



Supporting Numerical Difficulty in Schools

## **Supporting Numerical Difficulty:**

Educational Psychologists have a key role in supporting the learning of numerical and mathematical understanding (one area of which has been distinguished as Dyscalculia)

There are a number of policy and legislative documents available to support and guide practice.

## **Curricular Guidelines**

- ◆ Curriculum for Excellence Experiences and Outcomes
- ◆ Building the Curriculum 5
- ◆ NAR Supporting Assessment in Practice: A Professional Learning Resource
- ◆ NAR Flowchart

## **Legislation**

- ◆ Additional Support for Learning Act (2009)
- ◆ GIRFEC

## **Service Guidelines**

- ◆ Service Guidelines on Assessment, Consultation and Intervention
- ◆ Flowchart to support assessment of Numerical Difficulty

## Overview:

*'To face the challenges of the 21st century, each young person needs to have confidence in using mathematical skills, and Scotland needs both specialist mathematician and a highly numerate population'*

## Building the Curriculum 1

*Ensuring that all young people develop high levels of numeracy throughout the curriculum is a key responsibility of teachers and the underpinning ethos of CfE.*

### Key outcomes of numeracy and maths

1. Development of essential numeracy skills to enable full participation in society
2. Financial awareness
3. Interpretation of numerical information, make reasoned evaluation and informed decision making
4. Apply skills and understanding creatively and logically to solve problems, within a variety of contexts
5. Use technology effectively to enhance the development of skills and concepts.

Curriculum for Excellence experiences and outcomes detail a progression of skills in numeracy and maths development and are split into three areas. In order to develop, reinforce and extend learning, opportunities for learning and teaching in numeracy should be identified across the curriculum.

### Numeracy and Maths Experiences and Outcomes are split into three discrete areas:

- ◆ Number, Money and Measure
- ◆ Shape, Position and Movement
- ◆ Information Handling

## **Additional Support**

The development of numeracy and mathematical skills is complex due to the wide range of tasks that the learner will have to engage with, together with the range of cognitive processes which will have to be deployed. It is inevitable that there will be times when learners will require some level of additional support. Support provided will be contextual, within a staged intervention framework and will follow the guidelines of the National Assessment Resource Flowchart (NAR).

If appropriate support has been put in place over the longer term and the learner was still noted to have difficulties particularly in numeracy then further assessment may take place. This would be done in order to identify the specific nature of these difficulties, particularly if assessment demonstrated sound skills in subject areas where numerical skills were not required.

## **Definition of Dyscalculia**

*'Dyscalculia is a condition which affects the ability to acquire arithmetical 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'. (Department for Education and Science, 2001).*

Assessment at all times supports the individual needs of the child and planned interventions are couched within a staged intervention framework. Continual formative assessment strategies identifies targets to support progression and development and these targets are strategically linked to CfE experiences and outcomes.

## **Assessment:**

Building the Curriculum 5 states that '*Assessment approaches should be proportionate and fit for purpose.*'

Assessment should be circular and within a plan-do-review framework. It also should;

- ◆ Support and develop knowledge and understanding
- ◆ Provide feedback and clarity to parents and learners on strengths and areas of development
- ◆ Inform planning and identify next steps
- ◆ Inform practitioner reflection and continued professional development

## **National Assessment Resource (NAR):**

Supporting Assessment in Practice is an on-line resource to support assessment in schools. Assessment materials are stored to support educators on how CfE experiences and outcomes are being interpreted into practice. Exemplars available have been subject to external review and have received a quality mark.

NAR has been developed based on the following principles:

**Understand:** Develop thinking and practice of assessment within the context of CfE

**Plan:** Compare practice with other professionals to reflect and develop own planning

**Create:** Customize materials on NAR to meet needs in context

**Moderate:** Use exemplars as a focus for discussion to raise standards expectations and consistency

**Share:** Publish own assessments for other to use

**Use:** Use materials and shared understanding to convert E's and O's of CfE into practice

## **The Role of the Educational Psychologist in assessment**

The EP will undertake contextual assessment, considering variables at the level of the individual, school, home and community which may be impacting on the development of numerical/mathematical skills (see flow chart). Assessments undertaken by the Educational Psychologist will be agreed in collaboration with all stakeholders. These could take the form of;

- ◆ Analysis of samples of work
- ◆ Classroom observation
- ◆ Dynamic assessment
- ◆ Assessment of motivation/attribution
- ◆ Curriculum based assessment in collaboration with school
- ◆ Structured assessment (if deemed appropriate by all stakeholders)
- ◆ Analysis of target setting

## **Implications for Practice:**

Whilst it is recognised that there are a number of areas in conceptual numerical/mathematical skills which can impact on progression, research has indicated two areas as likely to cause difficulty in the continuing development of skills.

1. Numerosity: The understanding of numbers in a set
2. Subitising: The ability to process the numbers in a set quickly (up to 5 or 6) without resorting to individual counting.

