RED ROSE SCHOOL – MATHEMATICS POLICY

Updated: December 2022

Sec 3 Chapter

8

All policies are to be read in conjunction with the School's statement of its goals (Sec 1 Chap1),
ethos (Sec 1 Chap3) and
curriculum planning (Sec 3 Chap 4).
This policy outlines the purpose, nature and management of the Numeracy taught at Red Rose School

IMPORTANCE OF MATHEMATICS

Mathematics is a creative and highly inter-connected discipline that has been developed over centuries, providing the solution to some of history's most intriguing problems. It is essential to everyday life, critical to science, technology and engineering, and necessary for financial literacy and most forms of employment.
A high-quality mathematics education therefore provides a foundation for understanding the world, the ability to reason mathematically, an appreciation of the beauty and power of mathematics, and a sense of enjoyment and curiosity about the subject.

It is essential that our pupils understand the importance of mathematics and the key concepts and processes. Our aim is to strive continuously to get all of our pupils to fulfil their potential despite their learning difficulties.

Mathematical thinking is important for all members of a modern society as a habit of mind for its use in the workplace, business and finance; and for personal decision-making. Mathematics is fundamental to national prosperity in providing tools for understanding science, engineering, technology and economics. It is essential in public decision-making and for participation in the knowledge economy.

Mathematics equips pupils with uniquely powerful ways to describe, analyse and change their world. It can motivate pleasure and wonder for all pupils when they solve a problem for the first time, discover a more elegant solution, or notice hidden connections.

Pupils who are functional in mathematics and financially capable are able to think independently in applied and abstract ways, and can reason, solve problems and assess risk.

Mathematics is a creative discipline. The language of mathematics is international. The subject transcends cultural boundaries and its importance is universally recognised. Mathematics has developed over time as a means of solving problems and also in its own right.

Aims

As with the statement in the national curriculum for mathematics, our policy aims to ensure that all pupils, within any restrictions of their SpLD, reach their potential to:

- become **fluent** in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately.
- **reason mathematically** by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language
- **solve problems** by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions.

Mathematics is an interconnected subject in which pupils need to be able to move fluently between representations of mathematical ideas.

The programmes of study are, by necessity, organised into apparently distinct domains, but pupils should make rich connections across mathematical ideas to develop fluency, mathematical reasoning and competence in solving increasingly sophisticated problems. They should also apply their mathematical knowledge to science and other subjects.

Pupils will move through the programmes of study at different paces according to their SpLD. Decisions about when to progress will always be based on the security of pupils' understanding and their readiness to progress to the next stage.
Pupils who grasp concepts rapidly will be challenged through being offered more complex problems before any acceleration through new content. Those who are not sufficiently fluent with earlier material will be allowed to consolidate their understanding, including through additional practice, before moving on.

Information and communication technology (ICT)

Calculators should not be used as a substitute for good written and mental arithmetic. They should therefore only be introduced near the end of key stage 2 to support pupils' conceptual understanding and exploration of more

complex number problems, if written and mental arithmetic are secure.
Teachers will use their judgement about when ICT tools should be used.

Spoken language

The national curriculum for mathematics reflects the importance of spoken language in pupils' development across the whole curriculum – cognitively, socially and linguistically.
The quality and variety of language that pupils hear and speak are key factors in developing their mathematical vocabulary and presenting a mathematical justification, argument or proof.
They must be assisted in making their thinking clear to themselves as well as others and teachers should ensure that pupils build secure foundations by using discussion to probe and remedy their misconceptions.

EXTRACTS FROM NATIONAL CURRICULUM PROGRAMMES OF STUDY FOR MATHEMATICS SEPTEMBER 2013
See Annex A

Due to SpLD or related difficulties our pupils will make mathematical progress at different levels, within different areas and at different rates. For example, one pupil may have a strength in visual/spatial processing and therefore be able to manage higher order mathematics processing. However, if the pupil also has short-term "working" memory difficulties he will make errors when doing mental calculations. Where pupils have both short-term working memory difficulties and visual/spatial difficulties they are more likely to experience significant mathematical difficulties.
Also, for pupils with co-morbidity of dyslexia their difficulties are often not as significant in mathematics because a major part of their problem had been their inability to read and understand mathematical problems.

