The scope of special mathematics

This document describes the **scope of learning opportunities** and activities that schools for pupils with severe or profound learning difficulties need to provide to help their pupils develop mathematical skills and understanding. It draws from the QCA Guidelines for 'Planning, teaching and assessing the curriculum for pupils with learning difficulties'.
It presents material from that document in a clear way , by punctuating the paragraphs into separate listed statements , so that teachers can see a quicker overview of the scope what they should provide for **a range of pupils at each key stage**. This may be helpful to schools outlining schemes of work.

Whilst this document outlines the **scope of learning** it is **P Scales** that describe **levels of learning .**
A separate document is available from the author that takes the p scales for mathematics as written in the 2001 version of the Target Setting book and rearranges them into separate statements that make them much easier for teachers to scan and use.
The author has also prepared a recording bank based upon enhanced P levels and available on CD. Readers interested in this resource may contact the author at the address below.

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The importance of mathematics to pupils with learning difficulties

Mathematics runs through our lives providing ways of exploring, investigating and understanding the world.

It is a tool that supports our practical existence in many ways by helping us make comparisons, identify differences, investigate relationships and establish connections. We use these processes in our everyday lives -- and to support our learning in subjects across the curriculum during the school years.

Even in the earliest days our lives we have instinctual interest and appreciations of quantity, sequence, pattern and change; building upon these fundamental mathematical inclinations is vital to everyday life and learning.

The scope of special maths

Lessons for pupils with very special needs should focus on and build upon fundamentals, there is a great deal of mathematics to be learned before counting can be effectively learned and learning about counting itself involves the co ordination of many skills. Beyond counting special pupils need broad practical and learning experiences, to develop their appreciation of estimation, calculation, shape space etc.

Mathematics lessons and maths encountered across the curriculum offer pupils with learning difficulties opportunities to:

•Build on their awareness of events and actions and recognise changes in pattern, quantity and space that occur in their lives, both the immediate environment and in the wider world.

•Use their developing awareness to anticipate and predict changes.

•Use their awareness and developing understanding of pattern, space, shape and number, to develop problem-solving skills that contribute to making choices, taking decisions and gaining control over their immediate environment

•Extend mathematical skills, experiences and understanding which enable them to visualise, compare and estimate. For a few special pupils this may be achieved in abstract as well as concrete contexts.

•Begin to think about the strategies they use and explain them to others.

•Develop a powerful set of thinking tools to help them increase their knowledge and understanding of the world and, during the school years, to learn effectively in different subjects across the curriculum.

The nature of progress for special pupils.

The QCA guidelines recognise that special pupils may not climb the ladder of **Vertical Progress** at the same rate as their peers. Special pupils need time and wide experience to consolidate learning and apply it in wide circumstances – QCA describe this as **Horizontal Progress.** They also recognise that for some pupils who suffer degenerative conditions it is the schools role to support the pupil in **Maintaining Skills.**

When we observe the progress of typical children following the mathematics curriculum we usually look for increasing ability to manipulate number symbols in the processes of calculation. For special pupils who are developing fundamental understandings and

practical skills we need to be aware of different ways in which we might see them progress.

Pupils can make progress in mathematics by:-

•Developing their attention to **sensory properties** to encompass an appreciation of **mathematical properties** – *Appreciation of quantity, changes, sequence, shape space etc*

•Learning to use such information to anticipate, predict, and then actively respond to, or solve problems.

•Developing the ability to form mental representations, for some pupils these may be the most elementary of visualisations , for others representations may become ever more complex or abstract or symbolic, in the ways they represent information and enable the children to use and manipulate it.

•Increasing the breadth of their mathematical experience and their ability to apply it

•Communicating their understanding to others with increasing clarity

•Using mathematical information to make choices and decisions in an increasing range of contexts.

The scope of learning in Special Mathematics

The range of opportunities and activities at Key Stage One

Pupils at key stage 1 are encouraged to explore and to investigate using both familiar, preferred contexts as well as new events designed to attract their interest and curiosity. Teachers may modify the KS1 programmes of study to ensure that pupils have access to appropriate learning experiences.

