: Music: 'Senses' tape
 Fan: Pupils to indicate their turn
 Use 1, 2, 3, GO! to develop anticipation
 Pupils to indicate 'more'

Individual: Tactile: Pupils to indicate 'more'
 Pupils to make choices or show preferences
 Use varying amounts of an object, varying strokes, etc.

Handout 1.6 page 2 of 2

Whole body experience:

Spinning chair or physiotherapy ball
Use 1, 2, 3, GO! to develop anticipation
Pupils to indicate 'more'
Count the spins of the chair
Use 'stop' as the chair comes to a standstill

2. Staff: Tracey

Targets: Rebecca and Beth: To press a switch to operate a simple computer program, activate preferred stimulus and give visual attention to the resulting effect
To associate word 'more' with a repeated experience

Vocabulary:

more

Suggested activities

- Variety of software to operate via switch
- Small electric fan (Beth) – adult uses the term 'more'

Calculation

Objectives

- To demonstrate the relevance of calculation for children who are working towards level 1 of the National Curriculum in mathematics
- To explore the early stages of learning about calculation
- To identify opportunities to work on calculation in the daily mathematics lesson and throughout the school day
- To consider strategies for teaching classes with a wide range of abilities about calculation

Resources

- OHTs 2.1–2.9
- Video sequence 2: *Calculation*
- Handouts 2.1–2.3 for each participant
- Four or five interesting objects that can be counted
- Minute timer (optional)
- Flipchart and pen
- *Towards the National Curriculum for Mathematics: examples of what pupils with special educational needs should be able to do at each P level* (DfES 0637/2001): enough copies (or photocopies of pages 10 and 11) for pairs or groups of four
- Reference copy for presenter of *Planning, teaching and assessing the curriculum for pupils with learning difficulties* (QCA/DfES 2001)

Outline of the session		
Introduction The fundamentals of calculation	Talk	5 minutes
Issues in calculation The relevance of work on calculation to children with severe or profound and multiple learning difficulties	Talk Discussion Activity	15 minutes
Calculation activities Everyday opportunities for learning about calculation	Talk Discussion Activity	30 minutes (optional)
A lesson about calculation Introducing the lesson Group work and plenary	Video Discussion	35 minutes
Conclusion Key points from the session	Talk	5 minutes

Introduction

5 minutes

OHT 2.1

Objectives

- to demonstrate the relevance of calculation for children who are working towards level 1 of the National Curriculum in mathematics
- to explore the early stages of learning about calculation
- to identify opportunities to work on calculation in the daily mathematics lesson and throughout the school day
- to consider strategies for teaching classes with a wide range of abilities about calculation

Show **OHT 2.1**, highlighting the objectives and explaining that this session is about the second strand of the National Numeracy Strategy's *Framework for teaching mathematics: Reception to Year 6*. It has a particular focus on children who are working towards level 1 of the National Curriculum, and aims to show the relevance of work on calculation for these children.

Issues in calculation

15 minutes

OHT 2.2

Is calculation a relevant aspect of mathematics for our pupils?

Calculation is about adding, subtracting, multiplying or dividing numbers to find an 'answer'

Calculation is about identifying how quantities change (increase and decrease), and how we communicate about changes

Show only the heading of **OHT 2.2** and ask participants for their views on this question. Take feedback. Summarise the points made, which may include the following.

- Our children can't yet count to five with one-to-one correspondence – so how can they do calculations?
- Calculation involves abstract thought processes which are beyond our children.
- Surely we need to teach things in order – counting first, calculation later.

Show the first definition of calculation on OHT 2.2. Say that the views expressed are all legitimate if we define calculation **only** as adding, subtracting, multiplying or dividing numbers to find an answer.

Show the rest of OHT 2.2. Say that if we look at calculation this way, we can readily see the relevance to children with severe or profound and multiple learning difficulties.

