May 2022

Numeracy and Mathematics

Supporting learners with dyslexia

What is this guide for?

Many learners have difficulty with number. This may be linked to dyslexia or dyscalculia or could be due to other reasons such as interrupted learning. This is a practical guide to supporting all such learners but includes some specific information about dyslexia and its associated challenges for learning in numeracy and mathematics. It should be noted that there is no one size fits all approach to supporting learners and so in this guide we outline a wide range of suggestions that can be employed in everyday learning and teaching to create an inclusive learning environment.

What is dyslexia?

Dyslexia can be described as a continuum of difficulties in learning to read, write and/or spell, which persist **despite the provision of appropriate learning opportunities**. Sometimes learners find aspects of numeracy and mathematics challenging also. These difficulties often do not reflect an individual's cognitive abilities and may not be typical of performance in other areas.
The impact of dyslexia as a barrier to learning varies in degree according to the learning and teaching environment, and should be supported on an individual basis as there are often associated difficulties such as:

- auditory and/or visual processing of language-based information
- phonological awareness
- oral language skills and reading fluency
- short-term and working memory
- sequencing and directionality
- number skills
- organisational ability
- motor skills and co-ordination

The identification of dyslexia for every learner should include a learner profile which highlights strengths, areas of difficulties and should also suggest appropriate support and monitoring. This learner profile should be updated regularly to reflect any changes that have taken place.

Each learner will have an individual dyslexia profile and for some, numeracy and maths can be a strength, for others it can be an area of difficulty. Some common challenges relate across areas of learning, for example processing skills, working memory issues, sequencing, and organisational skills.

Scottish working definition of dyslexia

Identifying learners with dyslexia

The Addressing Dyslexia Toolkit provides indicators for collecting evidence to support the collaborative process of identifying learners with dyslexia. Some of those difficulties and challenges specifically related to the acquisition of skills in numeracy and mathematics are given below.

Early level	First/Second levels	Third/Fourth/Senior levels
• Understanding and developing initial number bonds • Finding and using links between initial number bonds • Learning early number language and procedures e.g. addition and subtraction • Associating numbers and symbols • Developing spatial awareness	• Understanding, applying and extending number bonds • Making links between number bonds • Learning and understanding number facts, language and procedures • Associating numbers and symbols • Remembering a short sequence of numbers • Understanding the concept of time • Understanding the concept of fractions	• Extending beyond initial number bonds into more complex links • Learning specific number facts, language, symbols and procedures • Remembering a sequence of numbers or steps in a process • Reduced computation speed (due to pace of processing) • Difficulty in understanding the concept of time

What strategies can help learners?

Difficulties with number can be linked specifically to dyslexia but may also be due to a combination of other learning needs such as dyscalculia. When thinking about learners who have dyslexia, it is important to consider the areas of numeracy in which they need support and what adaptations can be made to support them.

Many learners can find maths difficult because it is abstract. The Concrete, Pictorial, Abstract (CPA) approach builds on learner's existing knowledge by introducing abstract concepts in a concrete and tangible way. It involves moving from concrete materials to pictorial representations, to abstract symbols and procedures. Although CPA is often shown as three distinct stages from concrete to pictorial and finally moving onto abstract, a skilled teacher will go back and forth between each stage to reinforce concepts. Some learners might benefit from exploring the concrete and pictorial stages in more depth to allow for extended exploration and deeper understanding.

Technological tools such as text to speech software can be helpful. Mathematics textbooks can be downloaded from the *Books for All* database or the *Bookshare UK* website. Visual aspects such as the choice of font, spacing, background colour, and isolating or enlarging text to focus on one question at a time may all be appropriate in numeracy & maths**.** Digital tools such as Immersive Reader and MyStudyBar can assist in this. Many learners with dyslexia will have access to digital device in lessons and so will be able to take advantage of digital manipulatives such as those available on MathsBot.com or Math Apps | The Math Learning Center.

Some specific challenges within numeracy and maths and some practical solutions are outlined below. It is important to understand that not all these strategies will work with all learners all the time. The most important thing is to help learners identify what works for them. The more a concept can be demonstrated in a concrete or pictorial manner, the easier it will be to connect with a dyslexic learner. It should be noted that many of these strategies and solutions will already be embedded in current practice, and they are of benefit to **all learners** and contribute to the inclusivity of the learning environment.

