



# ADDRESSING MATHS ANXIETY

## A GUIDE FOR EDUCATORS

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## CONTENTS



#### **INTRODUCTION:**

What is the maths anxiety guide based on?	2
What is maths anxiety?	3
Why is understanding maths anxiety important?	4
How to use the guide	5
Self-reflection and understanding maths anxiety	6

## **APPROACHES:**

Relaxation	7
Expression of emotion	8
Cognitive reappraisal	9
Storybooks	10
Behaviours	11
Cognitive load	12
Recent developments	13





#### What is the maths anxiety guide based on?

This guide provides an overview of strategies that have shown promise in supporting learners with maths anxiety. These are largely based on evidence from empirical studies within the psychological literature. Despite the seemingly specific nature of maths anxiety, empirical attempts to reduce it are surprisingly varied. As such, our intention is to provide broad coverage of strategies within the published literature. It should be acknowledged that there is a wide body of literature more specific to learning and teaching maths. However, here we focus on more targeted ways to address maths anxiety directly, using psychological knowledge.

The strategies outlined in this guide can be utilised by educators across a range of settings, working with different age groups. While some of the approaches may initially seem to be more suited to a particular age group, these can be modified and adapted accordingly to be age-appropriate for the intended learners.





#### What is maths anxiety?

Mathematics (maths) anxiety can be described as the fear, panic, worry, and general negative emotion experienced in response to learning maths, engaging in mathematical problem solving, and even in response to numerical or mathematical stimuli. Sometimes a learner can experience heightened anxiety in specific maths situations, including those such as maths tests or when they feel their maths ability is being evaluated in some way. However, learners might also feel anxious about maths in a broader context, including situations that are not immediately or obviously evaluative. For example, they might experience anxiety in anticipation of a maths lesson, feeling gradually more anxious the closer it gets.

Learners might experience panic, and this might be associated with a fight or flight response; often, they will feel overwhelmed and might want to flee the maths situation in which they find themselves. Other times, maths anxiety might be associated with negative thoughts that can interfere with a learner's ability to concentrate, ultimately affecting their learning and ability to problem solve.

In extreme cases, a highly maths anxious learner could feel worried and nervous even in situations where they are not directly involved, e.g. listening to someone else talk about maths. Greater levels of maths anxiety are related to more negative attitudes towards the subject, including lower levels of enjoyment and perceived usefulness. Self-beliefs are also more likely to be negative among those with high maths anxiety, including having lower maths self-efficacy and generally being less likely to see oneself as a maths person.





#### Why is understanding maths anxiety important?

High maths anxiety can be considered a well-being issue. Acute anxiety, particularly episodes of panic, can affect a student's quality of life. Maths anxiety can also be persistent, negatively impacting a student's thoughts and feelings over a long period of time.

Maths anxiety can lead to avoidance of the subject and engagement with maths tasks. At the micro level, for example, learners might complete maths tasks quickly at the expense of accuracy. Maths anxiety can also negatively impact attention during a maths lesson, such as when listening to instruction and engaging with a task. At the macro level, higher maths anxiety can result in the avoidance of future study or careers involving maths.

Maths attainment is negatively associated with maths anxiety, such that learners with higher maths anxiety are more likely to under perform compared to those with lower maths anxiety. A high level of maths anxiety is also more likely to affect performance on more complex maths tasks, resulting in more errors and learners generally taking longer to attempt or complete their work.





#### How to use the guide

Maths anxiety research has predominantly focused on causes and consequences, but relatively little work has focused on viable and accessible intervention approaches that can be adopted in the classroom. In some cases, approaches have been devised around a learner engaging with more maths, which may not support maths anxiety directly. In other cases, trialled interventions have not been repeated in research to determine whether these deliver consistent outcomes in reducing maths anxiety. Here, approaches are described in terms of basic underlying mechanisms, but not necessarily providing full procedural details. This is because i), in the original published work, authors have not always reported such detail, and ii) there should be flexibility in which education educators adopt and use each strategy.

This guide provides a starting point - approaches that can be implemented and amended according to your practice and understanding of the learning needs of the learners that you teach. Educators have the benefit of having already established a learner-teacher relationship, from which familiarity, trust, and rapport will support decision-making and implementation of the proposed strategies.





It should be noted that interventions in the published literature are often based on limited testing in different groups or populations. Therefore, caution should be exercised when adopting strategies for use with groups upon which those strategies have yet to be fully tested. Likewise, as part of your own practice, it is necessary to consider sensitivities around the suitability of the various approaches in the context of culture, individual differences such as communication ability and SEND, and specific policies of the educational organisation in which you work.

