Maths

By David Cudworth, Specialist Advisory Teacher, Ups and Downs Southwest 2011

Children with Down syndrome often learn to read quickly and use their reading skills daily. Everyone supports their development in this area and reading often becomes a real strength for the individual child.

Although educators (and parents) work hard with the children on their reading, it is fair to say that the same level of attention is not always put into the acquisition of maths skills. Schools do not tend to indicate that maths is especially a problem to parents either, as early emphasis is often placed on celebrating the child's successes in reading and in speaking.

During their childhood years children with DS have very little need to learn maths skills or use money: adults freely give them any items that they need or desire. They do not need to save money or use it in shops. When they reach adulthood, though, living in supported accommodation and working in the community, they can be more disabled by their lacking in maths skills than in any other area. If they are to know how to pay rent, utilities, food and other necessities, then they need much more than simple instruction on how to use a calculator or to add up using counters – they need to grasp the basic understandings that underlie the use of mathematics.

Understanding maths needs to start early.

Importantly, too, if more young people with Down syndrome are to access interesting courses at college, then they need to have achieved a certain level in maths – often they are prevented from being accepted onto the courses they want by the colleges themselves because they do not meet the minimum requirements in maths needed to get on to the course, even if the course is a highly practical one that requires no specific maths skills.

Most authorities agree that students with DS have real difficulty with the abstract concepts of mathematics – but how much of this is due to the syndrome and how much is due to teaching that isn't geared towards the specific learning profile associated with Down syndrome?

If our expectations are that the pupils are not capable of learning maths, then we will not give them as much of an opportunity to learn it. With higher expectations and more consistent education, achievement for most individuals with DS improves. In any case, there is a wide variation in the ability of children with DS, and this variation makes it very difficult to second guess how far each child will go. One thing is for sure, though: there is no ceiling or plateau to the learning achievements of someone with Down syndrome.

In addition, individuals with Down syndrome are not the only students who are concrete thinkers and who have difficulty with the abstract concepts of maths. Yet much of the teaching of maths concepts in school is done at the abstract level. The focus for these students needs to switch to the functional uses of maths in daily living and to motivate the students to learn and practise useful maths skills.

Basic Skills:

- To have an understanding of what numbers and numerals are about.
- To be able to add and subtract.
- To be able to use these computation skills when needed: they may learn the maths facts for addition and subtraction, but not understand *when* they need to do one or the other.
- To experience some of the practical uses for maths such as in measurement and in telling the time.

The student who has mastered these basic skills can “survive” as an adult with appropriate support.

Children with Down syndrome should be taught maths skills in the classroom alongside their typically developing peers. In most other curriculum areas the class/subject teacher can differentiate the lesson’s objectives to meet the needs of the individual child. In maths, however, this is more difficult. Maths is much more of a sequential learning subject area, so the pupils will need to master the earlier-taught concepts before they can understand the maths activities of the general class. Children with Down syndrome go through the same stages of development as typically developing children, and this includes their acquisition of maths skills, but they reach each stage later on in their lives and they tend to stay there for longer. So, many students never reach the formal operations stage while at school that enables them to think abstractly about a situation and work out possible consequences based on experiences and formal learning. Students with DS understand so much better through hands-on learning and by real-life situations.

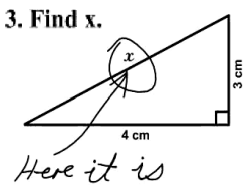
There is nothing wrong with the child following their own maths curriculum alongside their typically developing peers, who will obviously be working at a much different level, as long as the child is seen by themselves and their peers as working on their maths at the same time and in the same room as everyone else, especially if they are being taught alongside and by responsible and more able peers. Pupils with Down syndrome need to be with typically developing role models as much as possible in order to develop their independent learning skills and age-appropriate behaviour.

In order to teach a student with DS effectively, a knowledge of the specific learning profile is essential, and how the factors that inhibit and facilitate learning are especially relevant to maths.

Factors that Inhibit Learning

- Students with DS frequently have problems with **short-term and working memory**. In maths we often use short-term memory in learning numerals, computation facts and specific details about the current problem that needs to be solved. Working memory underpins the processes of maths: addition, subtraction, multiplication, division… Students with DS need help in overcoming these possible deficits in their memory. Problems with short-term memory have knock-on effects on long-term memory storage. When information is not of interest to them or has little emotional impact, they may seem to remember it one day and forget the next.

