

2nd
Edition

THE Dyscalculia Toolkit

Supporting
Learning
Difficulties
in Maths

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CD-ROM

200
activities

40 games

Age range
6-14



What is dyscalculia?

Developmental dyscalculia was first recognised in the UK by the DfES in 2001 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.'

There is a debate about whether true dyscalculia differs from the maths difficulties experienced by some dyslexic and dyspraxic learners, a debate I am happy to leave to the academics. What matters to me is the fact that the same sorts of intervention seem to help many pupils who are underachieving in maths, whatever label they have been given. I believe that the coming years will see a growing recognition of the particular problems and educational needs of dyscalculic learners, in much the same way as the last two or three decades have seen an increasing acceptance of the existence of dyslexia and a developing consensus about the best teaching and learning approaches for these pupils.

Research into dyscalculia is still at an early stage, but it is estimated that dyscalculia affects roughly 4–6% of the population. This equates to at least one child in any average classroom.

What are the indicators for dyscalculia?

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 include:

- ▶ an inability to subitise (see 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 daily life.

What about learners with other specific learning difficulties?

A dyslexic pupil might show many of the same indicators as those listed 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 would 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.

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 in 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.

A pupil with attention deficit hyperactivity disorder, may signal his (and it's usually a boy) presence by being unable to stop fidgeting or to sit still, being too easily distracted by outside stimuli, having a tendency to talk and interrupt excessively, and finding it extremely difficult to stay on task and see any undertaking through to the end. I mention the condition here only because nowadays pupils with ADHD or ADD tend to come under the umbrella term of 'learners with specific difficulties'. However, pupils with attention disorders may not have any specific problems with numeracy or maths once they have found a way to manage their impulsivity and concentration difficulties.

What kind of teaching do dyscalculic learners need?

All numeracy teaching should aim to help learners build up a sound mathematical understanding of numbers and their relationships. The basis of my own teaching approach with dyscalculic learners is to concentrate on numeracy and arithmetic, starting – crucially – with a variety of versatile concrete materials that provide practical experience and strongly visual models. Once a numerical concept has been understood at the concrete level, then, and only then, will I begin to lead the learner gradually but steadily towards some of the more abstract and symbolic methods associated with higher level mathematics.

My own view is that a set of Cuisenaire rods is indispensable for working with dyscalculic learners. I find it the best, most versatile and most powerful tool to offer learners who are struggling to build a coherent mental model of the number system. I supplement Cuisenaire rods at the lower end with discrete items, such as counters or nuggets, that can be arranged and re-arranged into dot patterns for the numbers up to 10, and at the upper end with Dienes blocks or other base-10 equipment that can combine with Cuisenaire rods for concrete modelling of 3-digit numbers. One of the great strengths of Cuisenaire is that numbers are not presented as a collection of ones, so that the learner's focus is directed away from counting and towards number relationships. See the Appendix on the CD  for an introduction to Cuisenaire rods and other concrete materials.

Dyscalculic learners, just like other learners, need to be able to count properly. Counting is, after all, the foundation of all numeracy. But, as soon as counting is secure, children have to be taught calculation strategies that do not rely on counting in ones. For this reason, I recommend plenty of work on building numbers from smaller components, splitting quantities up again into smaller chunks, and recombining the component pieces once more in order to fully explore the composition of numbers and the connection between addition and subtraction. The component work that I describe in this book is less static than simply learning the number bonds because its emphasis is on performing operations on numbers and seeing quantities change as a result of whatever action is being performed.

Working with chunks, or components, rather than ones, is the only antidote to the immature – and damaging – dependence on counting that is so common in pupils who struggle with numeracy. When counting is the only strategy known to learners, they have fallen into the ‘counting trap’. See the Overviews of Section 1 and Section 2 for more about this pervasive problem. The only way out of the vicious cycle is to explicitly teach learners calculation strategies based on components, i.e. chunks, and not on counting on, or counting back, in ones.

Similarly, the times tables work and multiplication and division activities that I recommend in this book are very far removed from the all too common practice of giving children a list of tables facts to learn by heart, a situation that leaves many pupils without any idea about what multiplication or division mean or how to use or apply the facts they have been asked to memorise. My teaching approach to tables is based on the area model of multiplication and division, a model that inherently connects multiplication with division from the very beginning and one that can be modelled with Cuisenaire rods to produce rectangular shapes that are easy to read, understand and visualise.

Problems with numeracy often go hand in hand with significant memory weaknesses. This is why simple repetition will never be a way forward for dyscalculic pupils, however hard or often they are drilled. The best way to work around learners’ memory problems is to focus on only a few key facts, those that are more important or have the widest application: first allow learners to thoroughly explore and internalise the key facts; then teach them explicitly how to derive whatever other facts they might need by reasoning logically from the key facts they already know.

Visualisation is a strategy that should be explicitly taught to dyscalculic pupils as a route towards mental calculation strategies. Immediately after a session of concrete work, pupils can be asked to close their eyes and try to recreate some of the work in their mind’s eye. Diagrammatic calculation methods, such as empty number lines for addition and subtraction or the area model for multiplication and division, can be introduced as a way of recording concrete work with Cuisenaire rods and later extended to support visualising techniques, thereby creating a bridge between concrete exploration with manipulative materials and the more abstract work that is the norm in mainstream schools. The transition between concrete and abstract work is an important stage that needs to be planned for and cannot be rushed.

My final observation about what kind of teaching approach works best for dyscalculic learners is a recommendation to break down every bit of teaching and learning into the tiniest of incremental steps and not to make any assumption about what pupils already know. For example, just because a child knows, say, that five counters can be arranged into the familiar dice pattern for 5, it does not follow that the same child will know that none of the other dice patterns can be created out of exactly five counters; or just because a child has discovered that adding 1 to each of the numbers up to 10 results in the next number in the counting sequence or that taking 1 away results in the previous number, it does not follow that the same child will know how to add 1 to a 2-digit number, let alone be able to work out how many to take away from a quantity in order to leave 1. Sound numerical understanding can only develop if it rests on secure foundations at every stage. The importance of tightly-focused practical activities that address only a single new idea at a time cannot be overestimated.