We will use this framework and programmes of study to influence our mathematics programmes of study and, in particular using the national curriculum attainment targets.
We have created a spreadsheet to show the progress of our pupils against the national curriculum.

MATHEMATICS & SpLD

The understanding of mathematical difficulties for persons with SpLD has been the subject of detailed research since the 1950s. The developments and consensus regarding 'labelling' remains uncertain. Moreover, the co-morbidity of mathematical difficulties with other learning difficulties is clearly understood. For example, for many years, the term Dyscalculia has been understood and accepted to represent mathematical learning difficulties.

DYSCALCULIA

The information processing problems which cause pupils to experience difficulties of a dyslexic nature e.g. short term memory, the sequencing and organisation of information and the speed of information processing can also cause difficulties in many areas of mathematics. The term often given to describe this is dyscalculia.

Dr Sionah Lannen, 2009: Red Rose School;
Chartered Educational Psychologist

Gross (2007) has proposed a 'pragmatic stance on the emerging dyscalculia label' whereby:

> *'educational psychologists might want to adopt the scientifically less interesting but educationally more useful approach of taking dyscalculia by its literal meaning (an inability to calculate). They can then start from the assumption that all children who struggle with numbers of the number system are to some extent dyscalculic'.*

The proportion with severe specific difficulties in mathematics is estimated at around 6%.

(Bynner and Parsons, 1997 and 2005; Every Child a Chance Trust, 2008)

There is a significant overlap between diagnoses of dyslexia and dyscalculia, ranging from 20% to 60% in different studies.

(Butterworth and Yeo, 2004)

In 2013 the term Dyscalculia was removed from the American Diagnostic & Statistical Manual of Mental Disorders (DSM 5), replacing it with a **Specific learning disorder with impairment in mathematics.** Our policy regarding mathematical learning difficulties is:

- we will continue to use the label Dyscalculia
- Dyscalculia is co-morbid with other learning difficulties
- As such, the pedagogical strategies and educational approaches are the same for most SpLD.

NATURE OF DYSCALCULIA DIFFICULTIES

The nature of the difficulties which are experienced by pupils with dyscalculia include the following:

✓ the learning of number bonds

✓ the learning of multiplication tables

✓ the understanding of concepts involving directionality, time and spatial concepts

✓ sequencing activities

- ✓ orientation - confusion can arise through having to process different operations in different directions spatial awareness

- ✓ visual discrimination resulting in confusion of signs

- ✓ mental arithmetic (mental manipulation of number/symbols in short term memory)

- ✓ maths language - can be at the root of many problems. General mathematical terminology with words like **perimeter, value** and **equals** may be unfamiliar. It is interesting to ask a class to define the word 'equals' and discover the many different replies, perhaps most commonly that it means 'answer'. These words all need to be clearly understood before they can be used in calculations. To complicate matters further, one single mathematical process can be described with a wide variety of terms. For instance, **multiply, times**, **product, of** or **add**, **increase**, **plus**, **sum** and **total.**

- ✓ the most consistent finding is that many have particular difficulty in retrieving arithmetic facts resulting in an excessive reliance on counting strategies, at an age when other children of the same age are relying much more on fact retrieval.

- ✓ word problem solving

- ✓ multi-step arithmetic

Pupils with dyscalculia are better at 'doing' than at 'naming' and a foundation of 'doing' is essential.

IT IS NOT A HIERARCHY

There is by now overwhelming evidence that arithmetic is not a single unitary ability at which people are either ‘good’ or ‘bad’. Mathematics has an interrelating/ sequential structure, but:

- ✓ several have suggested that it is not possible to establish a strict hierarchy whereby any one component invariably precedes another component

- ✓ though certain specific components may frequently form the basis for learning other specific components, they need not always be prerequisites

- ✓ though the different components often correlate with one another, weaknesses in any one of them can occur relatively independently of weaknesses in the others.

