The National
Numeracy *Strategy*

Guidance

Curriculum & Standards

The daily mathematics lesson

Guidance to support pupils with visual impairments

Teachers and Teaching Assistants in Primary Schools

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Raising Standards
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Excellence in schools

Visual impairments

Partial sight

The term 'partially sighted' is used to describe visually impaired pupils who work primarily through the visual medium. It extends from those with relatively minor visual difficulties to those who may be on the margin between print and braille and who are sometimes described as having low vision.

While the medical causes of visual impairment are numerous, it is possible to summarise the functional implications for partially sighted pupils under the following broad headings. The visual problems of any one pupil may fall into several categories:

- *Poor acuity* Acuity is the term given to the sharpness of the overall image seen by an individual. Both distance and near vision can be affected by poor acuity, but not necessarily to the same degree. Some pupils may be able to see quite small print on a page but be unable to see the blackboard, while for others the opposite may be true.
- *Central vision loss* Some pupils may have particular difficulty with their central vision – the area of the visual field that is used for detecting fine detail. They may be able to move around freely if the rest of the visual field is unaffected. These pupils often have most difficulty with tasks involving reading, writing and close observation.
- *Peripheral vision loss* This can create the opposite effect to Central vision loss, presenting pupils with particular difficulties in moving around and locating objects, but leaving them able to work quite effectively with detail by using their central vision. It can also present pupils with difficulty in finding the 'space' to record their answers on a question paper or workbook.
- *Interrupted vision* Some pupils' sight is affected by irregular patches of poor vision, so that they may have to scan objects consciously in order to see them effectively. Complicated visual tasks may become impossible for these pupils if they are able to pick up information only in disjointed fragments.
- *Low contrast sensitivity* Some visual conditions cause particular difficulties where an object to be viewed does not stand out clearly from its background. For such pupils the lighting and colour scheme of the school environment will be especially significant. They may find the clarity and contrast of print on the page more important than its size.

- *Adaptability to light* Many pupils with a visual impairment will find pronounced variations in light difficult to manage. Many find bright light painful (photophobia), while others may find it difficult to adjust visually when moving from a bright to a dimly-lit area or activity.
- *Impaired ocular mobility* Some visual difficulties arise from problems in controlling different muscle functions in the eye. Nystagmus, for example, involves a continuous involuntary movement of the eyes, usually from side to side, which creates significant focusing difficulties. Some pupils may have problems with convergence (the ability to train both eyes on the same object at the same time), while others may find it hard to shift their focus from a near to a far object.
- *Colour loss* Colour confusion on its own does not constitute a visual impairment, but it often accompanies and compounds other visual difficulties. The extent of colour vision loss varies between individuals, but the main educational implications remain the same – difficulty in distinguishing detail in pictures, maps and diagrams. Activities that are heavily dependent on colour-coding may present significant access problems to pupils with a severe colour loss.

Partially sighted pupils make up the majority of visually impaired learners. Their needs vary considerably and many are able to work with normal print. Paradoxically, their apparent ability to cope often creates a significant difficulty for partially sighted pupils, as it may lead to their very real needs being underestimated or overlooked.

Blindness

Pupils who are 'educationally blind' have insufficient sight to work through the visual medium of print, relying instead on their other senses. For most pupils in mainstream schools, this mainly involves working through touch via braille. However, being educationally blind does not necessarily mean that a pupil has no useful vision. Many braille-reading pupils retain some vision which may serve them well both in and out of the classroom, for close observation of practical work, for example, or for independent mobility.

Among those pupils who are completely blind, it is important to distinguish between those who have never seen and those who have seen and are now blind. Pupils' ability to grasp certain concepts will be greatly influenced by whether they have ever had direct visual experience of the world around them.

How do pupils with visual impairments learn mathematics differently?

