Maths Learning Difficulties and Dyscalculia

by Dr. Steve Chinn

Published by **Unique Ability Consulting**

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Foreword

Unique Ability Consulting was founded with one primary aim, to make people understand that everyone has a Unique Ability within themselves, search for it, as it is there. I have been very fortunate in my life to come across the right people who guided me in my childhood and gave me a stepping stone to the life I lead today.

Specific Learning Difficulties is one area which if not dealt with correctly will have an adverse effect on a person. We advocate that each person's ability is Unique, including people with Dyscalculia or Dyslexia and if given the right guidance and nurturing, life can transform for that particular individual.

Mathematics being one of my most difficult subjects and for many others, who struggle, we would like to help and educate with empowering teaching techniques and tools.

Today I stand very proud and openly say I am Dyslexic. This is thanks to the people in my life who have guided me, spent time with me and harnessed my capabilities. One of those people was my Principal and Maths teacher Dr. Steve Chinn. I am therefore so happy and honoured to be disseminating his work.

This book will give you an overview on mathematical learning difficulties and Dyscalculia in a user friendly manner. Developing teaching methods should be an important criteria for all.

It gives me great pleasure in introducing Dr. Steve Chinn's book which is published by **Unique Ability Consulting.**

Kabir Bhogilal
Proprietor
Unique Ability Consulting

Introduction

After 14 years of teaching in mainstream schools, in 1981 I took up a post which would make me the first Head of a new specialist secondary school for dyslexic boys. As a science teacher I was given the job of teaching mathematics to twelve very dyslexic students. I had been a very successful teacher in mainstream, but I was about to find out that I did not have the skills to teach my new students effectively.

In that brief biographical paragraph is the raison d'etre for the next 30 years of my professional life and one person's realisation that specialist teacher training is essential if children who experience specific learning difficulties in maths are to be educated to the same standards of achievement as their peers.

But in 1981 there was no expertise to be found to guide teachers on how to teach those dyslexic students who found maths persistently difficult, nor to teach those dyscalculic students, particularly since we were not aware at that time of that word and its implications.

A similar situation existed in the UK in the 1960s with dyslexia. Expertise was imported from the USA. Unfortunately such expertise was not available for maths difficulties.

Some work was, however, beginning in the UK. Anne Henderson wrote the first book on the subject, 'Maths and Dyslexics' which was published in 1989. Prof Tim Miles and his wife, Elaine produced an edited book, 'Dyslexia and Mathematics' in 1992 and 'Mathematics for Dyslexics: A Teaching Handbook' by Chinn and Ashcroft was published in 1993. The 4th edition was published in 2017.

Mathematics learning difficulties and dyscalculia remain well behind dyslexia in terms of research and understanding, but current knowledge is getting stronger. The goal now is to achieve similar levels of acceptance and understanding in education for dyscalculia and Maths LD.

This short book can only give an overview of the many issues that are involved in mathematics learning difficulties and dyscalculia, but it is an overview that should highlight problems and point towards understanding and interventions. There are some themes that run through the book, for example, using key facts in a developmental way. The themes acknowledge the need to constantly revisit topics and extend them, building on secure foundations.

There is a list of other books at the end of this book for those who wish to follow up any particular topics in more detail. My video tutorials on my website www.mathsexplained.co.uk will also show my approach in detail.

Chapter 1
Dyscalculia and Maths Learning Difficulties

As our knowledge of the theoretical bases of learning difficulties has improved so has awareness in many schools. It would be beneficial to include that knowledge in all teacher-training so that it is available at that critical interface between learner and teacher. *(The strategies and approaches described in this book will help many children, not just those diagnosed with learning difficulties)*. There is a long way to go, but we have started.

The concept of comorbidity or co-occurrence of learning difficulties and their influences is now recognised. I was unaware in 1981 that my students, who were identified as dyslexic, could also have very significant difficulties with maths.

At that time we in the UK were unaware of many difficulties that are now recognised, for example, Asperger syndrome. We didn't understand ADHD or dyspraxia. Kosc had written about dyscalculia in 1974, but few teachers were aware of its existence, although they were well aware of under-achievement in maths. Not so very long ago people argued, often quite vehemently, as to whether dyslexia was **'dyslexia'** or **'specific learning difficulty'** or even **'specific learning difficulties/ dyslexia'** *(and that's before we get to the discussions on 'difficulty' and 'disability').* These arguments did not include anything about the influence of dyslexia, and other learning difficulties, on learning maths.