Modification may involve

- Differentiated expectations – providing experience whilst recognising various outcomes as appropriate.
- Differentiation by support – providing resources, physical support, prompts or modelling etc.
- Selecting related content from corresponding areas of the programmes of study for earlier key stages and presenting it in age-appropriate contexts

The focus of teaching mathematics at key stage 1 may be on extending early learning experiences giving pupils opportunities to:

- Explore their environment to get first hand experience of differences in space, shape and quantity
- Develop an awareness of simple patterns and relationships
- Use this awareness to anticipate and predict within routines or familiar situations
- Develop a system for communicating this awareness and,
- Where appropriate, start to acquire specific mathematical language (including number words) in familiar or everyday practical contexts
- Take part in activities that involve counting.

All Pupils including those with profound learning difficulties

Should have opportunities to

- Develop their awareness of events in their immediate world through experience or exploration.
- They may develop awareness of pattern and quantities (1, 2, 3 and lots) in sequences of sounds or other sensations.

Most pupils (including those with severe difficulties in learning)

Should have opportunities to learn to

- Respond to mathematical information including position, shape and small quantities in active exploration, investigation and play.
- Begin to make connections, for example, in a short, familiar sequence they connect an event with the one that usually follows.
- They begin to share in aspects of counting tasks in concrete situations.

A few pupils will

- count small numbers in everyday contexts and
- use their knowledge of the sequence of numbers to develop early reasoning in mathematical situations.

•They start to use mathematical language and to use their counting skills when they solve simple,
practical problems.
•They can be helped to develop a system for recording, *for example, a tally syste*m.
• They make simple measurements by direct comparison.

Examples of opportunities and activities at key stage 1

Some parts of the key stage 1 programme of study may be too demanding for some special pupils. Staff will need to use their judgement, together with knowledge of each pupil's attainment and pace of learning, before making decisions about the application of particular parts of the subject. may become less demanding as pupils get older, but it may not be appropriate to teach these parts to some pupils during this key stage. It may be more appropriate to draw on materials from Curriculum guidance for the foundation stage.

Pupils at key stage 1 are encouraged to explore and to investigate using both familiar, preferred contexts as well as new events designed to attract their interest and curiosity. The following opportunities and
activities should complement the planning guidance in the framework for teaching mathematics from reception to year 6 and focus on supporting the earliest stages of the development of mathematical skills and understanding.

Number patterns

Pupils develop an awareness of number patterns in number activities

They may:

•Experience number patterns in a variety of contexts: visual, auditory, kinaesthetic and tactile,

for example,

-They feel beats of one and two on a resonance board,

-They see another child jumping one, two and three times,

-They hear two short rings of the school bell to indicate that it is dinner time.

With repetition, they show signs of anticipation by waiting or becoming still

•Shift their attention between one, two or three less familiar or new events or items,

for example,

-Look briefly at the first and then the second, or even third, puppet as it appears noisily before them, and then look back at the first

- Observe two items being hidden, for example, in sand, water or bubbles, and search for both of them or indicate an awareness that there is another by looking towards its location

-Make identical simple patterns, for example, taking turns to shake maracas twice, to put two marks on each picture of a ladybird, to knock two towers down.

Number skills

•Pupils develop a knowledge of some of the skill elements of counting in number activities

They may:

- Respond to familiar counting rhymes and demonstrate an understanding of the distinct context, for example, making appropriate gestures or actions

-Share in some aspects of the counting task, for example, through pointing or tagging as each item is counted or communicating the sequence of number words.

Understanding of space

•Pupils develop an understanding of space, position and movement in work on shape, space and measures

They may:

-Locate sources of sensation, for example, turning towards lights or sounds.

-Locate familiar items or people in the usual places.

-Communicate where an item is missing or not in an expected location

-Follow a sequence of stepping stones between each activity.

Understanding of shape

•Pupils build up their knowledge of the properties of shape in work on shape, space and measures.

