

Guidance on identifying dyscalculia and supporting children and young people (CYP) who have persistent difficulties in acquiring numeracy skills.

This guidance has been collaboratively coproduced through consultation with representatives including: Headteachers, Educational Psychologists, Specific Learning Difficulties Advisory Teachers and Parents.

1. Numerical/Numeracy Skills

Numeracy is defined as the ability to execute standard number operations correctly, consistently and fluentlyⁱ, and there are many different skills needed in order to become numerate. These include the ability to estimate and calculate using a range of strategies, with an understanding of these concepts both mentally and on paper.

Children acquire numeracy skills at different ages and at differing rates, and as a result start school with varying levels of numeracy. After a period of teaching, some children demonstrate difficulty learning to understand and manipulate number. Over time, these difficulties can be persistent, and lead to considerable distress and loss of interest in learning.

It is important that delays are identified as soon as possible, as early identification and intervention for numeracy difficulties have been shown to be more effective early in a child's education than interventions for older childrenⁱⁱ.

2. Definition of Dyscalculia

There is no doubt that some children have difficulties learning maths/numeracy skills for reasons other than inadequate educational experiences and/or profound/severe learning difficulties. While it is recognised that children and young people can struggle with maths and numbers, this does not always mean that they have developmental dyscalculia.

It is important to note that the development of mathematical skills is hierarchical and cumulative, i.e. you need to grasp certain skills and concepts before you can learn others; gaps in learning can have a significant impact.

Other factors that can have an effect on learning maths/numeracy can include:

- environmental: for example, lack of appropriate learning opportunities;
- emotional: for example, maths self-concept, maths anxiety;
- cognitive challenges: for example, slow processing speed, difficulties with working memory, visual processing, language processing;
- academic difficulties: for example, poor literacy;
- speech and language: receptive and expressive language;
- physical and sensory: for example, vision and hearing, and fine motor skills.

This list is not exhaustive but indicates a range of difficulties that can impact on maths performance. It is important not to underestimate the impact these difficulties can have.

Approximately 5-8% of school-age children have memory or other cognitive deficits that interfere with their ability to acquire, master and apply mathematical concepts and skillsⁱⁱⁱ.

Developmental dyscalculia is a specific deficit of a very basic capacity for understanding numbers, which leads to a range of difficulties in learning about number and arithmetic^{iv}. Research is not yet well developed but currently suggests the prevalence of dyscalculia to be around 5%^{v vi}, depending on definition.

Hertfordshire definition for Developmental Dyscalculia

Mathematics difficulties are best thought of as a continuum, not a distinct category, with Developmental Dyscalculia at the extreme end.

It should be expected that Developmental Dyscalculia will be distinguishable from general mathematical difficulties due to the severity of difficulties with:

- number sense: the ability to understand and use number and the number system (i.e. ordering);
- subitising: instant recognition of the number of items in a small group without counting^{vii};
- symbolic and non-symbolic magnitude: ability to discriminate quantity pictorially or in symbols (i.e. maths words and digits)^{viii}.

Dyscalculic learners may:

- have difficulty understanding simple number concepts;
- lack an intuitive grasp of numbers;
- have on-going problems learning number facts and procedures, performing fluent calculations, and interpreting numerical information.

Even if they produce a correct answer or use a correct method, they may do so mechanically and without confidence.

Developmental Dyscalculia is:

- a **persistent** difficulty in understanding and acquiring skills related to arithmetic and basic number sense **despite targeted intervention**;
- an unexpected difficulty in maths that cannot be explained by external factors;
- diverse in character and occurs across all ages and abilities;
- a specific learning difficulty for mathematics, especially arithmetic;
- often co-occurring with other learning difficulties and neuro-developmental difficulties.

An assessment of developmental dyscalculia is a process, not an event and should happen over time, taking into account a child/young person's patterns of strength and needs through the assess – plan – do - review cycle.

Acquired dyscalculia can arise as a result of traumatic brain injury.

Recent research has concluded that maths interventions should be individualised, based on assessments of a child's specific strengths and weaknesses within mathematics so that each individual child's weaknesses can be targeted effectively. This advice is in line with approaches to address maths difficulties by schools and ISL professionals in Hertfordshire.

Maths learning difficulties is an umbrella term used to describe problems with learning and applying mathematical facts and procedures^x. However, the exact nature of the difficulties may vary for each individual CYP. Some learners who do not meet the criteria for dyscalculia, (i.e. difficulties with subitising, number sense, magnitude and ordering) but still have severe and persistent difficulties with maths despite targeted intervention, can be described as having specific learning difficulties with maths.

3. Assessment of Numeracy skills and difficulties (including dyscalculia)

It is important that assessments take into account the different factors that could impact on a CYP's progress in numeracy skills.

To inform teaching, it is important to know what the CYP can do and what the next steps are to know what to teach the CYP next. The Assess – Plan – Do – Review cycle guide written by the Educational Psychology Service (EPS) has information and advice written for schools on how to do appropriate assessments. This is generic for all needs of the CYP and suggests that staff should gain information from a variety of sources, including class-based work, observations, progress over time, additional assessments, speaking to the CYP and involving parents/carers.

When a child or young person is not making expected progress in their numeracy skills, **teachers are best placed** to complete an accurate school-based assessment in order to inform an appropriate intervention to address those difficulties. The expected procedure is that the assessment of number development will be ongoing by schools (see Appendix 1 for information on the assess – plan – do – review cycle in relation to maths difficulties and dyscalculia). There is no single test available which will reliably indicate dyscalculia. There is a range of materials that can be used effectively by schools to pinpoint strengths and difficulties linked to maths, available on the Local Offer (see Appendix 2). These assessments can measure number skills and will identify the specific areas of numeracy that need developing through consideration of SMART (i.e. specific, measurable, achievable, relevant and time-bound) targets based on next steps and putting in place targeted interventions to address these. School staff should involve parents/carers and the CYP throughout this process. For more guidance on this, please see the Assess – Plan – Do – Review cycle guidance from the EPS.

As soon as maths difficulties are identified, schools should put in place appropriate reasonable adjustments and consider access arrangements.

The assessment of numeracy difficulties is a process rather than a one-off event, and without evidence of appropriately personalised / targeted intervention by schools, dyscalculia cannot subsequently be confidently identified.

For those children whose numeracy difficulties are persistent and not responsive to the evidence-based interventions delivered over time, following the assess – plan – do - review model, more specific assessments of strength and needs and bespoke interventions (based on these assessments) may be required.

