



Teaching numeracy and mathematics to children with Down syndrome

What are some of the learning characteristics for a child with Down syndrome?

Strengths include:

- Strong visual, kinaesthetic learner
- Strong visual learning skills:
 - Visual memory is more effective than auditory memory
 - Ability to learn and use sign/gesture
 - Responds well to visual resources- photographs, concrete materials, ICT, printed word
 - Learn well from practical demonstration
- Very sociable and a strong desire to be with, and learn from, their friends
- Good rote memorising capabilities that support the retention of facts and reduces the stress on short-term memory

Needs include:

- Short concentrated periods of activities interspersed with regular changes/breaks
- Support to remain on task- and only one demand made at a time. Can be very distractible and tire easily
- Difficulty with short term auditory/working memory affecting retaining and responding to verbal information and instruction. This also affects learning sequences and retaining instructions, so will need learning from listening to be limited with reinforcement through visual means
- Often a gap between their level of language comprehension and expressive ability
- Lots of opportunities to engage in practical activities and use of concrete tools to support learning
- Support to develop their gross and fine motor skills
- Very socially aware but need support to develop positive peer relationships

Numeracy and mathematics

Key points:

- Numeracy is an area of relative difficulty for the majority of learners with Down, and is more difficult than literacy, with numeracy achievements typically lower than literacy achievements (Buckley, 2007)
- The development of mathematical skills, thinking and concepts is likely to be affected by a combination of factors that may include:
 - Global developmental delay

- The child continuing at a concrete developmental level but being required to engage with more abstract concepts/thinking
- Limited experiences
- Delays in gross and fine motor skills
- Coordination and manipulation difficulties
- Difficulties with working memory make it hard for the child to store numbers or keep a track of numbers and sequencing whilst further processing is carried out
- Connections may be made very slowly and mathematics and perceived as a series of unrelated facts. Making these connections will take time and will be dependent upon effective structured teaching
- Teaching needs to take account of known language and memory delays and there is a need to employ methods that provide support for working memory including:
 - Breaking tasks into smaller steps
 - Using tangible materials
 - Providing repeated opportunities for practice
- There will be a longer term need for use of concrete materials, with lots of opportunities to explore and manipulate objects and teaching systems to help acquire early mathematical concepts
- Visual teaching systems (such as Numicon or Cuisenaire rods) can help the learner to associate numerals with particular visual images or colours
- The use of concrete materials will also be needed to support the development of higher level mathematics
- The use of structured concrete materials can support the learner to visualise mathematical processes, making them more real than pictorial representations, and the introduction of more formal written activities should only be made very gradually
- Ensure there is an emphasis on numeracy in everyday contexts

Numeracy

Key skills to teach:

- Classification
- Rote counting
- One to one correspondence
- Stable order principle- counting the same set of objects several times will always give the same result
- Cardinality of number- having counted a number of items in a set, the child knows the last number counted represents how many are in the group
- Conservation of number- knowing that the same number of objects remains the same in a group, regardless of the order they are counted in, or whether they are spread apart, close together, large, small etc.
- Recognition and use of written numerals
- Addition and subtraction
- Multiplication and division

Activities to support the development of these skills include:

- Sorting and matching objects according to a range of attributes (e.g. size, colour, shape and purpose)

- Counting forward and then backwards in one's. The priority initially is for the child to say the number sequence accurately rather than understanding what each numeral represents
- Play counting games:
 - Counting objects left to right using one to one correspondence. This can be with real objects or using IT software/apps such as Inclusive Technology '5 speckled frogs'. These can develop to:
 - Counting games that end before the complete set has been counted
 - Games that start at numbers other than 'one' (to prepare for addition and counting on)

Research has shown early counting and cardinal skills may be learnt more quickly when using IT software than real objects or pen and paper (Ortega-Tudela et al, 2006)
- Organising groups of objects so they are easier to count
- Sequencing groups, each containing 1-5 objects, in order from 1-5
- Matching numerals 1-5, placing them in the correct order, and selecting them on request
- Using numerals 1-10 introducing one digit addition (1 more) and subtraction (1 less)
- Counting objects to 20
- Using visual supports such as digit cards, number lines, number squares etc. that help the child see the relationships between numbers
- Practical experiences of combining and separating number groups (and shapes if using a visual teaching system) can provide visual images of simple addition/subtraction facts
- Using 2's, 5's and 10's to introduce multiplication and division, initially showing the repetitive addition of each and encouraging rote counting for multiplication. Division can be shown as sharing 2's, 5's and 10's

Mathematics

Key skills to teach:

- Establishing early mathematical concepts and mathematical language
- Time and telling the time
- Money- focusing on recognition and naming of coins
- Fractions

Activities to support the development of these skills include:

- Introducing mathematical language for shape, size, colour etc. and lots of practical exploration to explore early mathematical concepts such as light/heavy, more/less, conservation, etc. through play activities
- Teach maths concepts, skills and language together. Use of flashcards with key words/symbols can also be helpful
- Identify the mathematical language that needs to be taught through play, stories, and established/reinforced through structured learning activities and meaningful everyday situations. For example:
 - Time: again, now, later, tomorrow, yesterday, days of the week/month, seasons, etc.
 - Size: big, small, etc. and also comparative words such as bigger than, smaller than, etc.
 - Weight: light, heavy, lightest, heaviest, etc.

- Area, volume, capacity: Lots, empty, full, most, more, more than, less than
- Money: names of coins, how much altogether, price, change, etc.
- Shape: circle, rectangle, square, etc.
- Spatial concepts: in, on, under, first, last, bottom, top, etc.
- Using a digital analogue clock that provides the hours 1-12 but also the minutes in 5 minute intervals, such as:



This may help reduce some of the complex language involved in telling the time relying on a sole analogue clock (e.g. quarter to, 10 past etc.)

- When introducing money, it is important for the child to handle real coins and to also use them to undertake transactions- either in role play and songs such as '5 current buns', or in a shop
- Fractions involve use of a wide mathematical vocabulary and time needs to be spent familiarising the child with this vocabulary within meaningful contexts (e.g. same, different, bigger/smaller than, one half, halves, cut in two, etc.). This should be reinforced through a range of play activities (e.g. cutting up a playdough cake to share between 4 children)

Resources

- Buckley, S. (2007) *Teaching numeracy*. Down syndrome research and practice 12(1) p.11-14
- Down Syndrome Association and Down Syndrome Scotland. Including pupils with Down's syndrome: Primary. Information for teachers and learning support assistants. Available free from: www.downs-syndrome.org.uk
- Down Syndrome Association Education resource pack. Unit 57:Acquiring Mathematics and Numeracy Skills. Available free from: www.downs-syndrome.org.uk/for-new.../education-support-packs/
- Ortega-Tudela, J.M. and Gomez-Ariza, J. (2006) *Computer assisted teaching and mathematical teaching in Down syndrome children*. Journal of Computer Assisted Learning 22 p.298-307