Barrier/Issue	Can lead to difficulties with	Practical solution(s)
Working memory	• Learning and recalling number facts, formulae, and subject specific vocabulary • Following instructions and explanations • Losing place in a sequence of operations • Solving multi-step problems	• For classwork and assessments (including SQA exams) provide aids such as a 100 square, multiplication grid, place value counters or a calculator to aid numerical processing and explicitly teach learners how to use these aids • Create a OneNote digital jotter with a Maths section and then add pages with aids such as a multiplication grid, number lines and a fraction wall • Provide information in manageable chunks • Give one verbal instruction at a time, if possible, repeat instructions if given as a sequence • Model visual approaches that help learners tackle problems, such as bar modelling • Highlight distinct parts of complex problems • Make use of worked examples where scaffolding is gradually removed • Number steps or use flowcharts to help with sequencing steps in longer processes
Number skills	• Numeral mix up • Learning and recalling number facts, formulae, and subject specific vocabulary • Making links with prior learning • Remembering processes and methods of working • Knowing where to start when solving problems	• Allow more thinking time • Provide cards with number, number name and pictorial representation clearly labelled • Use playing cards, dominoes, and dice to reinforce visual number patterns • Use wall displays to support independence • Regular retrieval practice activities • Use a variety of approaches such as flashcards, online tools and games to reinforce number facts • Use mind mapping where appropriate • Provide links to helpful sound or video recordings to act as quick reminders and explanations • Be explicit in making links to prior learning and between aspects of learning • Use concrete and visual approaches to help learners organise their understanding • Encourage learners to use estimation to determine the reasonableness of their solutions • Encourage learners to take responsibility for checking they have answered the questions posed

Motor skills and co-ordination	• Written communication • Accuracy of measurement • Producing accurate drawings	• Provide alternative ways to record answers, such as templates, whiteboards, or squared paper • Provide digital tools to record answers such as interactive textbooks and worksheets, digital jotters, and accessible drawing tools and manipulatives • Enable the use of spoken responses where appropriate including the use of recording spoken responses digitally • Provide adapted tools and instruments where appropriate • Model carefully the use of mathematical instruments and allow time to develop proficiency • Use digital tools where appropriate • Use templates and digital tools for drawing shapes and graphs
Oral language skills and reading fluency	• Decoding and solving word problems • Explaining learners' own understanding	• To support reading, use digital learning resources to exploit the use of text-to-speech tools and to change font, line spacing, colours and line focus. • Read aloud word problems and repeat if necessary • Provide a glossary of terms which might include links to online explanations • Encourage learners to use concrete materials and visual approaches to give meaning to mathematical language
Auditory and/or visual processing of language-based information	• Understanding explanations • Understanding graphs, charts and tables • Understanding mathematical notation	• Use concrete materials and visual approaches to add meaning to verbal explanations • Highlight distinct parts of complex problems or reveal the problems in stages • Use consistent mathematical language regularly, carefully, and accurately • Allow for thinking time • Use real life contexts which are practical and meaningful • Colour code key features of graphs and charts • Teach explicitly and carefully the meaning of mathematical notation and offer opportunities for practice to embed knowledge and to apply it in a variety of contexts • Teach the mathematical words for symbols and provide a visual reference for these

Organisational ability	• Remembering equipment for lessons • Notetaking • Completing homework and learning independently • Following more complex procedures	• Make accessible equipment for lessons as appropriate • Provide (electronic) notes for learners to eliminate the need to copy from the board and to enable the use of digital accessibility tools • Recognise that some learners may prefer to take their own notes • Be explicit and clear about homework expectations, check for understanding and remember homework may take longer, so set a time limit • Use a digital classroom environment to have resources and assignments in one place • Number steps or use flowcharts to help with sequencing steps in longer processes • When using worked examples, allow plenty of time for thinking
Sequencing and directionality	• Counting and skip counting • Number patterns • Spatial awareness • Navigation	• Use physical movement e.g. along a large number track, to help with movement through a number sequence • Use physical and solid shapes when identifying properties alongside their visual representations • Use digital tools and templates for drawing shapes • Use visual and physical approaches to explain and model directional language