“Where a pupil continues to make less than expected progress, despite evidence-based support and interventions that are matched to the pupil's area of need, the school should consider involving specialists, including those secured by the school itself or from outside agencies.” (6:58 SEN Code of Practice 2015)^x

“A school should always involve a specialist where a pupil continues to make little or no progress or where they continue to work at levels substantially below those expected of pupils of a similar age despite evidence-based SEN support delivered by appropriately trained staff. The pupil's parents should always be involved in any decision to involve specialists.” (6:59 SEN Code of Practice 2015)

In line with the Hertfordshire graduated approach, specialist services such as ISL's SEND Specialist Advice and Support or the Educational Psychology Service (EPS) can become involved if:

- schools are able to evidence that they have delivered quality first teaching, i.e., the effective inclusion of all CYP in high-quality everyday personalised teaching and inclusive classrooms (see Appendix 4);
- baseline assessments (see Appendix 2) are in place and both universal and targeted support has been delivered and has been monitored consistently as part of the assess – plan – do – review cycle (Appendix 1);
- this support has been based on tailored CPA (Concrete, Pictorial and Abstract) interventions which have been delivered appropriately;
- the CYP is not making progress or making only very limited progress and remains significantly behind their peers in numeracy skills.

If the CYP meets the thresholds for involvement from ISL (see graduated approach, Appendix 3), a Specialist Advisory Teacher (SpLD) or Educational Psychologist (EP) involvement may include:

- consultation with school staff and parents (in line with the graduated approach) to explore interventions that have been put in place, look at pupil assessment information and make further recommendations on teaching and learning strategies. They may work with the school staff to achieve a better understanding of the factors that may be preventing the child from making progress;
- the SpLD teacher may contribute to staff development by providing specific difficulties with number training and model specific interventions relevant to the child's needs;
- work directly with the CYP to complete a detailed assessment of their strengths and difficulties and recommend targeted interventions based on the findings of the assessment. These should then be reviewed;
- **it is the responsibility of the school/setting to implement, monitor and review advice given by ISL professionals.**

The SpLD Advisory Teacher should be involved in the first instance if there is a specific, persistent numeracy need.

The EP will be involved in cases that are complex, for example, when maths difficulties/dyscalculia contribute to social, emotional and mental health needs. The EP may suggest further involvement from the SpLD Advisory Teacher should a specific and persistent number need be identified when involved in supporting a CYP who has complex needs.

A range of assessments pertaining to number concepts, decomposition/recomposition, language of number, fluency, working memory and visual processing speed may be completed by SpLD Specialist Advisory Teachers and/or Educational Psychologists as part of identifying strategies for teaching staff or to identify best practice and evidence-based intervention.

EPs and SpLD Specialist Advisory Teachers may use tests of cognitive functioning. These tests sometimes show that children and young people with numeracy difficulties also have difficulties with cognitive processes such as memory, language, visual-spatial and information processing. Cognitive assessments can be useful for overall educational planning and ensuring that there is the appropriate level of intellectual challenge in lessons. However, cognitive assessments do not provide the information needed to plan numeracy interventions and they should not be used to predict progress in numeracy.

The EP and SEND Specialist Advice and Support (SEND SAS) carry out assessments that focus on identifying tailored interventions and teaching strategies to support CYP in making progress in their learning and attainment. If through assessment, CYP are identified as having specific difficulties in maths or meeting criteria of dyscalculia as outlined in the HCC ISL definition, this will be stated in written reports.

Assessment over time and monitoring of the CYP's response to teaching is now accepted as the most effective way of identifying numeracy difficulties, informing intervention and determining the rate of progress^{xi}.

CYP with suspected visual-perceptual difficulties should be referred to an appropriate professional, e.g. Orthoptist, Optometrist or Ophthalmologist in the context of a comprehensive assessment of vision.

Herts for Learning have produced the [SEND Toolkit](#) to assist school staff in supporting CYP with SEND.

4. Intervention and support within schools

All CYP are entitled to fair access to the relevant support to meet their needs, including dyscalculia, that enables them to progress. It is important that both the individual numeracy skills causing concern and the CYP's ability to understand the content of lessons are considered when planning a support package. When planning any support, the emotional well-being and confidence of the CYP should be prioritised, with all adults having a clear understanding of the CYP's needs.

The Code of Practice (2015) provides statutory guidance for organisations that work with CYP who have special educational needs and/or disabilities (SEND), on duties, policies and procedures relating to Part 3 of the Children and Families Act 2014. The Code stipulates a process of assess – plan – do - review in identifying and meeting the CYP's SEND needs. This is also referred to as the Graduated Response.

Assessment through teaching provides a framework for the assess – plan – do - review process. It supports teachers and teaching assistants in monitoring the CYP's access to the curriculum (subjects where maths skills are involved) and response to a skill-based intervention. This takes into account assessments over time and emphasises the importance of analysing the teaching when reviewing a CYP's progress (see Appendix 1). It is important to involve the parents/carers and the CYP as part of the review process.

Reasonable adjustments need to be in place to address any numeracy difficulties. It is important that these are available to all CYPs in the class if they want them, and CYPs should be allowed to use them if they feel that they need them/would be helpful. Most CYP will naturally stop using them for more efficient methods when they feel that they no longer need to rely on resources to complete their maths learning. Examples of reasonable adjustments in lessons include (also see Appendix 4 and information from Jo Boaler^{xii}):

- visual resources;
- concrete resources and manipulatives;
- alternative methods of reading (e.g. reading pens, readers);
- alternative methods of recording (e.g. scribes, touch typing, voice-activated software);
- special arrangements to support verbal working memory and processing speed difficulties (e.g. additional time, avoiding unnecessary copying).

An accurate assessment of numeracy skills and/or other underlying difficulties is required to identify the specific areas to address. The content of an intervention will depend on the areas of numeracy causing concern and their associated pre-requisite skills.

It is important that the teaching methods used within any intervention are shown in research to be effective. Research emphasises that focusing on how and what children and young people are taught is more important than school structures, organisation, or where they are

taught. Consistent high quality teaching is more effective than other factors such as ability grouping, class size, individualised teaching and spending more money^{xiii}.