As part of using the strategies outlined within this guide in your own practice, we also encourage educators to monitor and track learner progress to determine whether there are any changes in maths anxiety, maths attainment, and general attitudes toward the subject. To support this, we have provided a fully validated and reliable measure of children's maths anxiety, whereby children can respond to a series of questions and the individual total score can indicate those who may be at risk of maths anxiety. This can be an initial indicator for educators to then implement targeted support, choosing from the approaches outlined in this guide. We also support flexibility and practitioner creativity as the approaches are trialled and monitored. In addition, we acknowledge that some strategies will take a direct approach by explicitly discussing maths anxiety with learners, whereas others might adopt a more indirect approach; a professional judgement is sometimes required.

To develop understanding of how approaches can be used in the classroom, along with any challenges experienced along the way, we encourage educators to give feedback via the QR code at the end of this guide.



## Self-reflection and understanding maths anxiety

Before progressing into more specific strategies, it is important to simply make time and space to facilitate discussion about maths anxiety. It is possible that learners may not recognise their feelings as anxiety. In particular, younger learners might experience confusion at how they feel about maths; they might have limited understanding of the concept of anxiety more generally. Therefore, an initial approach that has shown promise is to develop learners' understanding of anxiety and how this might support greater awareness and understanding of their own thoughts and feelings towards maths. As part of this, educators can look for opportunities to initiate conversations about learners' thoughts and feelings – this is discussed in the context of normalising maths talk later in the guide.

Passolunghi et al. (2020) exemplified a self-reflective approach to addressing maths anxiety in learners. Their 'maths anxiety training' involved a multi-stage process, including:

- i) knowledge and recognition of emotions through playful activities.
- ii) understanding what is causing changes in emotion, and what changes are observed in the body associated with changing emotions.
- iii) a focus on stories about other's feeling towards maths.
- iv) breathing exercises and safe place visualisation.
- v) turning negative thoughts into positive ones. A multi-strategy approach such as this reflects our own ethos regarding successfully addressing maths anxiety, starting with learners' understanding and recognising how they feel.





6

One way in which learners can self-reflect in the context of maths is through the use of **self-report scales**. Scales are useful for educators to identify learners in need of support. However, self-report scales can present an opportunity for learners to simply start thinking about their feelings towards maths, offering some context that might help them make sense of how they are feeling. When choosing a self-report scale, it is important to select one that is suitable for the age group of the learners. For example, for young children you might consider using the Children's Mathematics Anxiety Sale UK (Petronzi et al., 2018), and for adult learners you might use the Mathematics Anxiety Scale UK (Hunt et al., 2011). These scales, along with many more resurces, can be found here: www.marg.wp.derby.ac.uk

**Self-awareness, monitoring, and reflection** are important features of many targeted strategies for addressing maths anxiety. These are also part of a general approach to addressing maths anxiety which is emotion regulation. This can support learners to feel more in control of their emotions and avoid panic and feeling overwhelmed. A key feature of strategies that support emotion regulation is developing an awareness of anxiety triggers, thus enabling learners to anticipate their responses and implement various strategies at the right times.



#### Relaxation

For many, relaxation is an obvious way to tackle anxiety. In the context of maths anxiety, a few specific strategies have been tested. A common approach is **diaphragmatic breathing**, which involves learning how to breath in a more effective manner, using one's diaphragm. There are many useful instructional videos that can be freely accessed online to better understand this practice. An important aspect of this approach in the context of maths learning and testing is for learners to monitor their breathing and to refocus their attention as needed, taking a more mindful approach.

#### Mindfulness-based

strategies are a useful way to support learners in directing their attention. This may be particularly relevant in the case of maths anxiety because it is widely recognised that maths anxiety is related to preoccupation with unhelpful, intrusive thoughts, e.g. worries about failure, time pressure, and others' judgements.

Other, relatively simple, **relaxation strategies** that have been tested in the classroom include colouring and playing relaxing music. These offer flexibility in how they are used, especially given variation in learners' preferences.







#### **Expression of emotion**

8

When it comes to maths learning and testing, there is a great deal of variation in how learners express their emotions. Some learners will readily express how they are feeling, others will hide their feelings, whereas others might express certain emotions that do not necessarily outwardly reflect their inner feelings. In the latter case, a learner might appear angry or frustrated as a manifestation of their anxiety. As such, it is helpful to consider how educators can facilitate the expression of true feelings in ways that are cathartic and safe. One such approach is **expressive writing**, which provides learners with the opportunity to state, in written form, their thoughts, worries, and feelings. This is usually performed shortly before maths testing, as this is considered a typical anxiety-provoking situation for a learner who has high maths anxiety.



