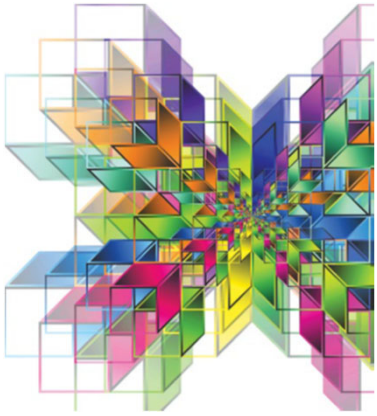
AQA
Realising potential

GCSE Maths: Teacher Virtual communities

Autumn 2021



Welcome

Helen Hindle is Head of Maths at a large comprehensive secondary school in Inner London. At her school, maths is taught in mixed attainment classes in years 7-10 and in either Foundation or Higher classes in Year 11, with no setting within those tiers. Helen is in her 4th year as Head of Maths and has previously been Head of Maths at schools in East Sussex and Havering. You can follow Helen on twitter @helenhindle1. Helen also has two websites, www.mixedattainmentmaths.com and www.growthmindsetmaths.com where she freely shares resources to support the development of a growth mindset within students and strategies and resources for teaching mixed attainment maths classes.

Today's event

- Overcoming maths anxiety and developing a growth mindset in your students.
- Problem solving – developing students' confidence and independence.
- Supporting students to learn effectively in classes with a range of prior knowledge.

This workshop shares strategies to help students overcome maths anxiety with a focus on strategies to develop students' engagement with multistep problem solving questions. It also provides strategies for supporting students in classes with a range of prior knowledge, as this is an issue which effects both mixed attainment classes and 'set' classes, particularly at the current time, following students' different access to, and engagement with, online learning.

Maths anxiety

Centre for Neuroscience in Education University of Cambridge

'Mathematics Anxiety is a negative emotional reaction to mathematics that can be debilitating.'

Centre for Neuroscience in Education, University of Cambridge

- It is recognised that maths anxiety is a separate issue from anxiety around taking tests in general.
- Maths anxiety is unique which can interfere with people's ability to manipulate numbers/solve mathematical problems.

The Centre for Neuroscience in Education at Cambridge University, recognises mathematics anxiety as a separate issue from anxiety around taking tests in general. They suggest that mathematics is unique in this sense as other subjects do not seem to develop subject specific anxiety. Mathematics anxiety leads to an avoidance of any situation in which mathematics may be involved and interferes with people's ability to manipulate numbers or solve mathematical problems. Mathematics anxiety can range in severity, the Centre for Neuroscience in Education estimate that between 2-6% of secondary school students suffer with 'extreme' mathematics anxiety.

What this can look like in our classrooms

- Students not wanting to verbally contribute answers or ask questions.
- Students preferring not to give a written answer rather than risk writing down an incorrect answer.
- Students trying to 'hide' mistakes.
- Students giving up.

Maths anxiety results in students not wanting to ask or answer questions during the teacher's explanation or class discussion for fear of 'looking stupid' by asking a 'silly' question or making a mistake in their answer. This is not restricted to verbal responses but shows itself clearly in students' work, especially in written assessments, when students skip a question entirely rather than attempting an answer. The certainty of gaining no marks for a question is a 'safer' option than the chance of gaining a mark when it goes hand in hand with a chance of committing to paper an incorrect answer or mistake. Maths anxiety also shows itself in students' class work when they use excessive crossing out to hide mistakes, tear out pages, choose tasks that are too easy for them or use a range of work avoidance techniques including low-level disruption. It also shows itself in those students who have given up, who don't revise before assessments, who don't complete homework as they see any such endeavour as a 'waste of their time' as they are certain that they are going to 'fail' maths.

Growth mindset

'The very best opportunities to learn come about when students believe in themselves.'

Jo Boaler, p5 *Mathematical Mindsets* 2016.

