

Dyscalculia and Difficulties with Mathematics

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Dyscalculia is an inherited neurological condition that affects the acquisition of skills in mathematics. Difficulties in numeracy are thought to be as widespread as literacy difficulties; however, there has been much less research on dyscalculia than dyslexia (Butterworth, 2004). The incidence of dyscalculia is currently estimated to be between 6-7% of the general population (Callaway, 2013), although the figure varies because researchers use different criteria to define severe mathematical difficulties.

Generally, students with dyscalculia will lack number sense: they will be unable to grasp number concepts, will have problems learning number facts, will have trouble performing simple calculations, and will be unable to apply their mathematical knowledge to solve problems. These students tend to be resistant to good instruction and may be unable to retain and apply what they have learned.

Every student's profile will be different, but students will typically have difficulties with:

- learning to count. Students may use immature strategies to calculate such as counting by ones, often with their fingers.
- recognising number symbols
- understanding mathematical operations and performing calculations
- learning and recalling basic mathematical facts, particularly the times tables

- recognising patterns in numbers
- understanding the structure of numbers such as place value and grouping
- telling the time
- reading and interpreting graphs and charts.
- grasping abstract concepts like multi-step algorithms, fractions and algebra
- applying mathematical concepts to everyday life, such as budgeting and time management skills (Understood, 2017)

As well as basic difficulties with number sense, students may experience other limitations that impact on their success in the mathematics classroom:

Language processing problems: Accurate word reading and good comprehension are essential to understand word problems and recognise relevant information in a question. Many words have several meanings so students need a comprehensive vocabulary to understand the precise meaning of mathematical terms (Garnett, 1998).

Visuo-spatial problems: Some students may have difficulty making sense of visually presented information and visualising concepts. Visual-spatial difficulties can result in a poor sense of direction, mixing up left and right, confusion between 'less' and 'more', and trouble with measurement (Szucs, Devine, Soltesz, Nobels & Gabriel, 2013).

Memory difficulties: All aspects of memory are involved in mathematics. Short term memory allows recall of sequences and procedures. Working memory provides temporary storage of facts and figures while performing a calculation. Long term memory allows immediate recall of facts and information. If one area of memory is weak, then that will have a significant impact on maths performance. Often a slow processing speed will accompany problems with memory (Lee Swanson, et al. 2001).

Attention deficits: A high level of sustained concentration is required to learn maths concepts. Students need to maintain attention to effectively

process new information, to recall maths facts and to self-monitor for careless mistakes. Attention deficits can have a significant impact on mathematical learning. Mental calculations follow an 'order of operations' and problem solving is often a multistep process. Students need to sequence each step in the right order to calculate the correct answer

Anxiety: Poor performance in maths can have a significant emotional impact. Constant failure leads to a loss of confidence, low self esteem and anxiety. When a student has a negative experience, they feel discouraged and this can lead to avoidance. High anxiety can have a direct impact on working memory leading to a further drop in performance. Some students soon believe that maths is difficult, so they give up and disengage from learning (Ashcraft, 2002).

Ways to support students with numeracy difficulties

Avoid rote learning, rapid fact recall and repetitive drills – these are empty of meaning and difficult to remember. Instead, we should teach the relationships between maths facts to develop students' understanding of basic number and operation concepts. By teaching for meaning, students are able find a solution using logic and reasoning when their memory fails them.

Pre-teach and review relevant skills and introduce new vocabulary to ensure that students have a correct understanding of the essential sub-skills



required to complete the task. Build on prior knowledge by connecting new information to background knowledge to provide the student with a solid foundation to build knowledge and skills. Develop a conceptual framework to store new learning and provide strategies so information is easily retrieved and applied.

Use simple, clear and concise language during explanations – always focus on critical content and break complex skills into small manageable steps. Provide a step-by-step demonstration of problem solving - model the skill by thinking aloud as you solve the problem. Students will learn to 'self talk' through the process. Then lead students through a range of worked examples, using prompting and questioning to actively engage students in the problem solving process.

Use manipulatives (concrete materials such as blocks) and visual representations (drawings or figures) to help students to learn basic maths operations, solve story problems and master abstract concepts like fractions and algebra, as well as to explain, simplify and clarify problems. Manipulatives and diagrams function as cognitive tools to connect students to concepts: they may make difficult ideas understandable, complex problems solvable and abstract concepts tangible (Butler, Miller, Crehan, Babbitt & Pierce, 2003; Cass, Cates, Smith & Jackson, 2003; Sowell, 1989; Witzel, Mercer & Miller, 2003).

Encourage students to verbalise their problem solving process – provide opportunities for students to explain concepts, describe procedures and discuss the ideas they are developing. Questioning helps students make sense of information and provides teachers with insight into learning. Frame questions to help students' gain new understanding, consolidate their learning and monitor their progress. Use feedback to check for understanding, and to provide positive reinforcement and corrective feedback. Reinforce that mistakes are an important part of the learning process – we learn from our mistakes.

Give students plenty of time. Students will need extra time to learn skills, process information and perform calculations. Allow plenty of opportunities to practise to consolidate learning and achieve mastery. Practice will increase fluency in processing, improve retention of information, facilitate recall and develop understanding. Students with learning difficulties will need more practice.

Provide scaffolding to promote success and build confidence. When students demonstrate mastery, you can gradually increase task difficulty as you decrease the level of guidance. Most importantly, teach for success so students see themselves as competent problem solvers. Then they will be more willing to attempt tasks and persevere with difficult problems.

References and Further

Reading:

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