- ✓ weakness in even one component can ultimately take its toll on

performance in other components, partly because difficulty with one component may increase the risk of the pupil relying exclusively on another component, and failing to perceive and use relationships between different arithmetical processes and problems

- ✓ a pupil may perform well at an apparently difficult task (e.g. word problem solving) while performing poorly at an apparently easier component (e.g. remembering the counting word sequence).

When pupils fail at certain tasks, they may come to perceive themselves as 'no good at maths' and develop a negative attitude to the subject.

The situation may be further complicated by the fact that children with mathematical difficulties can show seemingly random variations in their performance from day to day (Houssart, 2007).

RELATIONSHIP BETWEEN MATHEMATICAL DIFFICULTIES AND OTHER AREAS OF COGNITION

Most researchers do agree that mathematical difficulties are often, though not always, correlated with problems in other areas, and can be linked to:

- ✓ language difficulties
- ✓ spatial difficulties and / or
- ✓ difficulties with aspects of memory

(Chinn, 2004; Dowker, 2004, 2005; Gifford, 2005; Hannell, 2005).

LANGUAGE DIFFICULTIES

Language difficulties can affect pupils' ability to understand and make use of instruction, and their ability to encode and represent mathematical information. It also affects their ability to reflect on their own difficulties and work out useful strategies or ask effectively for help.
There are many reasons why pupils may find it difficult to monitor their own mathematical thinking, and most young children have limitations in doing so, but certainly language difficulties are likely to increase the problem.
Moreover, pupils with even mild language difficulties are likely to have difficulty in rote memory for mathematical information, such as the counting sequence, and, later on, arithmetical facts such as multiplication tables.

VISUAL-SPATIAL DIFFICULTIES

Visual-spatial difficulties will have a particularly direct impact on such topics as geometry and measurement, but may also affect arithmetic. Severe spatial difficulties may affect children's internal representations of numbers.
There is much evidence that most of us represent numbers and their relationships on an internal number line, though it is less clear to what

extent this is affected by individual differences in spatial ability within the normal range. Moreover, visual-spatial difficulties may affect children's ability to set out numbers and arithmetic problems in written form, and their ability to use and understand some of the concrete materials used in teaching arithmetic.

MEMORY DIFFICULTIES

Memory difficulties that affect arithmetic can be of two main sorts:

- ✓ problems in storing and/or retrieving arithmetic facts in long-term memory
- ✓ and problems with working memory: organising and keeping track of items and their order in memory while using these to solve problems.

Problems with working memory can have particular impact on mental arithmetic, where children may have trouble in keeping track of their steps in solving an arithmetic problem and may forget the first step in solving an arithmetic problem by the time they get to later steps.
This difficulty may be one reason for the fact that multi-step arithmetic is one of the aspects that children often find difficult.

Difficulties in arithmetic are sometimes associated with rather specific memory problems for numbers – in which case it can be hard to tell which is cause and which is effect, but such difficulties are sometimes associated with broader problems in verbal memory, spatial memory or both.

PRINCIPLES OF INTERVENTION

Interventions should be individualised; but that in many cases they do not need to be very time-consuming or intensive to be effective.

Interventions that focus on the specific components with which a particular child has difficulty are likely to be more effective than 'one size fits all' programmes. Therefore, intervention schemes should involve assessments of children's specific strengths and weaknesses within mathematics so that each individual child's weaknesses can be targeted effectively.

Dowker (2004)

ACT THINGS OUT IN THE RIGHT ORDER!