Numbers and the number system

Pupils with visual impairments:

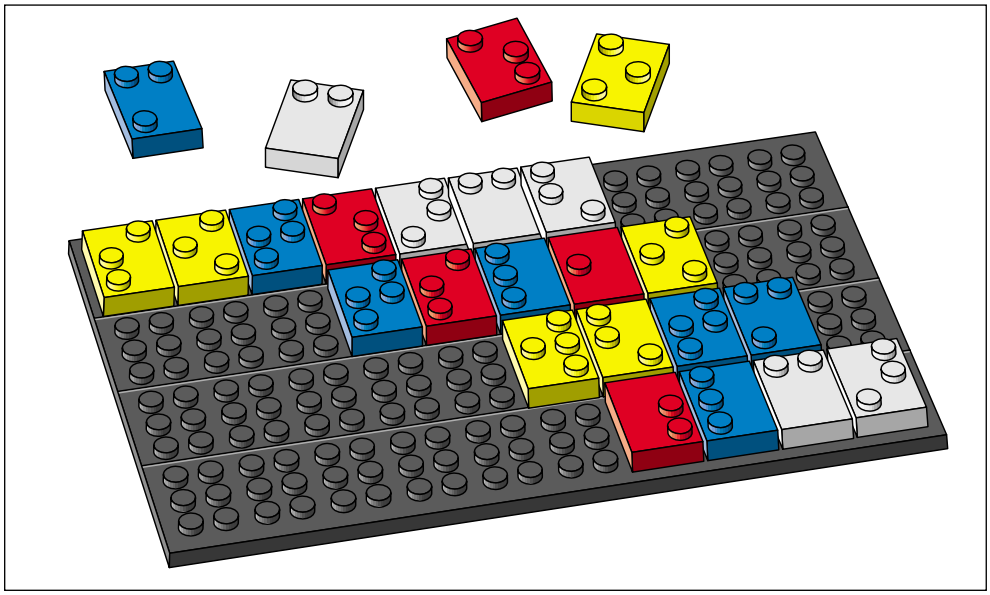
- *may use language for counting but not have understanding.*
  Early language experience is usually gained through hearing counting rhymes and joining in rote counting, supported by visual experience. All auditory experiences need to be accompanied by opportunities for concrete first-hand experiences.
- *often miss out on early number experiences in everyday life.*
  Blind learners will need to be given the basic information that sighted pupils absorb incidentally, such as the number of fingers on one hand, and that a dog has four legs. Tactile tallies, use of simple number lines, hand on hand, and auditory prompts will support the learner in all counting activities.
- *may find it difficult to understand a number as a whole.*
  Learners who are visually impaired may not be able to grasp the property of whole numbers. They will not view six chairs together at a glance, but will move from one chair to another to discover there are six. Practice needs to be given to develop ordering skills, with emphasis on *more* and *less*, matching, counting and comparing.

- *find the concept of zero difficult.*
  When a visual representation cannot be used, zero needs to be taught by comparing the auditory or tactile representation of *nothing* to *one*, or *some*.

- *may not get the same level of support from visual materials as their sighted peers.*
  Visually impaired learners need to be taught number patterns. On the 100-grid, the column of multiples of 10 may not be immediately apparent. The grid can be modified for learners with low vision and those using non-sighted methods. Place value will need more direct teaching, using tactile versions of place value cards that cue in the learner to increasing values. Emphasis can be given initially to the 'size' of the number in relation to its value, e.g. 700 is a bigger number than 5. (This becomes more difficult when comparing 700 and 688.)

- *may lack the necessary early experiences that support estimation skills.*
  Direct teaching using auditory and tactile experiences will be necessary to compensate for the restricted experiences learners may have of visualising quantities. Encourage learners to 'focus' first on one number – e.g. 'this is what it feels/sounds like' – before making comparisons with other quantities. At a later stage, learners may swiftly develop the skill to use their fingers to 'count' objects by grouping. Early experiences of known quantities are essential before this can happen.

- *may find the partitioning of large numbers difficult.*
  Early skills of partitioning up to 10 can be developed using counters, but this becomes unmanageable with bigger numbers. Using an abacus or place value blocks can support this area of learning. The base ten apparatus is also helpful.