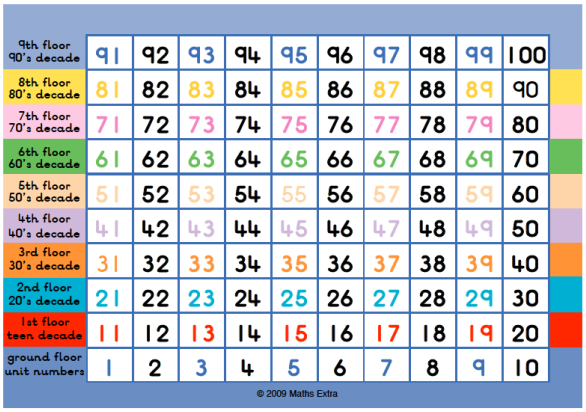
- Children with DS often have **fine motor problems and poor hand-eye coordination**. These delays make it difficult to manipulate objects and make writing numerals difficult and slow. As a further consequence of having fine motor problems, children with DS often do not get as much experience of exploring objects in their world during the early years at home or at nursery, and so miss out on that crucial stage in learning that typically developing children experience. And because they find things harder, people tend to do things for them, which creates a vicious circle of dependence and over-reliance.



- **Speech and language delay** is the biggest cause of frustration for teenagers and young adults with Down syndrome. Many children with DS have difficulties with receptive language, ie understanding other people's spoken messages. Difficulties with receptive language are especially likely to complicate maths learning, because so much of the language associated with maths is abstract or has double meaning. So, *"Find the missing number", "Write the number that is one less", "Write the number that is between _ and _", "Write the numbers in the correct order", "What number is higher/lower than"* etc are notorious problems

for pupils with DS. Specific maths vocabulary, such as the terms *net* and *table* also often cause problems, as do different ways of saying the same function: *add, plus, find the sum of … take away, subtract, minus … times, multiplied by …* and so on all compound the difficulties faced by pupils with DS. It is important, therefore, to teach all mathematics vocabulary and the associated concepts together.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100



9th floor 90's decade	91	92	93	94	95	96	97	98	99	100
8th floor 80's decade	81	82	83	84	85	86	87	88	89	90
7th floor 70's decade	71	72	73	74	75	76	77	78	79	80
6th floor 60's decade	61	62	63	64	65	66	67	68	69	70
5th floor 50's decade	51	52	53	54	55	56	57	58	59	60
4th floor 40's decade	41	42	43	44	45	46	47	48	49	50
3rd floor 30's decade	31	32	33	34	35	36	37	38	39	40
2nd floor 20's decade	21	22	23	24	25	26	27	28	29	30
1st floor teen decade	11	12	13	14	15	16	17	18	19	20
ground floor unit numbers	1	2	3	4	5	6	7	8	9	10

Which number is higher?

- **Auditory and visual impairment** also have a significant impact on the learning of maths concepts specifically. Processing information orally is much more difficult if you can't hear properly, and the focussing difficulties faced by many children with DS mean that working out or writing equations vertically is made more difficult when you have just learned how to work them out as a number sentence (ie across the page), and vital concepts such as place value are made harder if you have problems focussing on and confusing different parts of a number or equation. Educators need to remember that children with DS are visual and kinaesthetic learners, so they are much more likely to understand concepts if they can handle real objects rather than substitutes for the real thing (such as number teddies or plastic money) or problems that are written down.

- Due to the nature of the challenges they face, many children with DS are prone to developing **avoidance strategies**, affected by their motivation to take risks. Many children with DS are very sensitive to failure, so are often reluctant to give things a try. So adopting an errorless learning

approach to maths is essential. Many children with DS respond to highly motivating and rewarding activities and games.

Factors that Facilitate Learning

- **Strong visual learning skills.** Often teachers find that the pupil with Down syndrome can learn a concept more readily if they supplement their verbal explanations with a picture or visual prompt.

- Individuals with Down syndrome are often **keen communicators** despite language problems, and respond really well to praise and attention. Giving the child jobs and responsibilities will enhance their self-esteem and raise their profile in the class. Handing out books, worksheets or equipment teaches the vital concept of one-to-one correspondence in a real-life and everyday situation.

- **Ability and desire to learn from peers**. Pupils with DS usually enjoy interacting with their peers and often model peer behaviour. Choosing the right group of mature and responsible peers and providing the child with peer support are essential components of an inclusive education. Being with their peers is highly motivational for the vast majority of pupils with Down syndrome.

Teaching Maths to Pupils with Down Syndrome

As previously stated, children with Down syndrome learn better when taught alongside and with other children. Being taught 1-1 in a corner of the classroom, or in the corridor or a side room, is hard going both for the child and the adult trying to teach them, and goes against the principles of inclusive education. It is unrealistic, however, for a teacher (or especially a TA) to be expected to differentiate lesson after lesson when the general classroom level in maths is so far removed from the level of the individual child with DS. This

compares to delivering a general maths programme without a scheme or course to follow, and which teacher would be happy doing that?!