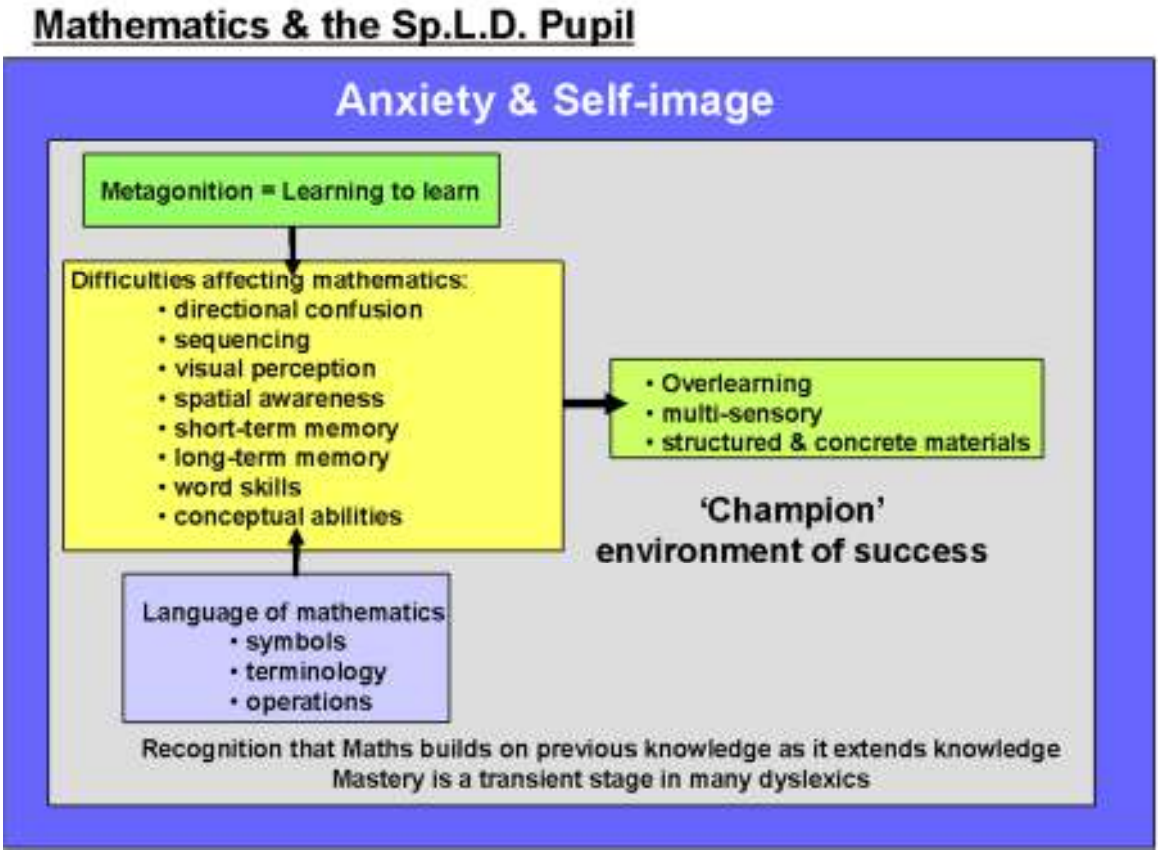
Since the central problem is likely to be that of relating symbols to the operations which they represent, it makes good sense for the pupil to first carry out the operations using **structured materials**. Then they should be shown how to **describe symbolically** what they have been doing.

The great advantage of using structured materials is that they ensure that 'doing' comes first and 'naming' afterwards. If the order is reversed, one is essentially confronting the pupil with dyscalculia with a mass of bewildering symbols and technical terms while not letting him/her have any clear idea of what he/she is supposed to do with them.
Once the necessary foundations have been acquired by 'doing', however, abstract reasoning, generalisations and discoveries should then follow.

MULTISENSORY TEACHING

When teaching Maths to pupils with dyscalculia therefore, the principles of multisensory teaching (visual, auditory, tactile-kinaesthetic) which apply to language work should also apply mathematics. For example, new mathematical concepts and processes should be introduced using concrete materials, diagrams, pictures and verbal explanation. Then the pupil should be asked to explain the process, instructions etc. in his/her own words.
Progress should be carefully monitored at each stage, checking that a particular concept has been thoroughly mastered and understood before moving on to the next step.