These areas have been implicated as foundational from which numerical and mathematical skills will be developed. Assessment in early years should note whether these skills are developed before progression is sought.

If evidence points indicates difficulty in numerosity and subitising, then additional support should be given in early number awareness.

Research into specific maths difficulties highlight that strategies and intervention for support and continued development are the same principles which would apply to all individuals requiring additional support in numeracy and maths. Planning, assessment and evaluation is linked to CfE and is tailored specifically to the learning needs of the individual.

## Appendix One: Descriptors of Numerical/Mathematical Difficulty

### Level of the Child

- ◆ Is there a lack of automaticity in basic numerosity?
- ◆ Is there evidence that the child can subitise?
- ◆ Does the child have difficulties with counting in order?
- ◆ Is there a recognition that the number symbol relates to a value?
- ◆ Can the child order numbers according to magnitude?
- ◆ Can they learn and retain basic number facts and generalise them to other areas?
- ◆ Is there evidence of processing difficulty?
- ◆ Is conceptual understanding of mathematical operations mechanical, lack structure, coherence or planning?
- ◆ Evidence of immature strategies- counting all components instead of counting on
- ◆ Does the child lack confidence in selection, processing and manipulation?
- ◆ During direct teaching and in plenary, can the child provide an explanation as to how they got the correct answer?
- ◆ Are previously learned number facts forgotten when a new concept is introduced?
- ◆ Does the child struggle with numerical skills but is progressing well in other areas?
- ◆ Can the child demonstrate understanding in visual elements of maths e.g geometry?
- ◆ Is there evidence of slower processing in comparison to other peers?
- ◆ Does the child find it difficult to notice patterns?
- ◆ Are there difficulties with calculations involving money?
- ◆ Is there are marked delay in understanding time?
- ◆ Are they showing strength in other areas of the curriculum?

## Level of the School

- ◆ Are learning intentions clearly articulated?
- ◆ Are learners actively involved in setting the success criteria?
- ◆ Is a balance of time achieved between direct teaching, pupil engagement and plenary?
- ◆ Is the maths curriculum providing opportunities for active and purposeful manipulation of learning?
- ◆ Are pupils given time and space to engage in peer learning?
- ◆ Is the learning environment driven by textbook and worksheets?
- ◆ Is numeracy being taught using a multi sensory approach?
- ◆ Have appropriate breaks been given?
- ◆ Is the child being given enough time to process information?
- ◆ Is learning being built upon? Are links made to prior learning?
- ◆ Has sufficient scaffolding been put in place?
- ◆ Is the teacher providing opportunities for the child to generate questions independently?
- ◆ Has the practitioner clearly noted concerns, what strategies have already been put in place to counteract? What has worked?
- ◆ What formative assessment strategies are being used? How do they link to NAR
- ◆ If a PSA is being deployed, what is their role?

## Home environment:

- ◆ What aspects of Numeracy and Maths learning which your child is progressing well with?
- ◆ Is your child having difficulties understanding the concepts of time, specifically when there is a numerical process attached. In 10 minutes what will the time be?
- ◆ Does your child have difficulties with calculating prices and receiving correct change?
- ◆ Does your child have difficulties with measurement? e.g filling kettle to defined level, measuring quantities for baking etc.
- ◆ Is homework more challenging and onerous to support when the task is related to addition, subtraction, division and multiplication?
- ◆ Do they get anxious or upset when engaged in activities which have to rely on processing numbers ?
- ◆ Have you been collaborating with the class teacher to access additional support?

## Appendix Two: Strategies to Support

- ◆ Allow the child additional time to process information
- ◆ Revisit basic concepts frequently
- ◆ Ensure consolidation on the teaching of number bonds and numerosity skills acquisition. Do not move to basic numerical operations until the child is secure in number bond learning and demonstrating automaticity
- ◆ Ensure that there is access to visual concrete materials at all times
- ◆ Use a variety of visual aids, e.g. cuisenaire rods, beads, coins, counters etc to support understanding
- ◆ Provide active learning opportunities: Ensure that the child has demonstrated comprehension of the concept before moving to the written form. This should be time intensive and only considered when the child is demonstrating a confidence in their learning
- ◆ Provide experiential learning. Continual relatedness to real life situations should be sought
- ◆ As visual representation supports children with specific maths difficulties, pictures and diagrams should be given to scaffold learning between concrete active experiences and abstract written work
- ◆ Steps must be discretely taught and supported in context. Provide written stepped instructions to support
- ◆ Formatively assess progress through open questioning and demonstration of learning. Use of NAR to support.
- ◆ Minimise the amount of strategies that the child has to learn to achieve successful learning
- ◆ Play games with numbers to reinforce learning
- ◆ Vary the mathematical language and teach each term discretely and explicitly. This omission creates many of the difficulties observed in conceptual understanding.
- ◆ Ensure this learning is continually reinforced
- ◆ Teach and reinforce links between addition and subtraction and repeated addition and multiplication and multiplication and division
- ◆ Make the links between number problems and real life examples
- ◆ Emphasise the concrete e.g. two more cars rather than two more.