Calculations

Pupils with visual impairments:

- *favour simple horizontal layout of calculations.*
  Learners may find it difficult to locate information on a page and will often lose track of where they are in a calculation. It is essential within the horizontal layout to model correct use of the equals sign in calculations. Methods of recording work need to be carefully structured, established early and then remain consistent.

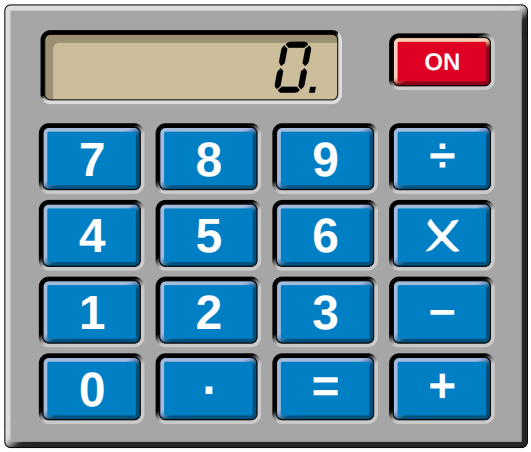
$$67 + 54 = 60 + 50 + 7 + 4$$
$$= 110 + 11$$
$$= 121$$

- *will often take longer to record their answers.*
  It should be acceptable for a pupil to work through a smaller number of examples, whilst still demonstrating an understanding of the task. It is essential to remember that sometimes the process is more important than the product, and at other times, practice of computation is needed.

- *are often very good at rote learning number facts.*
  However, numbers may be perceived as words, and this can mask a lack of basic understanding of number combinations (and partition). Learners need practice in grouping numbers in different ways so that the numbers can be experienced as wholes or as component parts.

- *often rely on their knowledge of known number facts to support calculation skills.*
  Skills of rapid recall are helpful in providing facts needed to support new calculations quickly.

- *need to be familiar with calculator keypads.*
  Simple large-display and talking calculators enable the learner to focus on the mathematics, without the hindrance of recording calculations.



Solving problems

Pupils with visual impairments:

- *may not benefit fully from the incidental experiences provided in the everyday environment that support the learning of classification skills.*
  Most sighted pupils observe things in their day-to-day experiences and make associations – e.g. tooth brushes … hair brushes … sweeping brushes … yard brushes – that lead to classification. Learners who are visually impaired are able to classify objects and experiences by taste, smell, or sound characteristics rather than visual ones. Planning a range of formal and informal accessible opportunities will promote the development of basic classification skills.

- *may have difficulties with problems that involve 'same' and 'different'.*
  Learners will need many matching and sorting activities using real objects (initially with a great difference in size, shape, texture and weight) before they can move onto a more subtle level of discrimination. It is important to use objects that are familiar, such as different types of footwear, before moving on to differences between shapes, lengths, etc. Labelling needs to be done verbally at the point of experience.

- *may have difficulty solving word problems that rely on visualisation skills.*
  Objects or numbers can be represented with concrete materials that can be manipulated to aid understanding of the problem, and support subsequent problem-solving strategies.

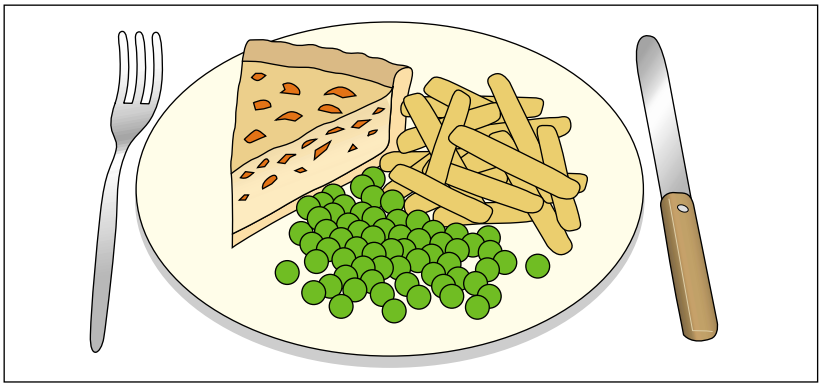
- *often find it difficult to participate in group problem-solving activities.*
  Visually impaired learners need to experience the different parts of a problem in order to understand the whole problem. They will need to experience or be talked through the different elements of the group problem in order to understand how the bit they are doing 'fits in'. Provision of individual sets of apparatus or materials supports understanding of the procedure or sequence involved in the whole problem.