To benchmark mathematics for our staff, we have drawn together all of the various interacting factors as shown in the diagram below:



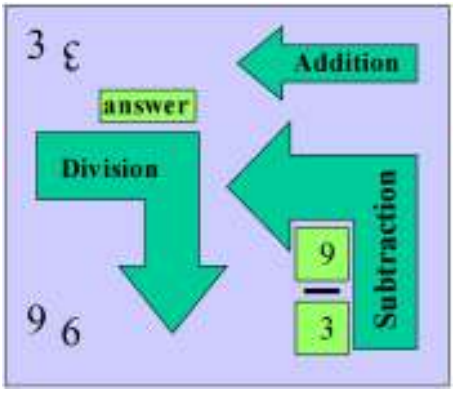
FACTORS WHICH MAY CONTRIBUTE TO LEARNING DIFFICULTIES IN MATHEMATICS

Different pupils bring different combinations of strengths and weaknesses to mathematics. These will interact with the subject and the learning situation to create different levels of success and failure.
Research has looked at deficits, which may affect performance in mathematics. These deficits combine to form a large part of the picture of what the pupil brings to the problem. Each deficit may make a different contribution to the overall problem, ensuring an enormous range of variation among pupils, which is typical of SpLD. A knowledge of the deficits provides a general background, which you must have firmly fixed in your mind as you individualise your approach to each pupil or as you work with a group.

POTENTIAL AREAS OF DIFFICULTY IN MATHEMATICS

DIRECTIONAL CONFUSION

Children may write numbers backwards, or may be confused by the inconsistent 'starting points' of algorithms, e.g. addition, where the child starts at the right and works left. Subtractions, where the child starts at the bottom right and has to remember to 'take' the lower number from the top number, 'borrow' from the left upper number and move left. Long division, where the child has to start at the left and move right and downwards while writing the answer at the top.



SEQUENCING PROBLEMS

It may be difficult for a child to count, especially using one-to-one correspondence. It is frequently difficult for a child to count backwards. Children may write 18 as 81 (which has some logic) or 26 as 62 (which doesn't). They may have difficulty remembering the sequence of steps to follow for long division. It may be difficult for a child to see a sequence.

VISUAL PERCEPTUAL DIFFICULTIES

The pupil may confuse +, -, - and x (especially if written carelessly) or 6 and 9 or 3 and 5.

SPATIAL AWARENESS

Spatial awareness is needed for work such as place value or distinguishing between 2 and z or three-dimensional geometry. In the classroom the pupil

may lose his place on the page (or board) from which he is copying. He may not be able to relate two-dimensional drawings to three-dimensional shape they represent.

MEMORY DIFFICULTIES

Once information is recorded and integrated, it must be stored so that it can be retrieved later. In general, there are two types of memory: **short term** and **long term**. Short term memory is what you remember as long as you are paying attention to it.

Short-term (working) memory

Poor short-term memory can create several areas of difficulty and has a strong influence on how a pupil processes numbers. Deficits in short-term memory combined with long term memory deficits create major problems. For example, a child trying to add 47 and 78 mentally has to hold the sum in his memory, probably work out 7 +8 (poor memory for basic facts), remember 5, carry 1, remember that he has to add 4 and 7 (and carry 1), work out 7 +4 +1, recall the 5 and put them all together in the right sequence 125.

Short term memory difficulties may even prevent a pupil from starting a problem: he may simply forget some or all of the teacher's instructions or, if his short term memory is overloaded, he may be left with absolutely no clues as to where to start. The pupil may not be able to 'hold' the visual image of the sum he is trying to solve. He may not be able to hold the sum in visual or auditory memory while he searches for a necessary number fact. (Indeed the working out of that fact, say 9 +6 by counting on, may overload the memory and leave him not remembering the initial sum.)

Long-term memory

Rote learning as a means of loading information into long-term memory is rarely effective with dyslexics, though teachers still persist in trying. Pupils with SpLD have significant difficulties learning basic facts such as times tables. This is particularly frustrating for parents who encourage the child to practise until he achieves mastery one day to find that the child had forgotten again soon after. Poor long-term memory may also handicap other areas of mathematics, such as recall or algorithms (methods) or formulae.