For social inclusion reasons alone, it is essential that the child participates in whole class introductions, even if the level is above that of the child. A good teacher is used to finding ways to include all the children in whole class times, and pitching the level to meet everyone's needs. Many children with DS enjoy these interactive times with their class/subject teacher.

It is easiest to fully include the child with DS during sessions that involve pair or group work, where they can be partnered with more mature and more able peers, with the support of a TA initially. Practical sessions working on shape or measure lend themselves particularly to pair and group work, and the pupil should be included in all of these.

When the typically developing pupils in the class are expected to work individually on a task, and this happens frequently in maths, then these are the times when the child with DS can focus on his/her individual learning, and it is easiest to do this by following an individualised maths programme. As previously stated, there is nothing wrong in having the pupil with DS working on their maths at the same time as the other pupils are working at their level. They will quickly realise that they are all there to work.

Two methods work particularly well with pupils with Down syndrome. **Numicon** and **Stern** have been designed to be used with students who are kinaesthetic and visual learners, and both are recommended for pupils with DS because they teach to their learning profile. In our experience, some children prefer one method and some prefer the other, but generally speaking Numicon works particularly well with nursery and younger children, Stern is more appropriate as the pupils get older, as it takes the pupils further and looks more "grown-up". Both methods come with comprehensive teaching guides, which make it easy for teachers and TAs to use on a daily basis with the individual child or small group.

Teaching Money

Always use real coins and never plastic imitation money. Children with Down syndrome will not necessarily be able to make the connection between the two, and they need to handle and feel the weight of real coins and notes. Introduce the value of each coin by sticking the coin onto its corresponding Stern number rod/block. Create opportunities for real situations using real money and make the learning relevant to the real world. One of the reasons why individuals with Down syndrome find reading so motivational is that they can see writing all around them and they find it very satisfying to read signs, notices, adverts and so on. So give them as many opportunities for spending and handling money as possible, both in school, at home and outside in the real world. Understanding why they need to learn something motivates them to learn.

Teaching Time

Most pupils with Down syndrome can learn to tell the time to the hour and the half hour quite easily. Teaching the analogue clock beyond that is more difficult for the majority of children with DS, but they can learn to tell the time much more easily by learning the digital clock first. **Charlotte's Clock**, linked to the Stern methodology, is an excellent resource that really makes telling the time easier to learn. As with money, teach clock times and the understanding of the concept of the passage of time utilising real activities, such as events in a typical school day. Use a daily calendar and practise constantly the concepts of today, yesterday, tomorrow, the days of the week and the months. Make use of a visual timetable to reinforce the concepts of first, next and last.

Using a Calculator

Use the calculator early and frequently. Whereas many teachers discourage the use of calculators with typically developing children because they consider them to get in the way of learning maths facts, calculators are a very useful tool for children with Down syndrome to overcome

working memory problems and to be successful without needing to do mental maths or paper and pencil computations. Make sure the calculators have large screens and large keys and are as basic as possible, in order to make them as easy to use as possible.

Minimizing Fine Motor Demands

Many children with Down syndrome find it harder and more tiring to hold a pencil and form numbers, and as a result they can rapidly lose interest. For this reason remember that it is important to set them up for success and make maths as accessible to them as possible, so minimize the amount of copying (from the board or a book) the pupil is required to do. Provide alternative means of recording achievement, such as copying out the problems yourself, or using photocopies, or having the pupil working directly into a workbook. For those pupils with very poor muscle tone or dyspraxia, which is not uncommon, then many teachers find using stamps a very successful alternative to writing down numerals all the time.

Key Points:

- Provide the students with hands-on activities where they touch and manipulate physical materials.
- Focus on the essential concepts, rather than just drill work with numbers.
- Use games and other activities that enable the students to enjoy the additional practice that they need to make sure that the concepts make it into the long term memory storage. (Remember that, in order to play games, the students need to be working and playing with other children. Games are not much fun or very motivational if they are played 1-1 with a TA in the corridor!)
- Make sure that the skills are used in meaningful, everyday activities.
- Start simply and build on successes.
- Make the work simple and clear and ensure success throughout the lesson.

Further Reading

Numeracy and Mathematics – Information Sheet (Cecilie Mackinnon, DSA Education Consortium 2005)

Teaching Math to People with Down Syndrome and Other Hands-On Learners (DeAnna Horstmeister, www.woodbinehouse.com)

Choosing the Right Classes and Peer Support – Information Sheet (David Cudworth, Ups and Downs Southwest)

Mathematics Resources

Stern: Maths Extra Ltd. Tel: 01747 861503 email enquiries@mathsextra.com

Numicon Ltd., Unit D, Prospect House, The Hyde Business Park, Bevendean, Brighton BN2 4JE. Tel: 01273 609991

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