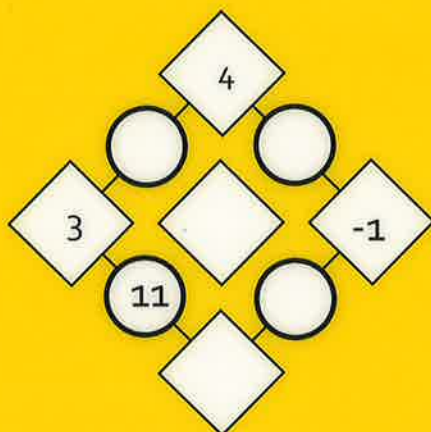


Overcoming Difficulties with Number

Ronit Bird

Supporting
Dyscalculia and
Students who
Struggle with
Maths

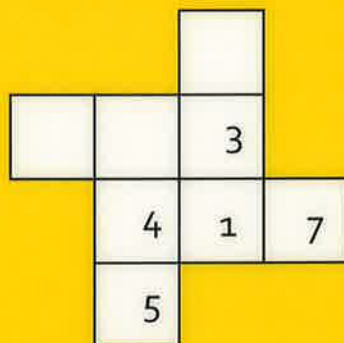
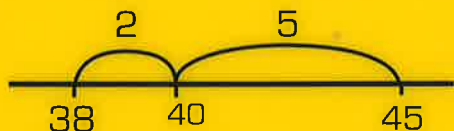
CD Rom

Age Range
9-16

40
Games

Structured
Teaching
Activities

$$\underline{38 + 7}$$



Background

Pupils underachieve in maths for all sorts of reasons. One of those reasons might be teaching methods that are not well matched to the pupils' learning needs; another might be the existence of learning disabilities. The Williams Review into maths teaching and learning in UK primary schools (DCSF 2008) gives a figure of approximately 6 per cent of pupils who have fallen significantly behind (i.e. who fail to achieve level 3 of the National Curriculum) by the end of Key Stage 2, the stage at which children transfer from primary to secondary school, and points out that this percentage has remained roughly constant for almost a decade.¹ Thus, despite the introduction of the National Numeracy Strategy in the late 1990s and the numerous government initiatives directed at improving maths teaching and learning in schools over the past decade, there is still a small number of learners who have significant and persistent difficulties with learning basic numeracy.

At the same time, there is growing evidence of specific learning difficulties affecting maths. Professor Brian Butterworth, Britain's leading authority on dyscalculia, estimates that 4–6 per cent of the population have dyscalculia, a disorder that is neurological in origin and that results in difficulties in learning about number and arithmetic.² Those working in the field of dyslexia estimate that 4–10 per cent of the general population are dyslexic;³ of these roughly 50–60 per cent are thought to have associated difficulties with aspects of mathematics.⁴ These types of specific learning difficulties are found in learners of any cognitive ability.

These different sets of figures are consistent with one another. They suggest that teachers should expect to find one or two pupils in every average class for whom maths will be a struggle. Whatever the cause of their difficulty, pupils who have not mastered basic numeracy concepts will find it impossible to make satisfactory progress at secondary school without specialised teaching to address their particular problems.

Specific learning difficulties affecting numeracy

Dyscalculia

Developmental dyscalculia was first recognised by the Department for Education and Skills (DfES) in 2001⁵ and defined as:

a condition that affects the ability to acquire arithmetical skills. Dyscalculic learners may have difficulty understanding simple number concepts, lack an intuitive grasp of numbers,

and have problems learning number facts and procedures. Even if they produce a correct answer or use a correct method, they may do so mechanically and without confidence.

As a teacher, you might suspect that you have a dyscalculic pupil in your class if an otherwise competent student has a surprising level of difficulty with ordinary numeric operations and relies on finger-counting, often for all four arithmetic operations, well beyond the age at which most of the others in the class have progressed to more efficient strategies. A dyscalculic learner stands out as having no 'feel for numbers' at all, no ability to estimate even small quantities, and no idea whether an answer to an arithmetic problem is reasonable or not. Memory weaknesses, both long-term and short-term, are a great handicap and result in a pupil with dyscalculia being unable to remember facts and procedures accurately, or consistently, no matter how many times they try to learn them by heart. Pupils who have dyscalculia simply cannot remember their times tables reliably, and you may find they can recall some facts one day but not the next. They are also likely to lose track of what they are doing when attempting any procedure that requires more than two or three steps. Even basic counting can be a problem for pupils with dyscalculia, especially counting backwards.

Indicators for dyscalculia are:

- ▶ An inability to subitise (perceive without counting) even very small quantities.
- ▶ An inability to estimate whether a numerical answer is reasonable.
- ▶ Weaknesses in both short-term and long-term memory.
- ▶ An inability to count backwards reliably.
- ▶ A weakness in visual and spatial orientation.
- ▶ Directional (left/right) confusion.
- ▶ Slow processing speeds when engaged in maths activities.
- ▶ Trouble with sequencing.
- ▶ A tendency not to notice patterns.
- ▶ A problem with all aspects of money.
- ▶ A marked delay in learning to read a clock to tell the time.
- ▶ An inability to manage time in their daily lives.

Dyslexia

A dyslexic pupil might show many of the same indicators as those mentioned above, because it is thought that at least half of all dyslexics also have difficulties with maths. Outside the maths classroom, you might suspect that pupils are dyslexic if they read and write much less willingly and fluently than you might expect, if they read and reread written material with little comprehension

and if their spelling is particularly weak, inconsistent or bizarre. Dyslexic learners show much greater ability and understanding when speaking than you could ever guess from looking at the scrappy and minimal amount of written work they produce. Other indicators are memory weaknesses, problems with processing auditory information, and difficulties with planning and organisation.