They may:

-Explore the properties of shapes, for example, feeling outlines, straight lines, angles or curves,

-Demonstrate an awareness of these features by choosing to group items with straight or curved edges together.

Choose shapes to build the highest tower.

- Adjust their grasp to fill a jar with handfuls of smaller items, for example, butter beans or sand , locate the posting hole for shapes and select the shapes that fit into it.

Communicating

•Pupils communicate about their mathematical experiences

They may:

-Record that they have taken part in an activity, for example, by using symbols

-Respond to mathematical language by demonstrating that they recognise simple shape and space vocabulary, for example, round, flat, top, bottom, inside.

The scope of learning in Special Mathematics

The range of opportunities and activities at Key Stage two

Many aspects of the programmes of study at KS2 are relevant to pupils with learning difficulties, with modification they can provide stimulating and challenging learning opportunities.
Modification may involve: -

- Differentiated expectations – providing experience whilst recognising various outcomes as appropriate.
- Differentiation by support – providing resources, physical support, prompts or modelling etc.
- Selecting related content from corresponding areas of the programmes of study for earlier key stages and presenting it in age-appropriate contexts

Pupils at key stage 2 are encouraged to respond to concrete, practical activities, - QCA guidelines note that activities need to capture and hold pupils' attention. Pupils are encouraged to form mental images and communicate about these, either indirectly through their actions or directly through language. - Asking pupils to estimate and make predictions encourages mental representation.

The focus of teaching mathematics at key stage 2 may be on extending the learning experiences of previous key stages,giving pupils opportunities to:

- Use their awareness of space, shape and quantity in responding to the environment
- Compare, contrast and be aware of similarities and differences in shape, space and aspects of measurement
- Match and sort, selecting their own criteria
- Learn to count and use counting to find out 'how many?'
- Add and subtract in practical contexts
- Use numerals to represent amounts and respond appropriately to mathematical symbols
- Represent mathematical information in different forms and be able to make simple deductions.

All pupils with learning difficulties (including those with the most profound disabilities)

- Encounter mathematical information relating to space, shape and quantity, and anticipate events and actions.
- Their emerging awareness informs their actions and they may modify their responses to achieve desired objects or events.
- With help, they respond to patterns, *such as sounds or tactile cues,* with anticipation.
- Their reactions show their awareness of changes and differences in position or location and the relationship between objects in the environment.

Most pupils with learning difficulties (including those with severe difficulties in learning)

- use mathematical information to anticipate events, predict outcomes and to solve simple problems.
- They begin to recognize relationships and use information about objects to sort and match.
- The development of mathematical language and understanding helps them
  apply labels to small quantities,
  recognise and describe shapes by name,
  and describe positions in space.
- Increases in their attention span and confidence help to extend their counting skills and their ability to represent data by recording numbers.

Given these opportunities in mathematics at key stage 2:

A few pupils with learning difficulties

- count reliably and solve simple number problems in more abstract situations.
- They begin to understand the rules or principles of counting and use their knowledge for checking.
- They develop confidence in the sequence of numbers -- and understand more and less.
- They carry out simple additions and subtractions.
- With encouragement, they use mathematical language to communicate position, and to compare,

*for example,differences in size, weight or quantit*y.

- Mathematical language and understanding helps pupils solve simple spatial problems.
- Pupils begin to present data in different formats. With help, they interpret this data and make simple deductions.

Some examples of appropriate activities and learning opportunities relating to

- ***Developing Counting***
- ***Shape space and measures***
- ***Handling Data***

are given on pages 141 and 15 of 'Planning, teaching and assessing the curriculum for pupils with learning difficulties – Mathematics' QCA 2001

<u>Examples of opportunities and activities at key stage 2</u>

Some parts of the key stage 2 programme of study may be too demanding for some pupils. Such parts may become less demanding as pupils get older, but it may not be appropriate to teach these parts to some pupils during this key stage. It may be more appropriate to teach the more demanding parts of the programme of study for key stage 1. Throughout key stage 2, staff can maintain and reinforce the knowledge, skills and understanding introduced during key stage 1 by applying these in different areas, and introduce new learning.