Research shows that **teaching** and interventions are most effective when the following are included:

- distributed practice, i.e. short, frequent teaching sessions (a little but often approach), that incorporate practise of identified skills, as this addresses any identified working memory deficits^{xiv};
- teaching of skills to fluency and generalisation, as well as accuracy^{xv}, by ensuring that there are sufficient opportunities for children and young people to practise the skills before moving on;
- a structured approach using task analysis that ensures that one new skill is taught at a time, ensuring that skills are taught in a hierarchical sequence, and includes mixing old and new learning, which minimises forgetting^{xvi}; e.g. Precision Monitoring^{xvii};
- ensuring CYP are fully informed about the purpose of interventions, their achievements and rate of progress^{xviii};
- peer-assisted learning^{xix};
- utilising appropriately trained teaching assistants to implement well-founded interventions^{xx};
- CPA (Concrete, Pictorial, Abstract) is a core feature of supporting CYP with numeracy difficulties^{xxi}.

It is important to implement an intervention/adjustment **consistently** for a reasonable amount of time (i.e. at least 4-6 weeks), to allow the CYP to get used to it and provide opportunity for improvement to be made. For example, a CYP's anxiety (see next section) may act as a barrier in accessing the intervention fully until they become used to it, meaning that any improvement may not be seen immediately.

Staff should monitor the impact of the intervention on the CYP as part of the assess – plan – do – review cycle.

5. Emotional/Affective elements impacting on maths performance

Emotional elements of learning are important when addressing performance in maths. One of the key negative emotional response is maths anxiety (MA). Maths anxiety can be described as “a feeling of tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations”^{xxii}. There is evidence to show that one in five people belong to a group of high maths anxious individuals^{xxiii}.

Research has found a connection between maths anxiety and maths performance, establishing that the higher the maths anxiety, the lower the potential performance in maths^{xxiv}. The origins of MA have been classified into three groups^{xxv} and include:

- environmental variables (e.g. negative experiences in class or family contexts; poor teaching; teacher and parent own anxieties about maths; extrinsic expectations);
- intellectual variables (child's level of cognitive abilities);
- personality variables (self-esteem, self-concept; attitude, confidence and learner behaviour).

Affective elements which are considered to have a positive impact on maths performance if developed effectively are:

- self-concept (what you think about yourself as a maths learner) and self-efficacy (how good you think you are at maths) are critical in the achievement and enjoyment in the subject^{xxvi}.
- mindset is an important consideration, with a positive attitude toward maths uniquely predicting maths achievement, even after accounting for multiple other cognitive-affective factors^{xxvii}.

A number of ways have been identified as promoting self-concept, self-efficacy and improved mindset about maths:

- key attitudes and behaviours to promote with pupils when doing maths activities have been identified in research^{xxviii xxix}. Some key themes are incorporated into the 5Cs: Being CALM, CURIOUS, CO-OPERATIVE, COMICAL, CONFIDENT (see Appendix 5).
- teachers helping students practise breaking down problems and using structured questions to improve their thinking around their approach to maths problems has been shown to have a positive impact on performance, as well as helping pupils to feel more comfortable by breaking down the task into manageable chunks.
- learning and enjoyment of maths has been found to be improved through co-operative group talk amongst pupils^{xxx} and working together to solve a problem.

6. Provision in Hertfordshire

The majority of CYPs' needs in this area should be met within the graduated response as described in the SEND Code of Practice within mainstream schools via SEN Support (see Appendix 1). It is the school's statutory responsibility to meet these needs from their delegated budget. Most CYPs' needs are met using a structured and systematic framework within school that incorporates the recommendations detailed above to varying intensity.

Schools can request support and guidance from the SEND Specialist Advice and Support (SEND SAS) as outlined in Appendix 3.

The Educational Psychology Service can provide consultation, training and support in effective evidenced-based interventions. For example, the Psychology Assistants provide training and support in Precision Monitoring, which can be accessed via the school's contact Educational Psychologist or through the DSPLs (Delivering Special Provision Locally).

Very occasionally, concerns about a CYP's numeracy level and progress continue despite a rigorous assess – plan – do - review framework that incorporates recommendations from specialist support services. In such cases, further assessment can be requested from the Local Authority through an Education, Health and Care (EHC) Needs Assessment in line with the SEND Code of Practice.

If an EHC Plan is in place, monitoring of the CYP's progress in response to intervention transfers to the Local Authority, in partnership with parents/carers and schools. This is achieved through the Annual Review process. In exceptional circumstances, where a CYP fails to progress with access to additional resources as described, specialist provision may be identified. These CYP usually have SpLD as part of a more complex special needs profile, e.g. they also have Social Emotional and Mental Health needs and/or Speech, Language and Communication needs.

7. Partnership with parents/carers

CYP's numeracy needs are best met when schools and parents/carers work in partnership, where there is mutual trust and where information is shared. In line with the SEND Code of Practice, parents/carers must be included in discussions and fully informed about the assess – plan – do - review process undertaken in school to meet numeracy needs.

As with all aspects of education and particularly SEND, parents who accept and understand their child's needs are best placed to support them and advocate on their behalf. Parents and carers are also key in helping their child to understand what specific maths difficulties and dyscalculia are, how they affect them as an individual and how to manage day to day.

Below are some starting points for parents.

- Hertfordshire SEND Local Offer: <https://www.hertfordshire.gov.uk/microsites/Local-Offer/The-Hertfordshire-Local-Offer.aspx>
- <https://mathsnoproblem.com/blog/author/judyhornigold/>
- www.stevechinn.co.uk
- <https://www.mathsexplained.co.uk/>
- <https://www.understood.org/en/learning-thinking-differences/child-learning-disabilities/dyscalculia/what-is-dyscalculia>
- https://www.youtube.com/channel/UCohFUmeat0UxOnNmRh92P_Q Ronit Bird
- Dyscalculia Pocketbook 2015 by Judy Hornigold
- Maths Learning Difficulties, Dyslexia and Dyscalculia: Second Edition (Dyslexia Essentials) Paperback – Illustrated, 18 Oct. 2018

8. Frequently asked questions

8.1. I am concerned about a CYP who seems to have maths difficulties

See flow chart to explain the process within the assess - plan – do - review cycle for supporting CYPs who you feel have maths difficulties (Appendix 1). It is important that rigorous assessment is completed over time, looking at the response to interventions and supports in place.

See also reasonable adjustments at the end of this policy to support these CYPs within the lessons when difficulties have been identified (Appendix 4).

See information about maths anxiety in this policy and implement advice as appropriate.

8.2 What help is available for teachers who are concerned about maths difficulties

The first port of call would be to talk to your **SENCo or maths subject leader**. Consider whether CPD is needed to support the teaching of maths (see HfL website) or to meet the needs of learners with specific difficulties (see the Hertfordshire Local Offer for information, resources and assessments and also access SpLD universal training).