A Definition of 'Learning Difficulties'

There is a long definition of **'Learning Difficulties'**, the then alternative term used for dyslexia in the USA in 1988. As you read it, note how comprehensive it is with regard to the influences, factors and comorbidity issues involved in LD:

> *Learning disabilities is a generic term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition of listening, speaking, reading, writing, reasoning or mathematical abilities or of social skills. These disorders are intrinsic to the individual and presumed to be due to central nervous system dysfunction. Even though a learning disability may occur concomitantly with other handicapping conditions*

> *(e.g., sensory impairment, mental retardation, social and emotional disturbance), with socio-environmental influences (e.g., cultural differences, insufficient or inappropriate instruction, psychogenic factors) and especially with attention deficit disorder, all of which may cause learning problems, a learning disability is not the direct result of those conditions or influences. (Kavanagh and Truss, 1988)*

A Definition of Dyscalculia

After an initial flurry of interest from the Department of Education in the UK, interest in dyscalculia seems to have waned somewhat recently. The definition that the Department published dates back to 2001:

> *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, or use a correct method, they may do so mechanically and without confidence.*

One of the earliest workers on dyscalculia and maths learning difficulties is Mahesh Sharma. His publications, **'Focus on Learning Problems in Mathematics'** and **'Math Notebook'** and his work was introduced to the UK by Patricia Brazil and Berkshire Mathematics.

Even though this definition is succinct, it is informative. My understandings of the various features covered in this definition are that: It states that these learners have problems with numbers and thus the quantities represented by the symbols. This infers problems at the very early stages of maths and thus, for children, almost the first maths experiences they meet. The use of the word **'intuitive'** suggests an inborn ability to deal with numbers/quantities. This should not preclude successful intervention to compensate for this for the majority of learners. Also, we have to remember that there is often a big difference between what children can repeat or chant and what they understand.

'Learning number facts and procedures' could suggest that a key approach to maths involves memorising facts and procedures. There is evidence to support this interpretation from several reports published in the UK. An over-reliance on memory is ineffective for any learner, but is very detrimental for many, particularly those with learning difficulties. There is further evidence that maths education in the UK is not effective for around 25% of learners *(Rashid and Brookes, 2010)* and our position in the PISA tables is most unimpressive. This leads into the part of the definition

about performing maths tasks mechanically and without confidence and probably infers that there is no ability to appraise answers for validity and correctness. The skill of estimation *(Chapter 19)* is not a natural one for many learners. This vital life-skill area of maths has, therefore to be taught, and in an empathetic way.

Chapter 2
Why children may not learn maths

In my lectures, the answer to my question to teachers, from across the UK and abroad, 'At what age are enough children giving up on maths in class for it to be noticeable?' varies, of course, but the most frequent answer I get is '7 years old.' Then I meet 18 year old students who know less maths than we expect a 10 year old to know.... despite some 13+ years of maths lessons. Amazingly and impressively, many still try, often spurred on by the reality that to enter the higher or further education course of their choice that they need a qualification in basic maths.

The percentage in the UK for whom this is a problem is probably at least 25% of whom some will be dyscalculic, some dyslexic, some dyspraxic *(Developmental Coordination Disorder)*, some all three. It seems obvious to conclude that the way they are being taught in the UK is not working.

So what factors are blocking learning? If it starts at 7 years old, we can't blame algebra, or even fractions, or even division, though these topics probably finish off a lot of children later on when they appear in the curriculum. It could be anxiety. That would be very bad, to have children as young as seven being anxious about maths to a level where they want to give up.

Basically, I don't know a definitive answer and I should. However, my review of the research suggests a number of factors.

Some reasons why children might give up on maths.

- Having to do maths calculations quickly.

» Learning facts and procedures *(without understanding them)*.

» The extremely judgemental nature of maths, especially. An answer is right, or it is wrong. The issue here is that failure rarely motivates, especially over-exposure to failure.