Pupils at key stage 2 are encouraged to respond to concrete, practical activities and to form
mental images and communicate about these either indirectly through their actions or directly through language. Activities need to capture and hold pupils' attention. Asking pupils to estimate and make predictions encourages mental representation.

As with key stage 1, the following opportunities and activities complement the planning guidance in the framework for teaching mathematics from reception to year 6 and support the earlier stages of developing mathematical skills and understanding.

Developing counting

Pupils consolidate their understanding of number, including their counting skills, and use
counting as a tool when they work on number activities

They may:

-Recognise sequences of sensation or movement and anticipate the next occurrence in sequence, for example, '1, 2, 3, go'
-Use their knowledge of number to anticipate an event, for example, when simple play routines have been established, such as variations of 'two bears diving into the water' or 'two mice appearing from their hole'
-Count reliably to 10 and recognise that 'one more' is the next number in the sequence and
'one less', the number before
-Count reliably and solve simple number problems in more abstract situations.
-They begin to understand the rules or principles of counting and use their knowledge for checking.
-They develop confidence in the sequence of numbers and understand more and less.
-They carry out simple additions and subtractions.
-With encouragement, they use mathematical language to communicate position, and to compare, for example, differences in size, weight or quantity.
-Mathematical language and understanding helps pupils solve simple spatial problems.
-Pupils begin to present data in different formats. With help, they interpret this data and make simple deductions.
-Represent numbers using fingers, their own tally system of marks and then conventional numerals, for example, keep a note of how many items are in the box, how many goals have been scored, how many pennies are in the purse
-Estimate the number of items and use counting to confirm the result, for example, when watching items being put into a tin
-Use their perception to estimate and then count to find out which group is larger or smaller.

Shape, space and measures

Pupils make direct comparisons between everyday objects in their environment as they work on shape, space and measures

They may:

-Shift their gaze between items and respond selectively to them, *for example, smiling at preferred events, reaching out for an item nearby*

-Compare and make choices on the basis of length, weight, height, for example, in circuit training or carrying shopping
-Devise their own criteria to sort and match items and guess what criteria others have used
-Recognise a time sequence of activities, begin to use a symbolic diary to understand the order of their day, and know times at which key events occur
-Make and follow a mathematics trail to find a particular location, for example, where the 'treasure' is hidden.
-Devise and use a non-standard measure for comparing two different things, for example, use the length of their reach.

Handling data

***Pupils represent information and communicate it to others in work on handling* data**

They may:
-Recognise that a symbol is associated with an event, person or object, for example, show anticipation of an event, look for the person whose photograph is in the set, 'in class today'
-Use a list, sorting circles, tally or simple block graph to represent data
-Interpret data, for example, to find which set has more, less or most.

The scope of learning in Special Mathematics

The range of opportunities and activities at Key Stage three

There are many aspects of the programmes of study at KS3 that at their fundamental levels are relevant to pupils with learning difficulties, appropriate interpretation that relates those aspects to pupils lives and needs can provide stimulating and challenging learning opportunities.
Modification may involve:-

- Differentiated expectations – providing experience whilst recognising various outcomes as appropriate.
- Differentiation by support – providing resources, physical support,prompts or modelling etc.
- Selecting related content from the corresponding areas of the programmes of study for earlier key stages and presenting it in age-appropriate contexts

The focus of teaching mathematics at key stage 3 may be on extending the learning experiences of previous key stages, and modifying the content of KS3 programmes of study so that pupils explore the fundamental meaning or practical implications in appropriate ways.

Giving pupils opportunities to:
•Form concrete and mental representations and images that help them see connections
•Recognise more subtle and relative cues, involving space, shape, position and number that match their circumstances and maturity,
•Develop mathematical language to support communication, *for example, describing features of shape and proportion*
•Use counting in a variety of contexts and to support problem solving
•Use and understand mathematical symbols in their immediate and wider environment
•Use measures to support everyday activities and to explore and investigate aspects of the wider environment
•Recognise the importance of strategies for checking or monitoring their mathematical (and practical number) solutions.