Ask participants to discuss briefly, in pairs, examples of fundamental events in children's lives in which they experience or need to communicate about **changes in quantity**. Take feedback, drawing out ideas such as:

- the experience of having 'more' (more chips to eat, more coins to hold);
- the experience of 'fewer' and 'all gone' (when members of the class are away, familiar people leave the room or sweets have been eaten);
- the experience of loss and gain (items being taken from them, or added to a collection);
- the experience of 'another one' (another drum beat or light flash, another turn in a game);
- the experience of comparing amounts ('Who has more?' 'Who has fewer?');
- the experience of combining, collecting and distributing (collecting coins from class members to pay for a trip; distributing items they need to take with them);
- the experience of sharing (when sweets are shared out between class members);
- the experience of changing groups of objects to make them the same or different in number;
- the experience of repeating (three beats on a drum, repeated several times);
- the experience of duplicating (pairs of gloves or shoes).

Say that examples like these demonstrate how learning about calculation fits in with recent guidance on interpreting the National Curriculum to provide lessons for such children that are 'appropriate to their needs and fundamental to their lives' (in the QCA/DfES booklet *Planning, teaching and assessing the curriculum for pupils with learning difficulties*).

Calculation is also important because of its very close links with understanding of numbers and the number system. Draw participants' attention to the fact that when we count we are actually doing addition (repeatedly adding one). You may wish to illustrate this with a row of objects on the table or overhead projector, or just using your fingers. When children learn to count up (or down), they begin to understand the nature of addition and subtraction.

Although calculation and numbers and the number system are interlinked, however, we also need to be clear about the difference in teaching about the two strands, so that we can offer children an appropriately balanced curriculum.

OHT 2.3

Towards level 1 in mathematics

Numbers and the number system

- Experiencing and appreciating quantities
- Recognising quantities
- Communicating about quantities
- Learning number names
- Beginning counting
- Representing numbers

Calculation

- Appreciating that quantities can change
- Recognising changes in quantities
- Communicating about changes
- Realising the consequences of changing quantities
- Beginning counting
- Manipulating quantities
- Recording changes in quantity

Put up **OHT 2.3**, explaining that it shows how work on calculation is closely related to but also extends work on numbers and the number system.

Note that beginning counting, as we have seen, appears both under numbers and the number system and under calculation, because counting forwards represents repeatedly adding one. Ask what type of calculation is involved when we count backwards (subtraction).

Encourage some discussion about the differences in emphasis in the two strands. Collect any key words on a flipchart. Make the point that when the content of a lesson is intended to be about calculation it is not just about numbers or counting **but should be about how quantities change, and how we communicate about changes**.

Emphasise that we should make sure that the experiences and language we provide for children are not only about number names and their order but also about changes.

OHT 2.4

Experiences which can contribute to developing fundamental ideas about changing quantities

- handling
- anticipating
- giving and taking
- collecting
- experiencing increase
- separating
- sorting
- distributing
- appreciating patterns and progressions
- estimating
- predicting

Show **OHT 2.4**. Explain that the OHT suggests some basic experiences that can encourage children to learn about changing quantities and therefore set the scene for learning about elementary aspects of calculation. Ask participants for an example of an activity in school which involves handling objects and also involves changing quantities. Then ask for an example of an activity involving anticipating, which relates to changing quantities. Continue down the list of bullet points, recording participants' ideas on a flipchart for typing up and distribution after the session.

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Activity

OHT 2.5

Activity: working at different levels

- Look at pages 10 and 11 of *Towards the National Curriculum for Mathematics*.
- Think of two children in your class who are at different levels.
- Think of an activity during which they might experience increase or decrease in quantities.
- How will each child be able to participate in the activity? What parts of the experience will be valuable to them?
- What vocabulary (words or phrases) might you use to help them:
 - learn to anticipate changes?
 - learn to estimate?
 - learn to describe or influence changes?

Show **OHT 2.5**. Say that the next activity is about how children who are at different levels will be involved in experiencing changes in quantities. Talk through the points on the OHT, giving examples of contexts in which children might experience increase or decrease in quantities: a sensory experience, a practical activity, making or baking, a game, giving or taking, hiding and finding, collecting or distributing.