A caveat to this approach is that success rates are mixed. It is highly likely that a range of factors contribute to how successful the approach is. For example, there are several specific ways in which an expressive writing task can be designed and implemented. It is also likely that learner characteristics need to be carefully considered, e.g. language, writing ability, and the ability of a

learner to understand their own emotions. As such, educators are best placed to determine the suitability of this strategy, whilst also considering creative ways to use it. Similarly, the Arts, e.g. drawing, painting, or drama, might offer a safe and creative space for learners to explore and express their feelings and thoughts about maths. This approach might be particularly useful for learners who struggle to articulate their emotions.



### **Cognitive reappraisal**

A key component of maths anxiety is how and what learners think. This often means that learners think in an unhelpful and sometimes incorrect way when it comes to their beliefs about their own maths learning and ability. **Growth mindset** is one concept that has received much attention in recent times, with higher maths anxious learners being more likely to have a fixed, rather than growth, mindset when it comes to maths. Maths anxious learners will often feel they are unable to learn new mathematical concepts and might hold the belief that they "just can't do it". Perceived failure in maths can also reaffirm a learner's self-beliefs that they are not a "maths person". There are ways to support the development of a growth mindset, including the use of the growth zone model (Johnston-Wilder et al., 2020) and reframing negative statements, such as "I can't do this maths problem" to "I can't do this maths problem yet". One feature of a growth mindset is the perception that struggle is an important part of learning maths; that making mistakes is both normal and helpful in building mathematical understanding.

Based on this, educators can consider ways to emphasise the **importance of struggle**, including the fact that struggle features in mathematical problem solving at all levels. Further related to this, educators can support learners by **challenging maths myths**. For example, this might include challenging the notion that i) mathematical problem solving is only about identifying a correct solution, ii) even the more adept mathematicians do not struggle, iii) inherently, a learner will have a higher maths ability based on personal characteristics such as sex or ethnicity, and iv) maths is not applicable to the real world. On the latter point, educators can go beyond typical examples, providing learners with examples of maths in a wide range of applications. Importantly, such applications should be relevant to what learners are interested in, whether that is a specific job, interest, or hobby.

A further area to explore in relation to how learners think concerns the notion of **challenge vs threat**. Typically, maths anxiety is associated with perceiving maths situations as more threatening; that they carry various risks (often to one's maths self-concept) and are something to avoid. Therefore, supporting learners to reappraise unhelpful thinking, i.e. to consider an upcoming maths task as less threatening, can have positive effects. Some suggestions for how to achieve this include i) identifying and challenging incorrect perceptions of past performance, and ii) developing learners' understanding of the benefits of heightened physiological arousal as a response to challenge, which, at an individual level, could be anything from entering a maths classroom to sitting a maths exam.



Research also tells us that learners sometimes **interpret what educators say** in a different way to how a message was intended, so being mindful of this when giving instructions or feedback to learners might pre-empt feelings of maths anxiety, e.g. emphasising support if a teacher intends to meet with the learner.

9



### Storybooks

Storybooks and games can be useful methods to promote mathematical exploration and engagement by enhancing the fun of learning. These can also create a non-judgment-based environment that can minimise concerns of incorrect answers or negative peer judgment. Storybook approaches – or other creative formats – can be tools for educators to initiate conversations with children and to encourage them to talk more about their feelings and possible worries about maths learning. By doing so, this can normalise discussions of maths feelings and make this part of maths lessons, including sharing ideas and approaches to feeling calmer. A storybook approach can provide a framework for reflection of maths feelings, particularly for younger children who may struggle to do this independently. This approach applies principles of expressive writing, and a technique called **bibliotherapy**. This involves learners reading about someone else's experiences and identifying with them, leading to an understanding that their own struggles can be addressed. This technique can facilitate discussions and emotional responses to encourage change in feelings towards a particular challenge, such as maths.

Within storybooks, positive maths messages can be embedded that focus on building, for example, self-efficacy and demonstrating the value of maths.

Petronzi et al. (2023) implemented a storybook approach in research with children aged 6–7 years and found that children responded positively to this approach which encouraged discussions about maths and fostered more favorable attitudes toward the subject.