- ◆ Do not emphasise neatness or organisation of work as this will increase and put pressure on cognitive processing. If setting work is an issue, provide support or set the work out for the child prior to the lesson beginning
- ◆ It is preferable to allow the child to problem solve in draft or note form to reduce anxiety surrounding neatness to enable them to concentrate on understanding
- ◆ Let the child make their own maths problems and share them with the class.
- ◆ It is essential that pupils are given opportunities to talk about what they are doing and what they are thinking. Do it....See it...Say it....Draw it....Write it....Understand it...  
(Emerson & Babbie, 2010)

### **Appendix Three: Evidence Based Intervention strategies:**

Enhanced Home/School Liaison (Baker, Gerstner & Dae-Silk (2002)

Focused teaching, scaffolding linking abstract concepts with visuals  
(Wright, Martland and Stafford, 2006)

Teaching a discrete number of strategies needed to solve problems (Dowker 2004)

The learning of number bonds through use of visuals e.g. dominoes reducing processing demand (Anderson & Lyxell, 2007)

Use of Multi-Sensory approaches (Goswami and Bryant, 2007)

Targeted interventions. Contextual curriculum based measurement (AIFL, Baker, Gerstner, and Dae-Silk, (2002)

Peer and co-operative based learning (Davenport & Howe, 1999)

ICT as a support to effective teaching/learning and assessment

## Resources and Assessment Tools

### Resources:

#### Catch up Numeracy Project:

Provides targeted intervention for children with arithmetical difficulties. Four stage programme based on Dowker (2004) peer reviewed paper.

Stage One: Formative Assessments: Strategies used to identify individual learning profile

Stage Two: Collaborative target setting: Sharing of targets with pupils and parents

Stage Three: Structured multi sensory individual direct teaching (15 mins, twice each week)

Stage Four: Evaluation and review: Monitor progress, ensure that intervention is continue to target need

**Emerson, J & Babbie, P. (2010)** The Dyscalculia Assessment, Bloomsbury, London.

**Bird, R. (2007). The Dyscalculia Toolkit:** Supporting Learning Difficulties in Maths. Sage Publications, London. Practical strategies, activities and games to enhance numerical skills

**Number Shark 4** (White Space Limited) [www.wordshark.co.uk](http://www.wordshark.co.uk). Fully customisable  
Introduces strategies to enhance problem solving skills age from 3-14

**Numbers Counts:** Intensive intervention programme for children where maths has been highlighted as a key barrier to learning. [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/182299/DFE-RBX-10-07.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/182299/DFE-RBX-10-07.pdf) for independent evaluation of impact on numerical skills

**Tut Pup:** Interactive resource designed to enhance numeracy skills and improve mental agility <http://www.tutpup.com>

**Power of Two:** Maths programme based on reinforcement of key skills and peer support. Focuses on mental maths skills beginning with number bonds, formal operations, fractions

and problem solving. Age range: Infants to basic adult numeracy. Each session lasts for 15mins and should be repeated 4 times each week.

## **Assessment**

**InCAS General Maths Assessment:** Computerised Assessment currently being piloted in some schools in the LA. Evaluation of it's efficacy will be undertaken at the end of the school year.

The assessment are not formal and are not designed to be used as a comparative data. They normally take 30 minutes to complete. The questions generated are based on individual responses and are decided based on how well the child has completed the previous question. InCAS maths assessments are designed for primary aged children and assess basic numeracy, shape, measurement and information handling. It is singular assessment and will only provide information based on the child's performance that day.

## **Standardised Tests:**

**WIAT: Weschler Individual Achievement Test: Subtests in numerical operations and mathematical reasoning: Assesses calculation, reasoning skills and fluency.**

**Calculation:** The individual will solve maths problems including the four operations of addition, subtraction, multiplication and division. Mathematical concepts of geometry and algebra feature

**Reasoning:** This assesses the individuals ability to process the problem, extract the information needed whilst discarding irrelevant information in order to identify the correct solution. The assessment includes problem involving basic operations, time, money and information handling.

**Fluency:** Timed response to assess the speed to which the individual can complete basic maths calculations. The duration of each of the three blocks of tests is 1 minute. The individual is asked to complete as many simple calculations in the areas of addition, subtraction and multiplication as possible.

## **Diagnostic Test:**

Butterworth, B (2003) The Dyscalculia Screener NFER Nelson

The assessment is timed and answers entered into a computer. It analyses numerical understanding and numerosity. Results of the assessment will not diagnose Dyscalculia, and will merely identify risk factors. Limitations of the screener include, child anxiety, and motivation. It also cannot ascertain other variables which may be impacting on the child's developing numerical skills, including environmental influence and quality of instruction. It also cannot identify targets in contextual learning and progression.