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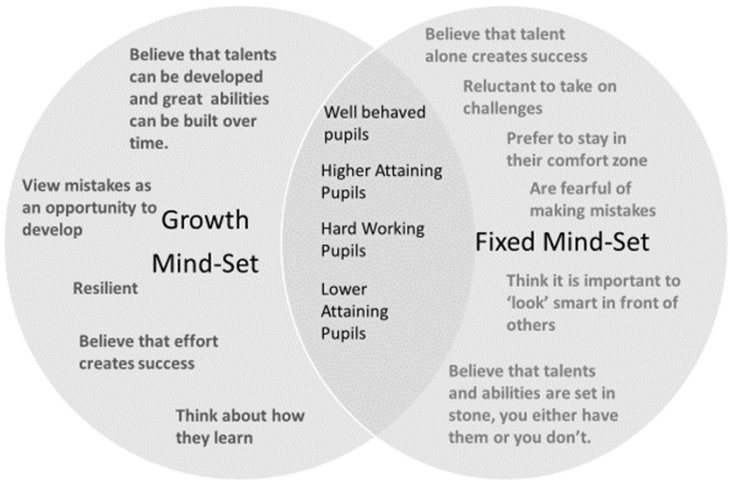
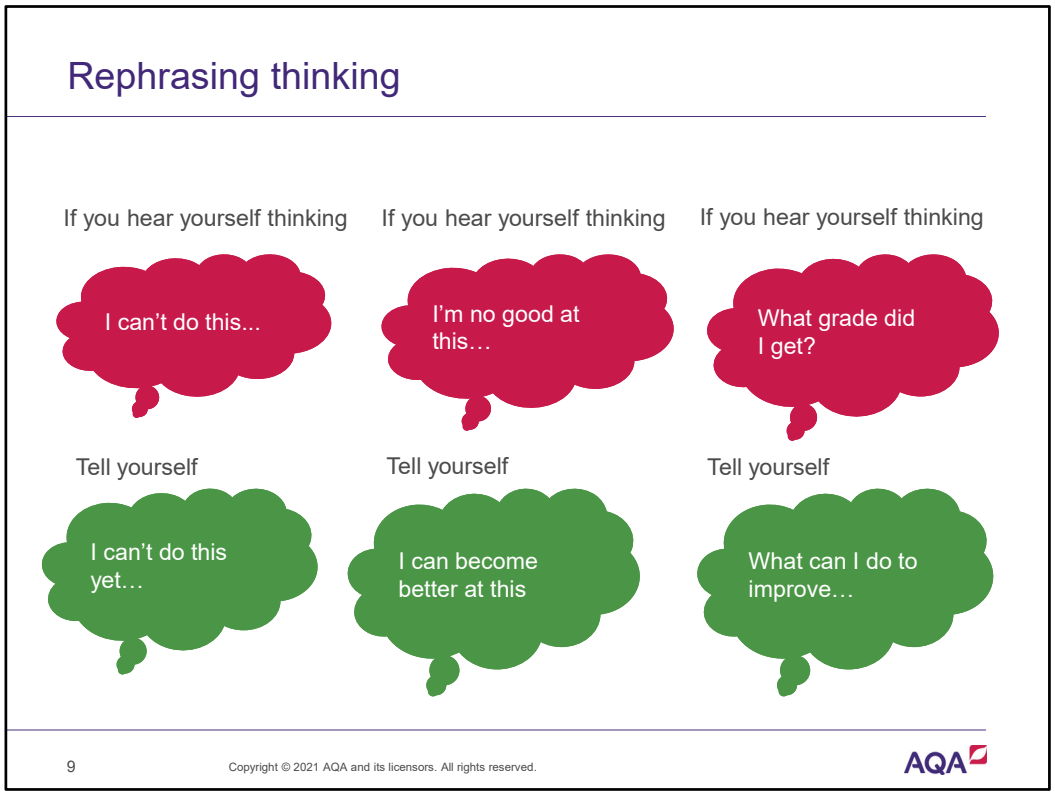
In her book, *Mathematical Mindsets*, Jo Boaler relates Maths Anxiety to students' inner beliefs that they are 'no good' at Maths, that they can never become 'good at Maths' and that Maths is a subject in which only certain people, with a 'mathematical brain' can be successful. She refers to this type of thinking as a 'fixed mindset' and references Carole Dweck's 2006 research. Boaler argues that Maths Anxiety can be overcome by developing a 'growth mindset' in our students, a belief that everyone has the potential to learn maths.