THE LANGUAGE OF MATHEMATICS: DIFFICULTIES IN NAMING

Symbols

Mathematical symbols can cause confusion. Children with SpLD. who have directional problems when reading from left to right will be even more confused in maths where ‘direction’ is worked from left to right but ‘addition’, ‘subtraction’ and ‘multiplication’ are worked from right to left.

Putting small directional arrows will help them remember where to start and using exercise books with ‘boxes’ will also help them to lay their work out neatly and make calculations involving place value easier. They should also head columns with the labels H (Hundreds),T (tens) and U (units) and should be encouraged to talk themselves through the computation so they do not inadvertently put numbers in the wrong columns.

Terminology

Maths has its own language and this can be at the root of many problems. General mathematical terminology with words like ‘perimeter’, ‘value’ and ‘equals’ may be unfamiliar. It is interesting to ask a class to define the word ‘equals’ and discover the many different replies, perhaps the most commonly that it means ‘answer’. These words all need to be clearly understood before they can be used in calculations. To complicate matters further, one single mathematical process can be described with a wide variety of terms. For instance, ‘multiply’, ‘time’, ‘product of’, or ‘add’, ‘increase’, ‘plus’, ‘sum’ and ‘total’.

Operations

Since the central problem is likely to be that of relating symbols to the operations which they represent, it is good sense that pupils should be able to carry out the operations first, using structured materials, and only secondly be shown how to describe symbolically what they are doing. Pupils with SpLD are better at ‘doing’ than at ‘naming’ and a foundation of ‘doing’ is essential. The great advantage of using structured materials is that they ensure that ‘doing’ comes first and ‘naming’ afterwards. If the order is reversed, one is essentially confronting the SpLD pupil with a mass of bewildering symbols and technical terms, not providing them with any clear idea of what they are supposed to do with them. Once the necessary foundations have been acquired by ‘doing’, then the abstract reasoning, the generalisations, and the discoveries should follow.

Concrete materials which are recommended for pupils with learning difficulties at the primary and high school level include Numicon, Cuisenaire Rods and Deanes Multibase Arithmetic Blocks.

SpLD pupils may have to rely on concrete materials for a longer period of time than their peers since they often find it difficult to memorise number

bonds. Showing them how to use a number line can speed work up considerably.

When teaching maths to SpLD pupils, the principles of multisensory teaching (visual, auditory, tactile-kinaesthetic) which apply to language work, also apply to the mathematics field. For example, when introducing new mathematical concepts and processes use verbal explanations, diagrams concrete materials, pictures and information technology. This could be followed by asking the pupil to explain the process and instructions, in his own words. Progress should be carefully monitored at each stage, checking that a particular concept has been thoroughly mastered and understood before moving on to the next step. A checklist is often the simplest way of doing this.

Word skills

‘***mathematical difficulties and language difficulties are likely to occur concurrently’***

A child needs to be able to read a problem with accuracy (and a certain amount of speed). The wording of mathematical problems tends to be precise and so needs accurate reading and interpretation. A child who misses key words or perhaps small words such as ‘not’ will be disadvantaged.

EMBEDDING PERSONAL LEARNING AND THINKING SKILLS - HOW WILL WE KNOW WHEN WE ARE ACHIEVING OUR AIMS?

In planning for progression, it is important to develop a clear picture of how learners demonstrate PLTS in the context of teaching and learning in mathematics and how those skills can raise achievement in this subject. For example, learners may demonstrate that they are:

- ✓ making personal choices about their learning and identifying ways to improve their work, for example by posing questions and developing convincing arguments
- ✓ increasingly selecting and applying their mathematics in real-life and beyond-school contexts
- ✓ extending and transferring their understanding, for example by using mathematics in increasingly complex or unfamiliar contexts, exploring ideas, and using mathematics to model and interpret situations.

ANNEX A

NATIONAL CURRICULUM: MATHEMATICS PROGRAMMES OF STUDY

https://www.gov.uk/government/publications/national-curriculum-in-england-mathematics-programmes-of-study/national-curriculum-in-england-mathematics-programmes-of-study