8.3 Why are manipulatives so important in teaching maths across the primary and secondary curriculum?

Research shows that a Concrete, Pictorial, Abstract approach is the most effective way of teaching new maths concepts and supporting understanding, e.g. using Dienes to support the teaching of tens and ones to using Numicon or Cuisenaire for ratio and percentages. Access to manipulatives should not be seen as a resource only for learners with SEND, but

should be available for all learners, supported by strong use of language to scaffold learning and visualisation techniques and skills. Manipulatives should be available throughout KS1 and KS2 for all pupils, and potentially into KS3, especially for teaching new concepts and for those students who are working below age-related expectations. These resources help to develop CYPs' visualisation skills so they can move towards pictorial or abstract representations of these concepts.

8.4 Why can games help maths learning?

Games that are carefully planned can target particular areas of maths difficulties or misconceptions. They will motivate pupils to give themselves plenty of practice in whatever mathematical technique or concept they need to understand. Playing games also reduces anxiety, which can enable learning to take place.

8.5 What else can help a CYP with their maths skills?

Research^{xxxi} shows that increasing maths activities at home increases children's maths achievement at school. There are lots of opportunities to use maths skills (numeracy and others) in everyday life and to have discussions around numbers and numerical concepts.

For example, you could:

- discuss odd and even numbers on doors while out and about, look out for road speed signs;
- help them to understand coin denominations when giving pocket money or when paying for shopping;
- ask them what the time is and talk about how long it will be until teatime;
- allow them to weigh ingredients for cooking; let them help you get the right number of items while shopping;
- discuss when setting the table how, if each person has three pieces of cutlery, and there are five people eating, that there will be 15 pieces of cutlery on the table, or simply ask them to count out enough of each item to lay the table.

All of these experiences will help the maths feel more real to the CYP and provide them with lots of different opportunities to practise their skills. When you start to look for maths opportunities in everyday life you will start to notice them everywhere!

8.6 Are all children and young people with maths difficulties dyscalculic?

No, there are some other reasons why children may struggle to develop their maths skills, for example, profound/severe learning difficulties/disabilities, speech and language difficulties/disorders, poor vision, poor hearing, early learning experiences, not having access to appropriate teaching or extended absence from school.

Maths difficulties lie on a continuum, and the most severely affected children and young people will need ongoing maths support throughout their education and into adulthood.

Dyscalculia is a very specific maths difficulty, but many CYPs may have specific difficulties that affect their learning in maths.

8.7 Is dyscalculia hereditary?

Dyscalculia and maths difficulties can run in families, which suggests there may be genetic or environmental factors. If there is a family history of maths difficulties, it is important to tell your child's teacher/SENCo.

There is, however, also a growing body of evidence that indicates intergenerational transmission of low maths achievement and high maths anxiety. The research^{xxxii} suggests that when parents are more maths anxious when supporting their children at home, their children learn significantly less maths and have more maths anxiety.

8.8 Is the involvement of an SpLD Specialist Advisory Teacher or Educational Psychologist needed in order to have maths difficulties or dyscalculia recognised?

Maths difficulties can be identified by following the Code of Practice (2015), using the assess – plan – do - review approach. Schools have access to the appropriate screening and assessment tools (see Appendix 2), so it is not always necessary to have an Educational Psychologist or other external specialists involved in order to support the CYP. However, staff in schools sometimes find it helpful to discuss the difficulties with a member of ISL, and can seek further, in-depth assessments (including consideration of dyscalculia), if a CYP's difficulties appear to be significant and persistent and it is felt necessary to do these assessments to inform action planning.

8.9 Does a CYP need to be identified as having specific maths difficulties or dyscalculia in order to access support in schools/setting?

No, all schools are already responsible for making reasonable adjustments for learners including access arrangements for exams (including extra time, scribe, reader). Schools also routinely put extra support in place for all CYP with SEND. Provision and intervention are based on level of need rather than categories of difficulty. This may involve CYPs being disapplied in external exams, including SATs. However, this should always be done in joint agreement with the CYP's parents/carers.

In order to reduce the chances of the CYP being seen as different, settings should always have regard to the self-esteem and mental health of learners when making changes in provision such as testing.

8.10 Will a private report identifying dyscalculia get more help for a child?

No, schools and ISL services can carry out the appropriate assessment and put in place the intervention for the child. However, if there is a private report, it will be considered.

8.11 Can identification of specific maths difficulties or dyscalculia be helpful?

Yes. Identification can help with a shared understanding of the challenges for the individual, and helps the individual makes sense of why some things are more difficult for them and develop self-help strategies to achieve the best they can. This can reduce frustration and support self-esteem and well-being.

Appendix 1: Assess – Plan – Do – Review Cycle for Maths Difficulties and Dyscalculia

In line with SEND
Code of Practice

Review

- Take account of views of CYP and family, as well as school staff
- Evaluate accuracy, fluency and generalisation of targets set
- Evaluate self-esteem and well being
- Where progress is good, identify what worked and how this can support next steps
- Where progress is slow:
 - Do targets need to be broken down further?
 - How can teaching / resources be adjusted to meet need?
 - What further assessment is needed to pinpoint strengths and difficulties?
 - Have all reasonable adjustments been implemented? Impact?
 - Does support need to be 1:1, rather than small group?

When all these aspects have been addressed and progress is still slow, consider involving external professionals e.g. SpLD/EP

Assess

- Gaps/misconceptions identified in class teaching
- Talk with the CYP and their parents/carers about strengths, difficulties, maths self-concept and confidence
- School based assessment (e.g. curriculum-based assessments) and exams
- SpLD number assessment
- SpLD checklists for memory and processing speed
- Explore other difficulties e.g. visual / language / motor
- Consider how far maths self-concept and confidence is affecting learning
- Progress towards SMART targets from previous APDR cycle (if applicable)

Do

- Implement reasonable adjustments and access arrangement with clear differentiation
- Be positive and supportive, address anxiety and promote self esteem, independence and metacognitive skills
- Use a concrete - pictorial – abstract approach to all learning and focus on teaching one skill at a time, with the most useful ones being taught first and ensuring that skills that can be confused are separated
- Time limited interventions. Focus on one skill at a time, teach directly and explicitly in a range of contexts and to high levels of fluency
- Mix old and new learning regularly to revise and overlearn previously taught concepts through repeated practice
- Monitor implementation to ensure provision is matched to need

Plan

- What reasonable adjustments are needed to allow for low-threshold, high-ceiling opportunities for all cognitive and linguistic levels?
- Would access arrangements be helpful in school and external exams?
- Focus to secure early number concepts and basic maths skills (i.e. through task analysis) that are most useful and can be generalised. Teaching should be clear.
- Use identified strengths to support planning and to tackle difficulties
- Ensure all staff involved are appropriately trained and equipped, time is allocated for necessary support and/or intervention, and suitable space is available
- Set specific, measurable, achievable, relevant time-based targets based on assessments with CYP, family and all staff involved

Appendix 2: Assessing for Maths Difficulties and Dyscalculia

An assessment of maths difficulties and developmental dyscalculia is a process not an event and should happen over time, taking into account a child/young person's patterns of strength and needs.