Language

Research suggests that for some learners, who have difficulties with aspects of numeracy and mathematics, the issue lies within the language of maths. Providing many opportunities for the explicit teaching, learning and use of mathematical vocabulary is key to understanding. According to the Education Endowment Foundation*, "Approaches which explicitly aim to develop spoken vocabulary work best when they are related to current content being studied in school and when they involve the active use of the new vocabulary."* When tackling mathematical problems, a lack of vocabulary, mathematical or otherwise, could lead to learners being unsure about what they are being asked to do. This can be heightened if some students are hyperlexic, so they read mechanically but do not ascribe meaning to what they have read.

Many words used in mathematics are terms specific to the subject area which may rarely be encountered outside the lesson, for example, multiple, factor, prime, trapezium, denominator. It is important to introduce these words explicitly first, explaining their meanings clearly, and to ensure these are modelled and used in relevant contexts. A digital glossary which is compatible with text-to-speech tools or audio definitions would be helpful.

Some words used in mathematics have different meanings when used in an everyday English context, for example, face, take away, match, odd, lots of, table, sum and product. It is important that children explore all the meanings they know for these words first, then focus on the mathematical definitions to understand how the terms are used in a mathematical context. Using specific mathematical vocabulary, such as 'multiplied by' alongside an explanation (where necessary) can help to avoid confusion, and these terms should be periodically revisited to promote retention and understanding. When introducing new vocabulary, plan the introduction of these words in a suitable context, for example, with relevant real objects, mathematical apparatus, pictures and/or diagrams, explain their meanings carefully and rehearse them regularly. It is useful to use every opportunity to draw attention to unfamiliar words or symbols with the whole class, in a group, or when talking to individual learners and to encourage their use in context in oral sessions, particularly through questioning. It is also important to share this information with parents and carers so they can support learners by using this language correctly and consistently.

Suggested general activities to develop foundations in mathematical language

Rich, open ended tasks	• Encourage exploration and discussion through engaging activities • Help develop mathematical thinking and reasoning skills • Enrich and enhance mathematical experiences
Encouraging creativity	• Provide opportunities to help learners think and share ideas • Promote exploration, curiosity, and investigative learners • Encourage learners to make and test their own conjectures • Incorporate elements of personalisation and choice
Promoting language through numeracy in context	• Mud kitchens – exploring more, less, empty, full, double, half, litres, ... • Construction zones – exploring taller, shorter, higher, lower, … • Planning journeys – finding arrival and departure times, choosing the best option, planning spending, giving directions • Measurement in context – cooking, designing, building, experiments • Collecting, displaying, and interpreting data – exploring the local environment, understanding news stories
Physical activities	• Learning through movement to support positional language such as above, beside, below, left, right, and ordinal numbers • Listening to and following instructions
Stories and Rhymes	• Using stories to make sense of the world • Supporting the learning associated with numeracy and mathematical concepts in a fun and familiar way
Talk Partners	• Provide opportunities for learners to engage in mathematical discussion with a partner • Provide a word bank to support conversations • Observe and probe for further explanation and reasoning

Where can you find more information and ideas?

SupportingMaths.pdf (dyslexiascotland.org.uk)

A Dyslexic Child in the Classroom – A guide for teachers and parents

Dyslexia: Make a difference - Maths - BBC Teach

Dyslexia and inclusive practice: An overview | Research | National Improvement Hub (education.gov.scot)

Information on Additional Support Needs and Associated Technology. (callscotland.org.uk)

Call Scotland posters and leaflets

On Glow:

https://glowscotland.sharepoint.com/sites/mathsplc/SitePages/Supporting%20Additional%20Needs.aspx

Further reading

Dyslexia: Mathematics (Numeracy; Statistics) (Supporting Learners with Dyslexia in the Secondary Curriculum (Scotland) Book 17) by Moira Thomson, available on Kindle.

Curriculum links

https://education.gov.scot/improvement/learning-resources/curriculum-for-excellence-benchmarks/

https://www.sqa.org.uk/sqa/45750.html

https://www.sqa.org.uk/sqa/81277.html

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