Ask participants to work in pairs on the task. After a few minutes, take feedback, emphasising that:

- teaching about changes in quantities can take place at many levels, including within a sensory curriculum;
- it is important to ensure consistent, planned use of vocabulary.

Talk through **OHT 2.6**, which lists key vocabulary relating to calculation.

OHT 2.6

Key vocabulary - calculation

At P1	One, again, more, enough, another, gone
At P2 and P3	One, two, give, take, put, more, lot, full, empty, none
At P4-P8	Number names, add, and, more, less, makes, how many now, altogether, biggest, smallest, take away, left/leave, same, most/fewest, first, second, third
At higher levels	One more/two more, take one away, count on/back, count up/down, how many more, how many have gone, left over, share, zero, order, how many times, double

Calculation activities (optional)

30 minutes



Activity

Give participants a copy of **handout 2.1** and briefly run through the instructions it provides for the activity. The activity is organised in three separate parts, each of 10 minutes. The first two parts are for groups of two to four participants, and the final part is a whole-group activity.

For the first part of the activity participants will need to refer again to pages 10 and 11 of *Towards the National Curriculum for Mathematics*.

It is suggested that you use a timer device like a minute egg-timer and call out the minutes as they *add up* during the two 10-minute periods of group work. This will remind groups to move on to the next part of the activity, but may also lead to discussion about whether there is 'enough' or 'too much' time; you may wish to call attention to the fact that words like those and 'more', 'fewer', 'many' are all related to the basic concepts of calculation.

Further optional extension activities from this session could include discussion about using cross-curricular mathematics opportunities. Such discussion would also offer opportunity to discuss age-appropriate practical mathematics for those who work with children across different key stages, or help develop thoughts that might contribute to the school's schemes of work.

A lesson about calculation

35 minutes

Introducing the lesson

Give participants a copy of **handout 2.2**, which provides an overview of the lesson that they are about to watch. Explain that it was written by the teacher specifically for these training materials, to support participants when watching the video sequence, and has more detail within it than would be included in the school's regular planning. Allow participants a few moments to look over the teacher's description of the lesson.

Explain that the video shows a lesson on calculation for children in a mixed key stage class in a school for children with severe or profound and multiple learning difficulties. The abilities of the children range right across the P levels. Though it may not be fully evident in the video, some children can be volatile while others may find it difficult to maintain attention.

The school has a flexible approach to staffing so that the regular class team of teacher and nursery nurse can be supplemented at different times during the week. In the video session an education support assistant is also working with the class, and the child who returns from a medical test part-way through the lesson is accompanied by an EAL (English as an additional language) assistant who supports her part-time.

OHT 2.7

Oral and mental starter and whole-class introduction

Issues to look out for:

- Do the children experience changes of quantity?
- Are different levels of participation supported?

Show **OHT 2.7** and explain that you will show the oral and mental starter and whole-class introduction first. Ask participants to consider the issues raised in the OHT as they watch the video. Make the additional point that, because all the strands of mathematics are interdependent, sometimes the same objectives recur in different strands, so it is important that we should bear in mind the particular emphasis that we seek in our particular lesson. For example, although there is a lot of counting in the video lesson, in a lesson about calculation key elements to look for are how appreciation of changing quantities is emphasised and how rote counting is extended to illustrate changes of quantity.

Stop the video after the teacher has explained three things that were important in the whole-class introduction: object permanence, visualisation, and experience of increasing quantities. The teacher's final words in this section are 'finally, experience and learn about increases in quantity'.

Give participants a minute or two to share their initial reactions to the video, in pairs. Now open out the questions on the OHT to general discussion.