All pupils with learning difficulties (including those with the most profound disabilities)

•Encounter a range of mathematical representations or images in different relevant contexts relating to space, shape and quantity.
•They may develop mental representations or images based on concrete objects and events and respond more consistently to differences in number, size and location.
•Pupils may begin to use information about number, size, location and pattern or sequence in their choice of objects or actions and communicate their choice.

Most pupils with learning difficulties (including those with severe difficulties in learning)

•Apply counting skills to making sets, adding and subtracting objects from their sets in a variety of practical contexts, including those involving money.
•They count up to 10 with increasing reliability and confidence.
•They may recognise pattern and symmetry and use this information to make predictions.
•They use and understand directional symbols in their immediate and wider environment.
•Through experience most pupils will extend their understanding of mathematical language, including the vocabulary of proportion, in everyday contexts and will reason using mathematical language, *for example, 'one fewer', 'one more' and 'half'*.

A few pupils with learning difficulties

•extend their understanding to relational or relative terms and are able to compare and contrast, to order and to sequence, *for example, they respond to mathematical terms such as 'tallest' and 'first' by selecting and placing an object in the appropriate position on a lin*e
•They carry out more complex mathematical tasks involving repeated addition or multiplication and
sharing or division and understand the relevance in practical, everyday contexts.
They use symbols with more confidence and think in abstract terms about numbers.
They use standard measures, including units of time, length and mass, and make comparisons.

Some examples of appropriate activities and learning opportunities relating to
•Solving number problems
•Shape space and measures
•Handling Data
are given on pages 18 and 19 of 'Planning, teaching and assessing the curriculum for pupils with learning difficulties – Mathematics' QCA 2001

Examples of opportunities and activities at Key Stage 3

Throughout key stage 3, staff can maintain and reinforce the knowledge, skills and understanding introduced during key stages 1 and 2, by applying them in different contexts, and introduce new learning.

The following activities indicate ways in which the mathematical skills and understanding can be developed.

Solving number problems

Pupils develop strategies to support their use of number skills to solve problems when they work on number and algebra activities

They may:
-Recognise sequences in familiar activities and contexts, *for example, the sequence of food sections in the supermarket*
-Develop a consistent response to number-related vocabulary, *for example, monitor their actions to add two spoonfuls of sugar, take one biscuit, take three steps, have two people join an activity*
-Monitor their own and others' counting to identify and communicate mistakes that have been made.
-Understand that counting can be used to make sets
-Compare amounts and count on or count back to calculate how much more or less count on to calculate change.
-Appreciate when common words are used as mathematical language
-Respond to and use mathematical symbols
-Select a strategy or tool to make calculations, *for example, use tally marks, fingers or a calculator to add or subtract items.*

Shape, space and measures

Pupils work on shape, space and measure

They may:
-Manipulate objects, explore and use different approaches to overcome difficulties when solving problems of space, shape or measure, *for example, use items as containers, turn items round to fit into a space, press air out of the item to reduce its size.*
-Use mathematical cues to identify an item, *for example, select an object from a set when given clues about its shape or size*
-Make comparisons, estimate and use standard measures in everyday activities, *for example, to weigh ingredients, to mark out a given gardening plot*
-Respond to, use and understand directional symbols, *for example, be able to follow arrows and to place them appropriately*
-Recognise the time at which familiar, regular events take place, tell the time on the hour and half hour and use this information, *for example, to plan when they should start organising the tuck shop, get ready for lunch, tidy up.*

Handling data

Pupils work on handling data

They may:
-Organise concrete or symbolic information so that they can understand and use it
-Use numerical information to solve problems, *for example, use a clock face to work out who ran fastest*
-Understand how to read and interpret a simple scale, *for example, the television display showing volume of sound, the board showing the depth of the water in the pool*
-Represent data through a variety of formats that describe and enable them to compare information about important features in their lives, *for example, individual graphs about swimming performance, group graphs on youth club activities.*

The scope of learning in Special Mathematics

At Key Stage Four

Throughout key stage 4 staff can maintain and reinforce knowledge, skills and understanding introduced during key stages 1, 2 and 3, by applying them in different contexts, widening the scope of application and introducing new learning.
Particular emphasis at key stage 4 is placed on pupils using and applying their mathematical skills and knowledge to make choices and decisions. Contexts for mathematical activity will include the work pupils undertake as part of accredited schemes, *for example, Bronze Youth Awards, Transition Challeng*e.