Dyspraxia

A typical dyspraxic pupil does not seem to have the same long-term memory problems as a dyslexic and so might be able to remember times tables facts with ease. Dyspraxia, also known as DCD (developmental coordination disorder), mainly affects motor control, which results in pupils being clumsy and uncoordinated, poor at planning and organisation, and unsuccessful at subjects like PE and sports that require balance and coordination. Dyspraxic pupils cannot process sensory information properly and are therefore forever tripping and falling, dropping and breaking things, and mislaying their belongings. In the maths classroom, dyspraxic pupils have particular difficulty handling equipment such as a ruler, a protractor or a set of compasses, and their written work is likely to be very messy and difficult to decipher.

Diagnosis

A quick and informal way of identifying pupils who need extra help, or further assessment, is to: (a) find whether pupils have difficulties counting backwards, (b) discover which pupils cannot remember times tables reliably, and (c) notice which pupils have no calculation strategies beyond counting in ones. A less subjective identification can be achieved by using Brian Butterworth's computer-based Dyscalculia Screener, published under the nferNelson imprint and obtainable through GL Assessment. The Screener, which is based on Professor Butterworth's neuroscientific research, can be administered to several pupils at once and produces a profile of each pupil that can provide evidence (or an absence of evidence) of dyscalculia. A formal diagnosis of dyscalculia can, like dyslexia or dyspraxia, only be given by a qualified educational psychologist after a thorough assessment.

How to help pupils who have difficulties with numeracy

The following principles summarise this book's approach to teaching and learning the key numeracy strategies.

- ▶ Start with concrete materials, making sure that the equipment you use is mathematically sound and is robust enough to model a wide range of numeracy topics. In my opinion, the best concrete resource is a collection of base-ten materials, such as Cuisenaire rods, supplemented by Dienes blocks.
- ▶ Allow the pupils to use the concrete materials themselves. Do not appropriate them solely for demonstration purposes.

- ▶ Never allow the concrete materials to be used mechanically, simply to find an answer. Their value lies in the way they can be used to support visualisation techniques and to build cognitive models.
- ▶ Target pupils who are using counting as their only calculation strategy. Before mathematical progress can be made, pupils must be helped out of the 'counting trap' by learning to think in terms of components, or chunks, for building or partitioning numbers.
- ▶ Allow plenty of time. This means allowing pupils as much time as they need to use concrete materials and to experiment with them. It means building into your teaching plenty of opportunities for recap and revision. It means pausing after asking a question so that a pupil has enough time to think about what the question means without feeling rushed, and yet more time to come up with a reasoned answer. It means addressing problems and misconceptions not at the end of the lesson or the end of a topic, but when there is still time enough for pupils to reconstruct their understanding. It also means removing the time pressure of having to get through a whole term's syllabus in a single term and instead allowing pupils to become thoroughly familiar and secure with one topic before moving on to the next.
- ▶ Engage in a lot of talk as you work. Encourage the pupils to talk about what they are doing at every stage. Get pupils into the habit of reflecting on what they do or see and on putting their thoughts into words. Use and teach a wide variety of appropriate vocabulary.
- ▶ Focus on practical activities and teaching games. Apart from the fun that is to be had from solving puzzles and playing games, let your pupils see that maths is something we do, not something we necessarily need to write down. Introduce written calculation as a way of recording only what the pupil has already done concretely and/or has already understood.
- ▶ Progress in very small steps. Break down the teaching and learning of every topic into tiny incremental steps and address only one new idea at a time.
- ▶ Aim to move pupils gradually from the concrete stage through the diagrammatic stage before moving to the purely abstract stage of calculation.
- ▶ Lighten the burden on pupils' working memory by encouraging them to minimise the number of steps in any calculation.
- ▶ Give more attention to how a solution is reached than to what the solution is.
- ▶ Let pupils make mistakes. Encourage them to see errors as not only inevitable but also a helpful part of the learning process.
- ▶ Teach each new strategy by building on a foundation of what is already known. Check that all the necessary pre-skills are secure. Make the connections explicit.
- ▶ Allow informal calculation strategies to replace standard written algorithms provided that pupils can consistently reach the correct solution in a reasonable amount of time.
- ▶ Minimise the amount that pupils are expected to commit to long-term memory by focusing on key strategies, i.e. those having the widest application. If there are several acceptable ways

of tackling or recording a calculation, do not expect your pupils to become familiar with them all. Instead, allow individual pupils to choose whichever method they are most comfortable with and encourage them to practise that method consistently.

- Teach reasoning strategies explicitly. Show pupils how to use logic and reasoning to extend their knowledge of facts and procedures.

References

- 1 Department for Children, Schools and Families (DCSF) (2008) *Independent Review of Mathematics Teaching in Early Years Settings and Primary Schools*. Ref: DCSF-00433-2008.
- 2 B. Butterworth (2004) 'Developmental dyscalculia', in *The Handbook of Mathematical Cognition*, vol. 1, 6, ch. 26, ed. J.E.D. Campbell, p. 455, Routledge.
- 3 Department for Innovation, Universities and Skills (a government department set up in June 2007), www.dfes.gov.uk/curriculum_literacy/access/dyslexia/
- 4 L.S. Joffe (1981) 'School mathematics and dyslexia', unpublished doctoral thesis, University of Aston, Birmingham, UK.
- 5 Department for Education and Skills (DfES) (2001) *Guidance to Support Pupils with Dyslexia and Dyscalculia*. Ref: DfES-0512-2001.