Group work and plenary

Draw participants' attention to the section 'Children will be learning to ...' at the top of **handout 2.2**. Point out that these objectives come from the school's scheme of work, which is based on the QCA guidance on *Planning, teaching and assessing the curriculum for pupils with learning difficulties*, and on the National Numeracy Strategy guidance *Towards the National Curriculum: examples of what pupils with special educational needs should be able to do at each P level*. The objectives give an overview of the aspects of calculation to be covered in the video

lesson. Such broad objectives may be useful in medium-term planning to ensure appropriate coverage, and in short-term planning to provide outline content when planning a series of lessons.

Observing and recording individual children's responses will need a finer focus, however. Distribute **handout 2.3**, which gives some examples of how the broad objectives might be interpreted in finer detail. The examples are linked to the P levels.

Before showing the rest of the video, point out that the teacher used individual objectives such as those on the handout to plan activities for three groups in her class:

- 1 sensory group
- 2 communication about change group
- 3 numerate group

OHT 2.8

Group work and plenary

Look out for:

- *ways in which children's sensory experience of quantity is being extended*
- *ways in which counting is used to extend understanding of changing quantities*
- *the extent to which different children's performances compare to the P level interpretations on handout 2.3*

Put up **OHT 2.8**. Show the remainder of the video sequence. Take brief comments on ways in which children's sensory experience of quantity was extended, and ways in which counting was used to extend children's understanding of changing quantities. Now ask participants, working in pairs, to look back at handout 2.3 and highlight the (italicised) objectives which they feel were achieved or partly achieved in the lesson shown on the video sequence.

Take feedback. Make the following points.

- The teacher was able to ensure that the lesson addressed the learning needs of children across the range of ability in her class.
- This range of learning needs was addressed in the whole-class introduction and plenary as well as in the small-group work.

Conclusion

5 minutes

OHT 2.2

Is calculation a relevant aspect of mathematics for our pupils?

Calculation is about adding, subtracting, multiplying or dividing numbers to find an 'answer'

Calculation is about identifying how quantities change (increase and decrease), and how we communicate about changes

Put up **OHT 2.2** again. Ask participants where they feel they now stand on the issue of the relevance of calculation to children working towards level 1 of the National Curriculum.

OHT 2.9

Key points

Appreciating and communicating about changing quantities is essential to effective daily living

Learning about changing quantities:

- extends children's understanding of the world
- extends children's experience of and learning about numbers
- lays the foundations for later work on other aspects of calculation

Opportunities to support work on calculation in the daily mathematics lesson can be identified throughout the school day

Teaching about calculation can take place at many levels, including within the sensory curriculum

Finish by showing **OHT 2.9**, reinforcing the key points from the session.



Objectives

- to demonstrate the relevance of calculation for children who are working towards level 1 of the National Curriculum in mathematics
- to explore the early stages of learning about calculation
- to identify opportunities to work on calculation in the daily mathematics lesson and throughout the school day
- to consider strategies for teaching classes with a wide range of abilities about calculation





Is calculation a relevant aspect of mathematics for our pupils?

Calculation is about adding, subtracting, multiplying or dividing numbers to find an 'answer'

Calculation is about identifying how quantities change (increase and decrease), and how we communicate about changes



OHT 2.3

Towards level 1 in mathematics

Numbers and the number system

- Experiencing and appreciating quantities
- Recognising quantities
- Communicating about quantities
- Learning number names
- Beginning counting
- Representing numbers

Calculation

- Appreciating that quantities can change
- Recognising changes in quantities
- Communicating about changes
- Realising the consequences of changing quantities
- Beginning counting
- Manipulating quantities
- Recording changes in quantity



Experiences which can contribute to developing fundamental ideas about changing quantities

- handling
- anticipating
- giving and taking
- collecting
- experiencing increase
- separating
- sorting
- distributing
- appreciating patterns and progressions
- estimating
- predicting



OHT 2.5

Activity: working at different levels

- Look at pages 10 and 11 of *Towards the National Curriculum for Mathematics*.
- Think of two children in your class who are at different levels.
- Think of an activity during which they might experience increase or decrease in quantities.
- How will each child be able to participate in the activity? What parts of the experience will be valuable to them?
- What vocabulary (words or phrases) might you use to help them:
 - learn to anticipate changes?
 - learn to estimate?
 - learn to describe or influence changes?



