

# Learning about number and maths

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## Adapting teaching to the learning profile of children with Down syndrome



This article begins with an outline of the research on the development of number skills and knowledge for typically developing children, and how that information can relate to the particular strengths and needs of children with Down syndrome. The significance of knowledge about the specific learning strengths and weaknesses usually experienced by children with Down syndrome is also addressed when identifying teaching approaches that may be helpful when addressing number skills.

At 2 to 3 years of age, typically developing children begin to use number words to 'count' as they play, showing that are beginning to explore and understand counting. By 4 years of age, many children can answer questions such as 'How many?' and 'Give me.....' questions for numbers up to 10. They understand 'more' or 'less' for small numbers, but they do not yet understand the ordinal nature of the number system, i.e., that each 'next' number represents 'one more'.

Throughout the primary school years, typically developing children begin to understand more about number concepts and the number system. By 8 and 9 years, most children know numbers up to 1000 and can count on or back in tens and hundreds. Within 0-100, they can count on or back in twos from any two digit number and order numbers to at least 1000, on a number line or number square. They know the 2, 5, and 10 times tables and understand the

concept of division. They are beginning to understand the units of time (second, minutes, hours, day, week, month, and year) and know the relationships between them. They can measure, weigh, and compare lengths, masses and capacities using standard units. They are also beginning to understand about money units (£, p). This level of achievement would certainly provide the knowledge and skills necessary of most everyday life and work situations requiring number and/or maths skills.



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## Influencing factors

Research with typically developing children indicates that number progress is influenced by:

### Social experiences and exposure to number in preschool years

Children's knowledge of number and maths concepts will vary according to the quality and extent of their learning opportunities at home and at preschool. Parents should be encouraged to draw their child's attention to the uses of number in everyday life and engage him/her in games that teach counting and quantity.

## Teaching methods

Maths teachers have differing views about the best ways to teach maths skills in the curriculum. Some feel that there needs to be a heavy emphasis on counting and mental arithmetic in the early years. Others advocate the use of more visual-spatial means of teaching number skills and mathematical concepts (such as Numicon and Cuisenaire). Drill and practice tends to be unpopular but there are good arguments for suggesting that children should practice the count word sequence, multiplication tables, and other addition skills until they become automatic so that they do not have to be consciously calculated when needed. Automatisation of these skills frees up space in working memory – the mental workspace used for calculations and problem solving. It may very well be that a combination of these approaches provides the best strategy for teaching maths and number concepts.

## Knowing the language and concepts of maths

Vocabulary learning needs to include words for number and maths. Parents play an important role in ensuring that they draw their child's attention to size, colour, shape and other attributes during every day experiences and introduce them to comparing and contrasting activities.

## The relevance of the skills to everyday life

Researchers have shown the positive effects of using examples and materials in the classroom that show children the relevant applications of their maths learning in their everyday lives.

## Reading ability

The ability to solve maths problems that are presented as written problems is influenced by reading ability and the ability to infer from text. Most children are slower at solving problems that are presented in this way and they may

need help to transfer the word problem into a number calculation.

## Motor skills for counting and recording (writing numerals)

Early progress with counting will be influenced by motor dexterity as bricks or other objects are often used to support counting at home and in the classroom. The ability to write the numerals and to record work will influence progress so alternative strategies may need to be implemented for children with writing difficulties.

## Working memory capacity

Children with poor working memory skills for their age have been shown to have difficulty with number and maths skills. 'Working memory' can be defined as the 'mental workspace' which supports the processing of incoming auditory and visual information. It is what allows you to hold on to information long enough in order to interpret meaning. Children who do not have age-appropriate working memory skills will have difficulty with tasks that involve them doing any kind of mental operation on information – such as mental arithmetic or reading for meaning. Children with working memory difficulties can be helped by the use of visual

supports for learning whenever possible as these will reduce the load on the memory system.

## Logical reasoning ability

The number system is a logical system and the ability to reason logically and work out relationships by inference will help children to understand the system, carry out calculations and solve problems.

## How this relates to children with Down syndrome

Information on the progress of children with Down syndrome with number and maths skills is very limited and, as with most things, there is wide variation of ability. The reasons for this wide range of variability in achievements are not yet understood, but the research seems to indicate:

- Achievements seem to be improving with better education and higher expectations
- Achievements are higher when children are educated in mainstream schools
- Numeracy skills usually lag behind literacy skills, but it is not clear why
- Children with Down syndrome master the early steps in counting in the same way as other children, but at a slower pace
- Their ability to learn the number word sequence seems to be delayed for mental-age and may be affected by speech production and auditory short-term memory difficulties. They may make more errors in counting tasks because of working memory difficulties
- Structured teaching, with tasks broken down into small steps and practised sufficiently, improve progress and develop new skills
- Teaching approaches that use visual supports to teach number seem to help, but as these are also structured methods, more research is





needed to identify the most effective visual support methods

- Children should be able to try all aspects of the maths curriculum and not be held back because they have difficulty with number calculations

## Developmental profile

When teaching maths and numeracy skills, strategies should take account of what is known about the development of these skills in typically developing children as well as what is known about the profile of strengths and needs for children with Down syndrome. This profile includes (but is not limited to):

- Delayed motor skills – making manipulating small items, drawing and writing difficult
- Delays in speech and language development – leading to an underestimation of understanding skills
- Auditory processing and working memory difficulties – making learning from listening very difficult
- Strengths in social understanding – enjoyment of learning from social interaction with peers and adults
- Strengths in visual processing and visual memory – learning from seeing is an important and effective strategy
- Strengths in using gesture – showing understanding by pointing to or choosing an answer

## General principles for teaching numeracy

### 1. Use the same stages in learning as other children

Children with Down syndrome learn about number in the same way as other children. They should therefore be included in all classroom activities with support, noting that they may need smaller steps with more practice at each step to master achievements. They will also benefit from a wide range of materials for counting activities, with practical examples of everyday application to generalise their skills and make them functional.

