UNPACKING DYSCALCULIA

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For some, mathematics is a wonderful subject. It is logical. It makes sense. For some students, mathematics is anything but. They are faced with added challenges in mathematics due to learning disabilities.

A learning disability is a disorder that inhibits the ability to process and retain information. These processing problems can interfere with learning basic skills such as reading, writing, and maths, and also interfere with higher level skills such as organisation, time, planning, thinking, long or short term memory and attention, interestingly, all skills needed in mathematics.

People with learning disabilities are generally of average or above average intelligence but with gaps between their potential and actual achievement. This is why learning disabilities are referred to as 'hidden disabilities': the person seems to be very bright and smart, yet may be unable to demonstrate the skill level expected from someone of a similar age.

Problems in numeracy are thought to be as widespread as literacy difficulties; however, there has been more research on dyslexia than dyscalculia (Butterworth, 2004).

Dyscalculia is a condition that affects the ability to acquire mathematical 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, they use a correct method, they may do so mechanically and without confidence. (The National Numeracy Strategy (DfES, 2000)).

Dyscalculia is an inherited neurological condition estimated to affect the acquisition of skills in mathematics for about 3-7% of the population (depending on the criteria defined by researchers...). However, the co-existence with other learning disabilities may be as high as 40%. This means that while a student is suspected or diagnosed with a learning disability like dyslexia, or ADHD they will most likely have dyscalculia even if this is not officially diagnosed.

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

- organizing objects and sets of items in a logical way;
- learning to count, students may use immature strategies to calculate such as counting by ones (difficulty skip counting), often with their fingers;
- subitising, determining which number is larger;
- recognising number symbols i.e. printed digits or confusing "1", "4", "4", "11"
- understanding mathematical operations and performing calculations;
- learning and recalling basic mathematical facts, particularly the times tables;
- recognising patterns in numbers;
- decomposing numbers;
- understanding the structure of numbers such as place value and grouping;
- telling the time, perception of the passage of time and difficulties sticking to a schedule;
- reading and interpreting graphs, charts, and maps;
- measurement and understanding spatial relationships/direction;
- finding more than one way to solve a maths problem;
- grasping abstract concepts like multi-step algorithms, fractions and algebra;
- applying mathematical concepts to everyday life, such as budgeting and time management skills.

These challenges can result in increased anxiety and negative attitude towards maths. We can support students with learning difficulties by appealing to their strengths rather than the areas they find most challenging. 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 enabling the student to 'act out' or visually represent the given problem.

Concrete materials and manipulatives (Cuisenaire rods, MAB blocks, counters) can assist students in developing the concept of number or learn basic operations such as addition and subtraction. Students should gradually transition towards using diagrams and pictures in place of concrete materials, and then move towards using symbols to represent number work in a more abstract way. Do not remove concrete materials too soon they will help to develop the student's understanding.

Consider for example using the 'bar method' popular in Singapore. The bar model allows students to draw and visualise mathematical concepts to solve problems. Some examples and activities can also be found on the r0Solve website.

Introduce and pre-teach new vocabulary: the language used in maths can have different meanings. Students need a comprehensive vocabulary to understand the precise meaning of mathematical terms. Use simple, clear and concise language. Focus on the important concept and break complex skills into small manageable steps.

Play games with dice and dominos so that students can recognise common dot patterns. Give multiplication grids and number bonds to reduce the stress of having to remember these facts and enable to access higher order maths concepts and skills.

Repetition and an 'over-learning' approach will help. Practice will increase fluency in processing, improve retention of information, facilitate recall and develop understanding. All students require many presentations before remembering and learning a new skill. Students with learning difficulties will need significantly more practice. Rhonda Fokotakis' Elementary Math Mastery series is highly recommended.

Give students more time. As already mentioned specific learning difficulties are processing difficulties. Being quick at maths does not guarantee success. However working memory capacity is further reduced by anxiety and fear of failure. As you can imagine, repeated failure or setbacks in maths can be defeating and demotivating. Students with low self-efficacy are reluctant to engage in tasks where those skills are required, and if they do, they are more likely to give up when they first encounter difficulty.

THE HISTORY OF MATHEMATICS

Tenesse Mills

We often associate ancient Egypt with pyramids, sphinxes, the Nile, Cleopatra, and Moses. However, the mathematics of ancient Egypt is also particularly fascinating, and has received considerable attention from researchers since the early 20th century.

An important source of our knowledge about mathematics in this era comes from the Rhind mathematical papyrus (Peet 1923). The papyrus is at least 3000 years old, and is likely to be a copy of an even older document. It is known as the Rhind mathematical papyrus because it was purchased by a Scottish archaeologist Alexander Henry Rhind (1833-1865) in Luxor, Egypt in 1858, and eventually found its way to the British Museum after his death.

The papyrus is essentially a set of solved mathematical problems, most of which are put in the context of some application to geometry, weights and measures, or financial transactions. However, it does not set out proofs of general statements as we see in Euclid's Elements. Particularly interesting is the treatment of fractions. The Egyptians had notations only for two types of fractions, namely $\frac{1}{3}$ where $n$ is a positive integer (or unit fractions) and $\frac{1}{3}$ which was exceptional. Other fractions were expressed as sums of two, or more, distinct unit fractions.

The first entry in the Rhind mathematical papyrus is a table of expressions for fractions of the form $\frac{1}{n}$ where $n = 5, 7, 9, 101$. There is no need to consider even values of $n$ because we can always reduce such fractions; e.g. $\frac{2}{3} = \frac{1}{n}$. The unit fractions must be distinct. So, for example, $\frac{1}{3} = \frac{1}{5} + \frac{1}{5} + \frac{1}{5}$. If you try a few yourself, you will see how difficult these problems can become. Try $\frac{3}{7}$.

We might wonder, how did the Egyptians effect these calculations?

REFERENCES