These assessments are the first steps for schools to follow if they feel that a CYP has maths difficulties. The results of these assessments should form the basis of agreed SMART targets and the strategies that are used to meet those targets (e.g. written in an Individual Education Plan/provision map).

Area of difficulty	School based assessments
A persistent difficulty in understanding and acquiring skills related to arithmetic and basic number sense despite targeted intervention ;	Response over time to targeted, personalised intervention through the assess – plan – do – review process. This should be delivered regularly by an experienced and / or trained member of staff.
Explore other areas of underlying difficulty that could be affecting progress in maths	<ul style="list-style-type: none"> ➤ SpLD memory checklist ➤ SpLD processing speed checklist ➤ Visual processing checklist ➤ Maths self-concept checklist (also Hertfordshire Steps anxiety mapping) ➤ British Picture Vocabulary Scale
Difficulty understanding simple number concepts	<ul style="list-style-type: none"> ➤ SpLD Baseline number assessment content and assessment guidelines ➤ SpLD Baseline number assessment pupil booklet ➤ SpLD Baseline number assessment resources
On-going problems learning number facts and procedures, performing fluent calculations, and interpreting numerical information	<ul style="list-style-type: none"> ➤ School-based assessments of calculation including multiplication facts including extra time as normal way of working as needed
Number sense – the ability to understand and use number and the number system	<ul style="list-style-type: none"> ➤ SpLD Baseline number assessment – as above
Subitising instant recognition of the number of items in a small group without counting	<ul style="list-style-type: none"> ➤ SpLD Baseline number assessment – as above
Symbolic and non-symbolic magnitude: ability to discriminate quantity in symbols (i.e. maths words and digits) or pictorially.	<ul style="list-style-type: none"> ➤ SpLD Supplementary magnitude assessment ➤ Ongoing observation

School Assessments available on the Local Offer

Appendix 3: Hertfordshire Targeted Services Offer – Summary - Specific Learning Difficulties (SpLD)

This 3-level model includes guidance on the identification and assessment of specific maths difficulties and dyscalculia, who should undertake such assessments and the recommended waves of provision.

Level 1 – Monitoring of progress – teachers. Level 2 – Skills assessment.

Level 3 – Comprehensive assessment.

UNIVERSAL SPLD - LEARNER PROFILE	UNIVERSAL – SCHOOL	UNIVERSAL – SEND SAS	IDENTIFYING maths difficulties and dyscalculia
<p>The learner is working generally within or just below age related expectations. Some difficulties with learning may include some misconceptions and/or taking longer to understand new concepts. Difficulties may be specific to one aspect of learning.</p>	<ul style="list-style-type: none"> • A broad and balanced curriculum is planned for all pupils and the school is flexible in adapting the core offer to meet needs of all pupils. • Opportunities are provided for small group work based on identified need. • High quality teaching, differentiated for individual pupils, is the first step in responding to pupils who have or may have SpLD in addition to environmental considerations. 	<ul style="list-style-type: none"> • Access to resources to support specific learning difficulties via resource centres. • Telephone consultation for quick queries re: SpLD e.g. advice re: resources or general strategies for SpLD. • Background information on specific learning difficulties for school staff available via professionals' web pages on Herts Local Offer. • Access to County wide training delivered by ISL to raise awareness of issues relating to SpLD and strategies to support difficulties. 	<p>Level 1 At this stage, it is class teachers who identify maths difficulties. They will notice individual differences and adjust their teaching. They will also be aware of the possibility that some children and young people may have specific maths difficulties and dyscalculia.</p> <p>Class teachers will discuss concerns with parents / carers and explain that the possibility of specific maths difficulties will be explored with more specialist school colleagues e.g. SENCo in the light of the child and young person's response to maths interventions and taking account of Herts SpLD online information and support.</p> <p>Class teachers will also explain to parents / carers the interventions that are being put in place using the assess – plan – do review cycle and will work with families to ensure there are no underlying difficulties.</p>
UNIVERSAL PLUS – SpLD LEARNER PROFILE	UNIVERSAL PLUS - SCHOOL	UNIVERSAL PLUS – SEND SAS	IDENTIFYING maths difficulties and dyscalculia
<p>The learner is working just below age related expectations in specific curriculum areas and progress is limited in specific areas of learning and development. At the lower end of the average range for attainment with some difficulties relating to SpLD using Herts SpLD Outreach assessments or similar. Low level difficulties in the acquisition/use of reading, spelling, writing, handwriting and numeracy skills. Learner may experience some difficulties with pace of curriculum delivery.</p>	<ul style="list-style-type: none"> • Some additional and/or different provision enhances the core offer. • TAs are used flexibly so that the teacher can focus on individuals and groups. • Activities and time built into lesson planning to give opportunities for pupils to work on their own targets. • Alternative forms of recording routinely offered and used: ppts, oral presentation, mind maps, vocabulary pictures/lists etc. • Progress in interventions is recorded and shared with teachers so that 	<ul style="list-style-type: none"> • Provision of SpLD baseline assessments to support the assess – plan – do – review cycle in schools. • Accredited training relating to pupils with specific learning difficulties for school staff in partnership with external agencies. 	<p>Level 1 At this stage, it is class teachers who identify maths difficulties. They will notice individual differences and adjust their teaching. They will also be aware of the possibility that some children and young people may have specific maths difficulties and dyscalculia.</p> <p>Class teachers will discuss concerns with parents / carers and explain that the possibility of specific maths difficulties will be explored with more specialist school colleagues e.g. SENCo in the light of the child and young person's response to maths interventions and</p>