### 2. Good teaching strategies

There is evidence that the teaching that children receive influences their progress just as much as their learning abilities. Children with Down syndrome vary widely in their rates of progress in learning maths and numbers, as do typically developing children. Therefore, some children with Down syndrome will achieve at the same rate as other children in a mainstream classroom, and the strategies recommended for use for children with Down syndrome will benefit all children in the classroom.

### 3. Build on social strengths

Children with Down syndrome have strengths in social learning. To build on this strength, games and activities that include counting and number should be incorporated into everyday experiences. Daily opportunities could include counting items into a basket, counting favourite toys, counting number of plates, cups, forks, etc at dinner, and so on. Turn taking games are an effective way to teach number as being part of a group ‘takes the pressure to perform’ away and children are getting effective models while they wait for their ‘turn’.

### 4. Take note of speech production difficulties

Speech and language difficulties need to be considered for all children with Down syndrome. Their learning ability is many times grossly underestimated because they have difficulty saying words. Extra

practice at the number words, using both numerals and the written words, will help them to learn to say them. Learning to count and to understand quantity should start in the pre-school years and should be presented with the support of visual material, such as numeral cards and signs. Teaching should not be delayed because a child cannot say a word.

Children with Down syndrome also need a way to show their understanding if speech and language difficulties prevent them from ‘telling’ the answer to a question. Using pictures or numerals may be a way of providing a correct answer rather than ‘saying’ the answer.

### 5. Building language knowledge

Because children with Down syndrome usually have a language delay, there is a risk that they are not introduced to the words and concepts that they need in order to understand maths. The concepts are not always more difficult than those for words they already understand, but sometimes they have not had exposure to the words in contexts where they can learn what they mean. Language learning for maths should continue throughout school years.

### 6. Support delayed motor skills

Delayed motor skills can make the manipulation of small objects for counting activities very difficult. This needs to be taken into account when choosing materials. This general motor delay can lead to writing difficulties so support with numeral cards, a scribe, work sheets that give choices for the answer and the use of the computer are ways to support a child who is not able to write a solution to a mathematical problem.

### 7. Take note of auditory processing and working memory difficulties

Children with Down syndrome are visual learners and have more difficulty learning from listening alone. Visual supports for learning about number include written numerals, number squares, times tables, calendars, and the computer. The visual images for numbers support the learning of the spoken number names.

## 8. Visual and multi-sensory learning helps

Visual or multi-sensory learning strengths should be used to aid the understanding and use of the number system. One example of this type of material would be the Numicon system, which provides a clear visual-spatial representation of the number system and shows the relationships between numbers to support the understanding of addition and subtraction. The Numicon activities support an approach to teaching number through the recognition of patterns, through play with the materials and through activities to help children 'see' the whole numbers without counting by developing mental images of them.

### 9. The importance of practice

Children with Down syndrome will benefit from sufficient practice to enable them to learn number. Children need to be taught information to learn it. They need to practice it to remember it. Practice leads to retention of information and more practice (overlearning) leads to automation. Automated skills require little conscious effort to use, therefore, freeing up working

memory space for mental processing during tasks. Overlearning also leads to information being made available for further learning and use in new procedures. Practice activities should be fun and varied and have real life relevance as often as possible.

## Summary

Consistently good teaching strategies throughout the school years are needed before the achievements of individuals with Down syndrome reflect their true potential for the development of maths and number skills. Pupils need a high standard of teaching, using a variety of techniques and approaches, with daily practice and everyday relevance. Social inclusion within the school and the community will help children apply their maths and number skills to everyday life. Increasing numbers of children with Down syndrome are improving their skills with access to better teaching at school, higher expectations within the family and at school, and greater opportunities to use their skills independently in the community.



## Recommended reading

*Number skills for individuals with Down syndrome – An overview* (2001). Gillian Bird and Sue Buckley. *Down Syndrome Issues and Information*. The Down Syndrome Educational Trust.

*Number skills development for infants with Down syndrome (0-5 years)* (2001). Gillian Bird. *Down Syndrome Issues and Information*. The Down Syndrome Educational Trust.

*Number skills development for children with Down syndrome (5-11 years)* (2001). Gillian Bird and Sue Buckley. *Down Syndrome Issues and Information*. The Down Syndrome Educational Trust.

*Number skills development for teenagers with Down syndrome (11-16 years)* (2002). Gillian Bird and Sue Buckley. *Down Syndrome Issues and Information*. The Down Syndrome Educational Trust.

*Memory development for individuals with Down syndrome* (2001). Sue Buckley and Gillian Bird. *Down Syndrome Issues and Information*. The Down Syndrome Educational Trust.

*Evaluating the Numicon system as a tool for teaching number skills to children with Down syndrome* (2005). Joanna Nye, Sue Buckley and Gillian Bird. *Down Syndrome News and Update*, 5(1), 2-13.

## Additional information

- [www.downsed.org](http://www.downsed.org)
- Address enquiries to: [enquiries@downsed.org](mailto:enquiries@downsed.org)
- See Numicon at [www.numicon.com](http://www.numicon.com)
- All *Down Syndrome Issues and Information* books and Numicon materials are obtainable from The Down Syndrome Educational Trust. Please visit the downsed online shop at <http://shop.downsed.org/>