Key vocabulary - calculation

At P1	One, again, more, enough, another, gone
At P2 and P3	One, two, give, take, put, more, lot, full, empty, none
At P4-P8	Number names, add, and, more, less, makes, how many now, altogether, biggest, smallest, take away, left/leave, same, most/fewest, first, second, third
At higher levels	One more/two more, take one away, count on/back, count up/down, how many more, how many have gone, left over, share, zero, order, how many times, double





.....

Oral and mental starter and whole-class introduction

Issues to look out for:

- Do the children experience changes of quantity?
- Are different levels of participation supported?



Group work and plenary

Look out for:

- ways in which children's sensory experience of quantity is being extended
- ways in which counting is used to extend understanding of changing quantities
- the extent to which different children's performances compare to the P level interpretations on handout 2.3





Key points

Appreciating and communicating about changing quantities is essential to effective daily living

Learning about changing quantities:

- extends children's understanding of the world
- extends children's experience of and learning about numbers
- lays the foundations for later work on other aspects of calculation

Opportunities to support work on calculation in the daily mathematics lesson can be identified throughout the school day

Teaching about calculation can take place at many levels, including within the sensory curriculum



Handout 2.1

Calculation activities: appreciating changing quantities

First 10 minutes – what the P levels say

The booklet *Towards the National Curriculum for Mathematics* gives examples of what pupils with special educational needs should be able to do at each P level. In pairs or fours look at pages 10 and 11 for a few minutes and discuss whether the examples:

- extend children's appreciation of quantities;
- help them become aware of changing quantities;
- develop their ability to communicate about changes.

Second 10 minutes – opportunities for practical calculation

List some events in everyday or school life when children experience or need to communicate about changing quantities. They may be lessons, social, practical, creative, exploratory activities or games.

Discuss ways that you might organise such activities to emphasise mathematical learning opportunities.

- What words or phrases might you use to help children learn to anticipate changes, and learn to describe or influence changes?
- How are different children involved at different levels?

Final 10 minutes

Feedback: as a whole group, list some of the activities on a flipchart.

Handout 2.2

A lesson about calculation: 'egg addition'

Children will be learning to:

- experience and respond to fundamental aspects of addition
- experience, anticipate, estimate or calculate successive increase
- create or respond to combinations of groups
- visualise quantities
- associate number words and symbols with quantities
- depict quantities with fingers, pictures, marks or numerals

Starter	Whole class	Group work	Plenary
Resources			
Music tape – One little finger Fingers Egg box of samba eggs	Samba eggs Plant pot Fingers Large numeral cards	Sensory group: two eggs each Communication about change group: five eggs, blue tray, collecting tube, puppet Numerate group: Number line box, polished pebbles, tray, small numeral cards	Select as appropriate from resources used throughout lesson
Activity			
In the class circle, introduce lesson with familiar song to experience and practise counting together Introduce the samba eggs and give one to each child <i>Support</i> – Encourage comment from communicators. Model finger numbers	Around the table collect each child's egg in turn under the plant pot Question to encourage visualisation and finger representation as eggs accumulate Show numeral cards <i>Support</i> – Model finger numbers, ask children to show quantities with their fingers, squeeze children's fingers in sequence <i>Note:</i> Activity could be extended by pupil participation, either controlling the plant pot themselves or directing adult's actions, e.g. telling her to add one or two, or holding up an addition sign	Sensory group Appreciate one, two, none Handle shiny bell eggs and shaker eggs held in one and two hands. Sequential touching Experience or respond to <i>language:</i> touch, hold, another, got one, more, two, none Communication about change group Observe and participate in changing quantities; connect changes to number language. Each time place increasing quantity of eggs in tube and tip them out on to tray. Use puppet to create focus and extend pointing. Experience and respond to <i>language:</i> count, how many, another, more, number words to 5 Numerate group Choose numbered drawers containing pebbles Represent with fingers and recognise numeral cards Using tray, combine groups – find out how many. Use and respond to <i>language:</i> how many, add together, altogether, numbers to 10 <i>Note:</i> May extend activity collecting pebbles on whiteboard, drawing circles around them to join the sets – writing the numerals	In class circle, review the activities and achievements of the lesson. Pupil may demonstrate – adults may model and provide comments that reinforce language and concepts encountered in the lesson Close lesson by emphasising key objectives – teacher or pupil replacing the eggs in the box. Stress the growing quantity in the box – diminishing number on the tray
Key vocabulary			
Number words, show, how many, one, each, all, everybody	Another, one, how many, add another, more, number words		Language of increase as used throughout the lesson; introduce language related to decrease