	learning is transferred, and focussed teaching can be planned to address any difficulties.		taking account of Herts SpLD online information and support. Class teachers will also explain to parents / carers the interventions that are being put in place using the assess – plan – do review cycle and will work with families to ensure there are no underlying difficulties.
TARGETED - SpLD LEARNER PROFILE	TARGETED - SCHOOL	TARGETED – SEND SAS	IDENTIFYING maths difficulties and dyscalculia
Persistent difficulties in the acquisition/use of literacy/numeracy skills and there is evidence of an increasing gap between their performance and age-related expectations. Progress is slow and ongoing tailored additional support is required to ensure progress and/or access to the curriculum. Below average range for attainment and evidence of ongoing difficulties relating to SpLD using Herts SpLD Outreach assessments or similar. There may be co-occurring difficulties e.g. independence and organisation.	<ul style="list-style-type: none"> • Assessment using SpLD resources (or similar) to identify strengths and difficulties and to plan for learning. • On-going opportunities for 1:1 support focused on targets in relation to SpLD assessments and following SpLD Outreach advice (appropriate records kept). • Routine opportunities for overlearning and practice of basic skills on a regular basis. • Regular monitoring and evaluation of programmes to measure outcomes against starting points. 	<p>Service request for named, issues focused consultation/advice (up to one term) – SpLD SAS support may include:</p> <ul style="list-style-type: none"> • Support for schools to select and interpret SpLD assessments and results and use these to set and review precise short-term targets relating to identified learning difficulties. • Advice in relation to Service Request regarding classroom strategies/resources. • Support to implement targeted interventions through advice, exemplar teaching and observation. • Core training with up to date evidence or research-based programmes. 	<p>Level 2 The class teacher and SENCo assess the child and young person's difficulties and response to intervention. The main purpose of assessments undertaken at this level is to plan further teaching in the expectation that it will significantly advance the child and young person's progress.</p> <p>However, in many cases the teachers will consider whether or not the CYP 'appears to have specific maths difficulties' and discuss their emerging view with the child and young person's parents.</p> <p>The main decision being made is about what more should be done to counter the particular difficulties the child and young person is experiencing.</p>
TARGETED PLUS SPLD LEARNER PROFILE	TARGETED PLUS – SCHOOL	TARGETED PLUS – SEND SAS	IDENTIFYING maths difficulties and dyscalculia
Progress is very limited , despite evidence of appropriate and sustained support in school following SpLD Specialist Teacher advice. The learner is operating at a level well below age related expectations and there is evidence of an increasing gap between them and their peers and s/he may be showing signs of frustration or loss of self-esteem. Well below average range (SS 70 – 79) for skills such as working memory, processing speed or indicated by other relevant assessments. Significant and persistent difficulties in the acquisition of literacy/numeracy skills. Possibly some complexity of other needs. Significant difficulties with organisational skills and	<ul style="list-style-type: none"> • An individualised learning programme is developed with support from SpLD Outreach Service and SENCo. This is overseen by qualified and experienced teachers and TAs are directed. • Daily opportunities for 1:1 support focused on specific targets plus opportunities for 1:1/small group work based on identified needs. Intensive and varied opportunities are provided to develop automaticity in reading and writing or number skills. • Assistive technology is used to support learning where appropriate. • Manage access arrangements for internal and external examinations and assessments. 	<p>Service Request for named, personalised assessment and advice (time limited, up to one-year max) – SpLD SAS support may include:</p> <ul style="list-style-type: none"> • The specialist teacher undertakes further assessments to identify strengths and difficulties, seeks views of learner and family and takes account of relevant external reports. • Tailored advice/report enables school to understand difficulties, regularly set and review longer term targets and take effective action through personalised time-limited intervention programme. 	<p>Level 3 Appropriately qualified professionals, (when involved) in consultation with parents and the CYP's class teacher, may make a decision as to whether or not the child and young person has specific maths difficulties or dyscalculia in accordance with the Hertfordshire definition of number difficulties and dyscalculia</p> <p>The professionals regarded as 'appropriately qualified' should be those who are identified as such i.e. be appropriately qualified and experienced members of school staff, psychologists or specialist ISL SpLD teachers.</p>

independent learning may be present.			
SPECIALIST SpLD LEARNER PROFILE	SPECIALIST - SCHOOL	SPECIALIST – SEND SAS	IDENTIFYING maths difficulties and dyscalculia
Learner may have an EHCP which indicates specific learning difficulties. The learner will experience significant, complex, persistent and enduring specific learning difficulties. Significantly below average range for attainment and skills related to SpLD e.g. working memory, phonological skills, processing speed or indicated by other relevant assessments with SS below 70.	<ul style="list-style-type: none"> Curriculum planning reflects levels of achievement. Substantial adaptations may be required in at least the core subjects to allow the learner to work and be assessed on programmes of study appropriate to the learner rather than the key stage. An individualised learning programme is developed with support from the SENCo and advice from education and noneducation professionals as appropriate. Qualified and experienced teachers oversee and direct TAs to deliver aspects of the programme acting on advice from external specialists. Frequent opportunities for small group work based on identified need. 	<p>Service request for named, personalised assessment and advice (longer term) – SpLD SAS support <u>may</u> include:</p> <ul style="list-style-type: none"> The specialist teacher undertakes further assessments as required to identify strengths and difficulties, seeks views of learner and family and takes account of relevant external reports. Tailored advice enables school to understand difficulties and take effective action through: <ul style="list-style-type: none"> personalised intervention programme; advice for parents enables support at home; exemplar teaching and modelling of interventions, resources and strategies and assistive technologies; CPD from specialist staff ensures that mainstream staff have understanding of SpLD related to learner; specialist teacher supports school in ongoing reviews of progress against targets set and personalised support. 	<p><i>In most cases pupils at specialist support will have had a range of needs and strengths identified but where appropriate level 3 will also be applicable</i></p> <p>Level 3 Appropriately qualified specialist teachers and other professionals, (when involved) in consultation with parents and the CYP's class teacher, may make a decision on whether or not the child and young person has specific maths difficulties or dyscalculia in accordance with the Hertfordshire definition of developmental dyscalculia.</p> <p>The professionals regarded as 'appropriately qualified' should be those who are identified as such i.e. be appropriately qualified and experienced members of school staff, psychologists or specialist ISL SpLD teachers.</p>

See Hertfordshire [Local Offer](#) for further information.