- *will focus more on the oral language element of problem-solving.*
  Mathematical language and problem-solving language should be used consistently. Adults working with the pupil need to agree on both the vocabulary and the structure of the problems. Consolidating understanding of the language to be used, prior to the lesson, is essential. Known words that have different meanings in the mathematical context need to be introduced in a practical situation to ensure understanding.

Measures, shape and space

Pupils with visual impairments:

- *often use knowledge of the numbers on a clock face to orientate themselves and objects within their environment.*
  This supports simple skills such as locating food on a dinner plate – 'the peas are at half past'. Acquiring understanding of this as early as possible has many advantages.



- *find mathematical problems that directly or indirectly involve distances difficult.*
  Relate distance and time problems to real experiences. Time walks of a known distance. Give a time and ask 'How far could you walk' to encourage an estimate. Use known knowledge of time and distance relationships to calculate the time it will take to travel twice that distance. Introduce new problems, building on information that is known and experienced first-hand.

- *may not be able to grasp the concept of perimeter.*
  The understanding of 'all the way round' is very difficult for pupils who are unable to see something as a 'whole'. In order to develop these skills, it is important to begin with objects that can be experienced within the pupil's reach. Use arm or hand spans to measure the distance around a desk, book, cupboard or door.

- *exist in a 3-D world, but find it very difficult to comprehend a 2-D drawing which represents a 3-D object.*
  Visually impaired learners are accustomed to examining one aspect of an object at a time. It is far more difficult to examine the 'wholeness' of an object by tactile methods than by visual inspection. Pupils need to have a clear grasp of 2-D shapes before 3-D aspects are introduced. It is essential not to use 2-D representations of 3-D shapes at any time. Pupils may be encouraged to draw the relationship between everyday shapes and solid 'known' shapes in order to demonstrate their developing understanding. (The introduction of nets can support this understanding.)

- *may need to use specialist equipment to support their learning of symmetry.*
  The use of split paper fasteners, folded card and grids will support pupils' understanding of symmetry and reflection.

- *need lots of concrete experiences of plane shapes.*
  It is more appropriate to give visually impaired learners an outline of a shape, for example a triangle, and allow them to experience the different properties from 'inside' and 'outside'. The outline of a shape will feel very different to a 'filled' shape. It also provides more support for pupils to draw around the inside of the shape than the outside.

- *often have difficulties reading scales.*
  The use of tactile or talking scales will support pupils in measuring activities. The introduction of large-scale 'number line' scales will allow pupils to offer approximations in relation to measurements. The use of key markers with which pupils become familiar may cue pupils towards the correct measure.

Handling data

Pupils with visual impairments:

- *will benefit from using a tactile approach to simple graphs and charts.*
  The use of cubes on a tactile board, and magnetic shapes on a magnetic board, will allow pupils to interpret their results and to manipulate 'new' data. Peg boards and the abacus may also be used to represent data or support tallying.

- *need to be trained to develop good organisational skills when participating in data-handling activities.*
  Pupils will find these types of activity very difficult if there is an expectation of collaborative group work. The working area of a visually impaired learner needs to be carefully prepared so that objects can be easily located. It is important that the learner is able to follow the route through the data-handling cycle.

References

Organisations

VISPA
(Visual impairment and special needs advice)
'Thorstone'
Old Aston Hill
Hawarden
Deeside
Flintshire
CH5 3AH

RNIB
244 Great Portland Street
London
W1N 6AA

Publications

Mason, H.L. *Visual Impairment*, London, David Fulton Publishers, 1997

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