The focus of teaching mathematics at key stage 4 may be on giving pupils opportunities to:

- Recognise symbols and mathematical representations and understand their significance in both the immediate and wider environment.
- Respond strategically to quantities and numerical information, from estimations, counts and measurements including time, to make choices and decisions, to plan and to anticipate outcomes .
- Communicate their choices to others, increasingly with explanations of their reasoning.
- Use mathematical knowledge and understanding to respond strategically to issues, including selecting and collecting relevant data, representing data and drawing conclusions from it.

All pupils with learning difficulties (including those with the most profound disabilities)

•Encounter a range of mathematical representations or images in different relevant contexts relating to space, shape and quantity.
•They may develop mental representations or images based on concrete objects and events and respond more consistently to differences in number, size and location.
•Pupils may begin to use information about number, size, location and pattern or sequence in their choice of objects or actions and communicate their choice.

Most pupils with learning difficulties (including those with severe difficulties in learning)

•Numerical information has meaning in a range of contexts and pupils are able to calculate for a purpose in a variety of practical situations.
•Use a clock, with support, to track time during the day and begin to tell the time on the hour and half-hour.
•Use practical experience of standard measures to plan measuring and to solve problems.
•As well as making individual measurements confidently, they compare measurements and extend their ability to estimate and make predictions.

A few pupils with learning difficulties

•Think strategically using mathematical knowledge and understanding,
•Communicate their reasoning and describe their strategy.
•They respond to problems, selecting the practical approach and mathematics they wish to use.
•With encouragement, they are able to evaluate their success and reflect on whether their mathematical strategy was correct.

Examples of opportunities and activities at Key Stage 4

Throughout key stage 4, staff can maintain and reinforce knowledge, skills and understanding introduced during key stages 1, 2 and 3, by applying them in different contexts, and introduce new learning.
Particular emphasis at key stage 4 is placed on pupils using and applying their mathematical skills and knowledge to make choices and decisions. Contexts for mathematical activity will include the work pupils undertake as part of accredited schemes, *for example, Bronze Youth Awards,Transition Challenge*.

Making choices

Pupils apply their mathematical skills and knowledge to make choices and decisions, which helps them work individually and as part of a group

They may:

-Learn and devise new symbols, including signs that are personal to them or community signs and symbols, *for example, road signs, shop signs, symbols used in timetables including TV and travel*

-Use their understanding of quantity and number, estimate, count and calculate to solve practical problems, *for example, 'Is there enough bread for lunch?', 'Do we have enough teabags?' or 'How much money do I need to buy this?'*

-Use their understanding of the vocabulary of shape and space to inform their actions and those of others, *for example, selecting the large one or the packet with triangles or requesting the seat at the back*

-Use their understanding of fractions and proportion, *for example, to cut a pizza into quarters, fold the paper in half, use twice as much flour as fat in a mixture*

-Recognise amounts of money, displayed in different ways, and use their knowledge and understanding of money when buying items

-Use measures including standard measures to inform decision making, *for example, 'How much sugar do we need?' 'Do we have enough butter to make biscuits?' 'How much should we buy?'*

-Use symbolic diaries to understand the order of their day and simple timetables, *for example, to plan TV viewing or radio listening, to find the starting time of films, to know when buses, coaches and trains should arrive and depart.*

-Extend their understanding of duration to estimate how long the journey takes and work out the appropriate departure time from home or school

-Collate group or individual data and decide how to represent it to others, and consider the implications of their decisions, *for example, presenting information appropriately for a prospective college tutor or a work experience employer.*