Appendix 4: Inclusive Classrooms for Specific Learning Difficulties

Practical Resources

- **Prompt cards** e.g. bpd, simple / complex sounds, letter / digit formation, sentence starters, worked examples of key punctuation
- High frequency **word lists** easily available (appropriate to key stage/pupil/subject)
- **Resources for writing**, e.g. alphabet strip - lower and upper case, range of pens, pencils, grips and sloping boards available as required
- **Resources for spelling** e.g. phoneme and syllable frames, mini whiteboards, spelling journals, range of dictionaries as appropriate, ask SIRI etc.
- **Scaffolding** available e.g. problem-solving grids, writing frames
- Trays, cupboards, drawers clearly **labelled with picture prompt** if possible and **colour coded**
- All pupils reminded and encouraged to use a range of **1st hand equipment** readily available. (e.g. number lines, Numicon, 100 squares, Dienes, word mats, electronic spell checkers etc).
- **Visual timetable** and **memory prompts** (e.g. sticky notes, individual whiteboards, jottings) to promote independence
- **Reduce glare on IWB** and experiment with **pastel backgrounds** for visual comfort. **Write clearly** and **use colour / layout** to organise information for easy access.

The Learning Environment

- Opportunities for children to work in a range of **groupings**; **seating** carefully planned; **distraction free** working space available.
- Arrangements in place (e.g. buddying, adult support, pre teaching, talk partners) to enable all children to **access learning**
- **Effort** as well as achievement clearly valued
- Clear messages (written as well as oral) promoting **positive learning behaviours** to encourage resilience and allow all pupils to learn from mistakes
- **Appropriate behaviour** (including learning behaviours) noticed, praised and reinforced
- **Independence in learning** is actively promoted - learners develop self-help strategies





- **Additional adults** promote independence, protect self-esteem and increase pupils' inclusion within their peer group
- A selection of **reading books** available (including high interest, low reading age texts)

Day to day strategies

- Learning objectives and date on **stickers or scribed** for pupils who have difficulty copying or short date available on board for pupils with writing or copying difficulties
- **Paper stand** for pupils with visual tracking / working memory difficulties when copying or working from text is essential –avoid all unnecessary copying
- **Copies of text** available to highlight/ underline / annotate as well as read from board
- All **board writing and labels** in line with school handwriting policy
- Use of **spelling strategies** and organisational strategies e.g. **mind mapping** demonstrated regularly by adults during lessons
- All pupils can **see and hear** the teacher and any resources in use
- **Displays are uncluttered and include** key vocabulary, steps to success, examples of good work (variety of levels) picture stimulus, questions to engage
- Adults speak clearly, **sum up regularly** and **check understanding** during lessons
- Give **instructions in the order of tasks** and provide **written versions of multi-step** directions. Use **working walls** to support with steps to progress, children's work as well as adults.
- **New vocabulary** clarified, written up, displayed, returned to, modelled in use – pre teach key vocabulary and texts where necessary
- Provide **texts appropriate to reading abilities, read instructions aloud** if needed, encourage **paired reading**, do not ask learners to read aloud (unless they want to) and **check comprehension** through summary, prediction and clarification
- Effective **use of ICT** as an access strategy (e.g. on-screen word bars, predictive word processing, speech to text) and build in opportunities to learn keyboarding skills
- Opportunities are provided for **alternative forms of recording** e.g. scribed/ word processed/ photographs, recorders etc.

- **Expectations** e.g. outcomes and time available **made clear** and **adjusted to need**
- Differentiated lesson **planning** shows opportunities for all children to work with teacher as well as TA and takes account of range of learning preferences
- **'Stickability'** of new learning facilitated by range of strategies e.g. metaphor, analogy, colour, humour, drama, 1st hand experiences - links made to new learning and 'bigger picture' of learning journey
- Adults and learners aware of **strengths as well as difficulties**, **targets** set and **progress** towards these
- Range of sensitive opportunities and methods for **self /peer assessment** during the lesson as well as at the end
- **Questions** pitched to challenge pupils at all levels, **thinking time / opportunities to make jottings** built in as needed
- **Range of opportunities for pupils to contribute** e.g. making suggestions from which the children can choose, speculating, making a personal contribution from own experience
- **Marking** in line with school policy - comments read aloud to learners if necessary and time allowed to respond to marking. Mark for content rather than spelling where appropriate, and identify most helpful words e.g. high frequency, to address in spelling practice.
- **Homework** differentiated and recorded clearly for learners with reading / writing difficulties
- **Instructions** clear, chunked with numbered, written reminders and / or opportunities for pupils to repeat and clarify
- **Worksheets** have clear font, lines/ paragraphs numbered (both ends), information chunked e.g. questions interspersed with text if possible, include diagrams, picture clues and bullet points, copied on cream or pale pastel colours if needed, double line spaced if necessary

Appendix 5: Behaviours to Encourage

				
Calm	Curious	Co-operative	Comical	Confident
relaxed	questioning	discussing	fun	positive
composed	challenging	demonstrating	enjoyable	assured
unruffled	enquiring	supporting	engaging	secure

Calm: Remember the adult is a key factor in conveying anxiety to pupils – so think about your own anxiety levels prior to a session and be aware of how this may transfer to pupils you are working with. Breathing activities will support calmness at a physiological level.

Curious: Open questions are key – try not to shut down questions by focusing on just getting the right answer. Metacognitive questioning will support a more thoughtful approach and strategy to problem solving.

Co-operative: Encourage talk between pairs during the problem solving and in whole group discussions when reflecting of their approaches. Support pupils to model how they arrived at an answer with others in the group. Support reflection of what went right and how they could improve their approach or strategy next time. Encourage peers to give feedback on each other.

Comical: Keep the atmosphere light and not too serious so that pupils feel motivated to come to sessions. Try and support understanding that maths is fun and relevant to the pupils outside the classroom in their daily life.

Confident: provide feedback based on what they have done well – be specific and use examples of what they did well. Try not too generous with just general feedback like “well done”. Encourage the use of self-talk and self-coping statements.