Specifically, children who had self-reported medium to higher maths anxiety using an age-appropriate maths anxiety rating scale, expressed more positive attitudes towards maths by the end of the story, whereby they were more solution-focused and described proactive actions for another learner who might be worried about maths. Problem solving opportunities - which children enjoyed contributed to changes in attitude and children engaged with these independent of instruction or guidance. These findings suggest that children can be receptive to positive messages about maths which can be integrated into a range of resources and creative approaches and can help support emotion regulation. Encouraging children to talk about feelings, to understand these, and to develop coping strategies may help to build confidence in maths. This also aligns with cultivating a supportive learning environment in which effort toward success in maths is praised.



10



#### **Behaviours**

Many maths anxious learners use **procrastination** as a short-term coping strategy for avoiding maths, including in-class and at-home maths activities. Learners can be supported in **i**) identifying when behaviour represents procrastination, and **ii**) ways to encourage avoidance of procrastination itself, e.g. rewarding engagement with maths activities. Similarly, a tactic often used by maths anxious learners is to complete maths tasks as quickly as possible, sacrificing accuracy. Therefore, rewarding genuine attempts can be a useful way of engaging learners who are otherwise speeding through their work simply to avoid the anxiety it generates. Also, because maths anxious learners sometimes **self-impose time pressure**, it can help if educators explicitly state if there is no time limit, even encouraging learners to take their time.



Research indicates that children in early education can perceive maths as being a competitive subject, and children who are less secure in their ability - or who are experiencing a degree of maths anxiety – are likely to struggle to maintain the pace and workload of higher performing children. The competitiveness of maths means that some children are negatively impacted if they, for example, finish work after their peers or not at all, and some children can internalise the cause of their failure (e.g., 'I'm rubbish at maths). Learners can become wary of wider negative peer judgement, and scenarios where they may be called on to solve maths problems in front of peers, which can increase evaluation anxiety. Educators should therefore be mindful of the extent of this anxiety experienced by some learners. One approach could be to build a learner's confidence by asking relatively simple questions when it is done in front of others. Other options could include the use of mini whiteboards where individual learners write a response that only the teacher can see. In extreme cases of maths anxiety, a learner might simply need some reassurance that they will not be "put on the spot" in a maths class.



### **Cognitive Load**

Maths anxiety approaches can also focus on how maths is learned and leads us to consider cognitive load. Learning occurs when information transitions from short-term to long-term memory, but only a limited amount of information can be processed at once. Therefore, learning can be impacted by having too much information to process. In some instances, extraneous cognitive load, such as **excessive instructions**, may contribute to the development of maths worries and anxiety if learners are unclear on task expectations and they struggle to complete work. Cognitive load in maths can be better managed by providing clear and concise guidance (reducing unnecessary information), repeating information as needed, allowing learners to work independently, and presenting information in various formats. As a final note, maths anxiety exists in many learners with special educational needs and disabilites (SEND), which can appear **hidden**. In such cases, the concept of cognitive load becomes particularly relevant.





#### **Recent developments**

Several UK institutions currently use **therapy dogs** to support staff and student mental health, and have also supported children with reading anxiety, raising awareness of their emotions and improving behaviour. Therapy dogs are now being explored in terms of the potential benefits surrounding maths learning and managing feelings toward maths

For example, Soll & Petronzi (2023) found that children's self-reported maths anxiety was lower after engaging in a structured 2-week therapy dog intervention. This included two 15-minute focused therapy dog sessions in the maths class, and children worked with maths problems in a dog-themed workbook to enhance fun and engagement whereby questions and problems were framed around the therapy dog.

To challenge potential negativity linked to, for example, making mistakes, positive messages about maths were framed around the therapy dog, e.g., "Mistakes are Riddley's [therapy dog] superpower!" Moreover, emotion regulation was promoted by asking children to engage in self-reflection and cuddle the dog whenever they experienced maths related worries. This approach aimed to help them identify their worries and learn how to manage them effectively.



## **SUMMARY**

 Image: Mathematics

 ANXIETY

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This maths anxiety guide has given a brief overview of some of the psychological approaches that have been proposed within the academic literature. In some cases, these have been empirically tested, but it is always worth noting that educators are best placed to consider **i**) the suitability of strategies for their learners, and **ii**) ways in which such strategies can be modified and combined. It is our hope that the strategies outlined here provide a starting point for educators in thinking about new ways to address maths anxiety.

We welcome you to let us know your experiences in adopting and adapting the strategies presented here. This can be done by scanning the QR code.



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