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Video lesson objectives linked to P levels

P1(i) Pupils encounter activities and experiences. They may be passive or resistant, *for example, they may show simple reflex responses to sounds, to objects coming into their field of vision, to touching or to objects being placed in their hand.* Any participation is fully prompted.

P1(ii) Pupils show emerging awareness of activities, *for example, grasping different objects briefly when they are placed in their hand, showing some awareness that the experience and communications from adults about the objects are connected.*

P2(i) They begin to show interest in people, events and objects. They accept and engage in coactive exploration, *for example, lifting objects briefly towards the face in shared investigations, tracking objects briefly, showing some interest in sequences of objects.*

P2(ii) Pupils begin to be proactive in their interactions. They perform actions, often by trial and improvement, and remember learned responses over short periods of time, *for example, repeating an action with an item of equipment or anticipating another item.*

They cooperate with shared exploration and supported participation, *for example, maintain for some time the handling and feeling objects passed to them or respond when they are offered a second object.*

P3(i) Pupils begin to communicate intentionally. They seek attention through eye contact, gesture, or action.

They participate in shared activities with less support and request events or activities, *for example, use gesture to obtain another item.*

They observe the results of their own actions with interest, *for example, show awareness of losing or gaining as they play giving and taking.*

They remember learned responses over more extended periods, *for example, remembering routines from previous lesson.*

P3(ii) Pupils use emerging conventional communication and may initiate interactions and activities, *for example, dropping objects to prompt responses from adult and anticipating responses about gaining and losing.*

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They may respond to options and choices with actions or gestures, *for example, pointing to or giving one object rather than another, or indicating items that they want in a giving and taking activity.*

They actively explore objects and events for more extended periods, *for example, manipulating objects, collecting in piles, groups or stacks.*

- P4** Be aware of cause and effect in familiar number activities, *associate increase with words like 'another' and 'more'.*
- P5** *When cooperating with others in combining or separating groups, demonstrate they are aware of contrasting quantities, for example, one and lots.*
- P6** Show awareness of vocabulary such as 'more' and 'fewer', *demonstrating understanding in practical situations.*
- P7** Respond appropriately to key vocabulary and questions like 'How many?' *Follow practical instructions to change small quantities, for example, add one/take one away/put two more in the box.*
- P8** In practical situations, add one to or take one away from a number of objects, *taking one item from a known group and indicating how many there are (up to 10), beginning to use vocabulary involved in practical addition and subtraction.*
- NNS Reception** Begin to relate addition to combining of two groups, counting all the objects; extend to combining three groups. Find one more and one less than a given number.
- Begin to relate addition to counting on. Begin to relate addition of doubles to counting on. Find a total by counting on when one group of objects is hidden.
- Separate (partition) a given number of objects into two groups. Select two groups of objects to make a given total.
- Begin to relate subtraction to 'taking away' and counting how many are left. Remove a smaller number from a larger number and find out how many are left by counting back from the larger number. Begin to find out how many have been removed from a larger group of objects by counting up from a number.
- Work out by counting how many more are needed to make a larger number.