-
- ⁱ Sharma, M.C. (2019). *Dyscalculia and Other Maths Difficulties*. Paper presented at British Dyslexia Association conference on Dyscalculia, 14th June 2019.
- ⁱⁱ Geary, D.C. (2015). Preschool Children's Quantitative Knowledge and Long-Term Risk for Functional Innumeracy. In S. Chin (ed) *The Routledge International Handbook of Dyscalculia and Mathematical Learning Difficulties*. Oxon: Routledge
- ⁱⁱⁱ Geary, D.C. (2004). Mathematics and learning disabilities. *Journal of Learning Disabilities*, 37, 4-15.
- ^{iv} Butterworth, B. & Yeo, D. (2004). *Dyscalculia Guidance: Helping pupils with specific learning difficulties in maths*. NferNelson Publishing Company Limited: London.
- ^v Jarrett, C. (2018). *UK study finds children with maths difficulties (SLDM and dyscalculia) far less likely to receive an official diagnosis than their peers*. <https://digest.bps.org.uk/2018/09/18/uk-study-finds-children-with-maths-difficulties-sldm-dyscalculia-are-100-times-less-likely-to-receive-an-official-diagnosis-than-peers-with-dyslexia/> [Accessed 18/03/20].
- ^{vi} British Dyslexia Association (2019). *Neurodiversity and cooccurring difficulties – dyscalculia and maths difficulties*. <https://www.bdadyslexia.org.uk/dyslexia/neurodiversity-and-co-occurring-differences/dyscalculia-and-maths-difficulties> [Accessed 18/03/20].
- ^{vii} Gifford, S., (2018) *Subitising*. [Subitising \(maths.org\)](http://www.maths.org) .
- ^{viii} De Wolf, M., Grounds, M. A., Bassok, M., Holyoak, K. J. (2014). Magnitude comparison with different types of rational numbers. *Journal of Experimental Psychology: Human Perception and Performance*, 40(1), 71–82.
- ^{ix} SpLD Assessment Standards Committee (2019). *SASC Guidance on assessment of Dyscalculia and Maths Difficulties within other Specific Learning Difficulties*.
- ^x DfE (2015). *SEN Code of Practice*. London: DfE
- ^{xi} Vaughn, S. & Fuchs, L.S. (2003). Redefining Learning Disabilities as Inadequate Response to Instruction: The Promise and Potential Problems. *Learning Disability: Research & Practice*, 18(3), 137-146.
- ^{xii} Boaler, J. *Setting up Positive Norms in Math Class*. <http://www.youcubed.org/wp-content/uploads/Positive-Classroom-Norms2.pdf>
- ^{xiii} Hattie, J. (2009). *Visible Learning*. London: Routledge.
- ^{xiv} Baddeley, A. (1997). *Human Memory: Theory & Practice*. Hove: Psychology Press.
- ^{xv} Haring, N.G. & Eaton, M.D. (1978). Systematic instructional procedures: An instructional hierarchy. In N.G. Haring (ed), *The Fourth R: Research in the classroom (p23-40)*. Columbus, Ohio: Charles E. Merrill.
- ^{xvi} Solity, J.S. (2008). *Michel Thomas: The Learning Revolution*. London: John Murray.
- ^{xvii} Roberts, W. & Norwich, B. (2010). Using precision teaching to enhance the word reading skills and academic self-concept of secondary school students: A role for professional educational psychologists. *Educational Psychology in Practice*, 26(3), 279-298.
- ^{xviii} Education Endowment Fund (2017). *Improving Mathematics in Key Stages Two and Three: Guidance Report*. London: EEF
https://educationendowmentfoundation.org.uk/public/files/Support/Publications/Maths/KS2_KS3_Maths_Guidance_2017.pdf
- ^{xix} Wegerif, R., Littleton, K., Dawes, L., Mercer, N. and Rowe, D. *Widening access to educational opportunities through teaching children how to reason together*. [\(PDF\) Widening Access to Educational Opportunities through Teaching Children how to Reason Together | Rupert Wegerif - Academia.edu](http://www.academia.edu/34844444/Widening_Access_to_Educational_Opportunities_through_Teaching_Children_how_to_Reason_Together)
- ^{xx} Education Endowment Fund (2018). *Making Best Use of Teaching Assistants*. London: EEF
https://educationendowmentfoundation.org.uk/public/files/Support/Publications/Teaching_Assistants/TA_RecommendationsSummary.pdf
- ^{xxi} For example: <https://mathsnoproblem.com/jerome-bruner-theories-put-into-practice>
- ^{xxii} Richardson, F. C., & Suinn, R. M. (1972). The Mathematics Anxiety Rating Scale: Psychometric data. *Journal of Counseling Psychology*, 19(6), 551–554.
- ^{xxiii} Ashcraft, M. H., & Kirk, E. P. (2001). The relationships among working memory, math anxiety, and performance. *Journal of Experimental Psychology: General*, 130, 224–237.
- ^{xxiv} Collingwood, N & Dewey, J. (2018) 'Thinking Your Problems Away': Can maths interventions be developed to address both the academic and affective aspects of learning in primary aged children? *Educational & Child Psychology: Special issue, September 2018*, 76-92.

-
- ^{xxv} Devine, A., Fawcett, K., Szűcs, D., & Dowker, A. (2012). Gender differences in mathematics anxiety and the relation to mathematics performance while controlling for test anxiety. *Behavioral and Brain Functions*, 8(33), 1–9.
- ^{xxvi} Reyes, L. H. (1984). Affective Variables and Mathematics Education. *The Elementary School Journal*, 84(5), 558–581.
- ^{xxvii} Chen, L. (2018). Positive Attitude Toward Math Supports Early Academic Success: Behavioral Evidence and Neurocognitive Mechanisms. *Psychological Science*, 29(3): 390–402.
- ^{xxviii} Boaler, J. (2016). *Mathematical Mindsets: Unleashing Students' Potential through Creative Math, Inspiring Messages and Innovative Teaching*. San Francisco, CA: Jossey-Bass.
- ^{xxix} Lee, Clare; Johnston-Wilder, Sue; Pardoe, Steve; Baker, Janet; Heshmati, Holly and Nyama, Joyce (2018). *Mathematical Resilience Workshop*. In: British Congress for Mathematics Education 9, 3-6 Apr 2018, Warwick.
- ^{xxx} Kramarski, B., Mevarech, Z. R., & Arami, M. (2002). The Effects of Metacognitive Training on Solving Mathematical Authentic Tasks. *Educational Studies in Mathematics*, 49(2), 225-250.
- ^{xxxi} Berkowitz, T., Schaeffer, M., Peterson, L., Gregor, C., Levine, S., and Beilock, S. (2015). Math at home adds up to achievement in school. *Science*, 350 (6257), 196-198.
- ^{xxxii} Maloney, E., Ramirez, G., Gunderson, E., Levine, S., and Beilock, S. (2015). Intergenerational Effects of Parents' Math Anxiety on Children's Math Achievement and Anxiety. *Psychological Science*, 26 (9), 1480–1488.