» The inconsistencies in early arithmetic confuse children, making bigger challenges on memory and blurring concepts.

» Being asked to do tasks that are beyond the capacity of the child's working and short-term memories.

» The vocabulary and language of early maths is often everyday vocabulary and language, but used in a maths setting. This is bad for communication and is an example of inconsistencies.

(For a longer discussion on these factors see Chinn, 2017a or Chinn and Ashcroft, 2017)

The combinations of these factors and their relative impact on a child will differ from child to child.

Effective communication in maths.

As ever in teaching and learning, communication is critical. In maths, teachers are not merely communicating facts and information, they are communicating concepts. There are a number of essential elements in communication:

» **Short-term memory:** If instructions or information are given out at a level that exceeds the short- term memory of the child, the information will not be remembered by the child, and when short-term memory forgets an item or items, it forgets completely. Thus the communication has failed at the first hurdle.

» **Working memory:** This is the memory that is particularly important for mental arithmetic. Assuming the pupil has enough short term memory capacity to remember the question, he then has to use working memory to compute an answer. If the working memory capacity is inadequate for the task, then he will fail. That makes him anxious then the problem gets worse, because anxiety can depress the capacity of working memory even further.

» **Consistency is reassuring:** It makes the general background of life secure, so that new experiences can be dealt with. Without that consistency and the security it brings, learning will be less effective. For example, fractions give the impression of inconsistency if they are not explained carefully, in the vocabulary used, in procedures and in number sense.

» **Speed:** Having to do maths calculations quickly can challenge children with special learning needs, who often are slower at processing information. This creates more anxiety, which results in less working memory capacity, more failure, more anxiety, less motivation and the cycle spirals.

Chapter 8
Basic facts for addition and subtraction

These are the **'facts'** for the addition of any one digit number or ten to another one digit number or ten. That is, from 0 + 0 to 10 + 10. They are probably known as **'basic'** facts because, if students know them, they can work out all other whole number additions. There is an equivalent collection of basic facts for subtraction, from 20 – 10 to 0 – 0.

One of the most useful things about these basic facts is that they can be used to work out a fact that may have been forgotten, or to check it, if the learner is not 100% sure of the answer. These basic facts interlink. For example, if you know that 10 + 7 is 17, and you understand that 9 + 7 will give you an answer that is smaller and smaller by 1, then from 10 + 7 = 17 you can get 9 + 7 = 16, without counting 7 onto 9, or indeed remembering the fact.

So, if pupils can use number skills to work out more facts and answers from the ones that they do remember, then it is worth considering which facts are the most useful to memorise.

Vocabulary and language

There are a number of words that are used for the addition symbol (+) and the subtraction symbol (–). Learners need to be familiar with these words.
So, for example 7 + 6 can be said as:
7 plus 6
7 add 6
7 and 6
7 and 6 more
7 more than 6
the total for 6 and 7 is …..

and 13 – 6 can be said as:

13 minus 6

13 take away 6

What is the difference between 13 and 6?

13 subtract 6

What is 6 less than 13?

Images, symbols and concepts

The images and/or materials that could be used to illustrate these facts include counters, coins, Cuisenaire rods, base ten blocks and number lines. Creative minds could find many other resources, such as candies.

The concepts here are that:

addition and subtraction are reverse **'operations'** so

the two operations are linked

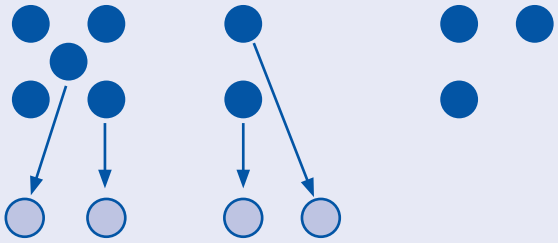
the numbers interlink, eg 7 + 6 = 13 13 – 7 = 6

There can be an interaction between the vocabulary used and the manipulatives that are used. For example, subtraction can be implied with the words:

'What is the difference between 7 and 4' or 'From 7 take away 4'.

The first can be modelled with Stern blocks, which can be compared to show the **'difference'.**

The second can be modelled with counters



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Every Child Has A Unique Ability

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