Mindsets



It is important to note that students can move between mindsets and can have traits of both. Mindset should be seen as a spectrum which individuals can move along at any time. It is also important to realise that mindset is not necessarily linked to mathematical attainment, but a fixed mindset is likely to hinder individual progress whilst a growth mindset is likely to enhance it.



As teachers we can model a growth mindset in our classrooms by showing that we value progress over attainment. Use every assessment/mock exam as an opportunity for formative assessment. Provide students with a QLA sheet which includes how to find the relevant information to improve understanding and reattempt similar questions. Students could be given a QLA sheet with the relevant clip from a maths website resource. Students are also provided with a sheet which gives them a corrected version of the question they answered incorrectly and a similar 'challenge question' to demonstrate that they have understood the feedback given.

Celebrate progress at every opportunity

You could show student's progress in places such as:

- classrooms
- assemblies
- corridor displays.

Growth mindset can too often be a token gesture in which 'inspirational' posters with quotes from sporting celebrities and famous people are displayed, in which they talk about how their determination and effort lead to their success. Although this has a place it is more important to share with students inspiration from within their peer group. Which students have made the most progress since the last assessment/mock exam? How did they do this? What behaviours did they demonstrate in the classroom and in their independent learning which lead to this success? Remind students that ' if they can do it, so can you.'

Activity 1

Which mindset do you model in your classroom?

Promotes a fixed mindset	Promotes a growth mindset
Praising students for being smart	Praising effort and strategies
Formative comments that emphasise achievement	Formative comments that emphasise effort and application
Praising students for achievements that come easily	Building robust self-confidence
Spending time documenting intelligence and ability	Spending time developing intelligence and ability
Directing students to which tasks to complete	Giving students a strong voice in the learning process and a sense of purpose
Boosting self-esteem	Providing constructive criticism
Place importance on grades/levels rather than learning	Place importance on learning rather than grades/levels

In groups you could discuss one of the strategies you currently use to promote a fixed mindset and how you could tweak these to instead promote a growth mindset.

You could also discuss examples of strategies you use in the classroom which promote a growth mindset amongst students.

Problem solving

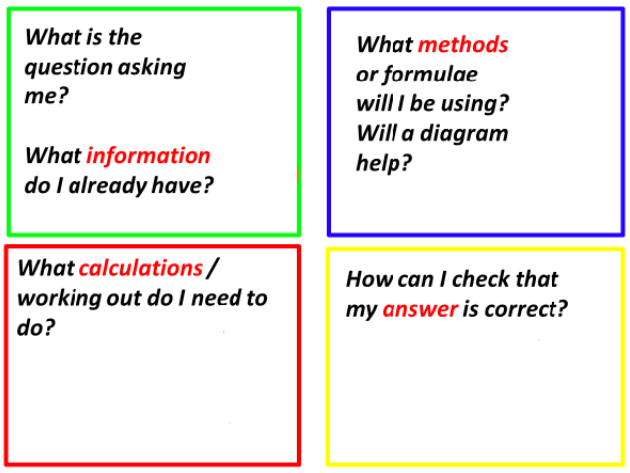
Encouraging students to attempt multistep problems

'Boxing up' or 'Information, Methods, Calculations, Answer (IMCA)' is a strategy for:

- working out (for writing)
- discussing (asking each other questions)
- thinking (asking yourself questions).

Using 'boxing up' in the classroom provides a way for students to self scaffold. When a student asks a teacher for help, the teacher is trained to respond with a series of questions to scaffold the student's thinking. 'Boxing up' provides students with a technique to self question. It encourages and supports collaboration between students when problem solving by structuring the dialogue between students. In the early stages of 'boxing up' it helps students to physically draw and 'fill in' each box, however, in the long term students need to see 'boxing up' as a series of questions to think about when problem solving, with only the calculations needing to be recorded. 'Boxing up' helps to overcome maths anxiety by structuring students' responses to multistep questions, by encouraging them to attempt a question and recognise that they can identify certain steps to take, methods to use, diagrams to draw, even if they are unable to get all the way to a complete or final answer.

‘Boxing up’ or ‘IMCA’



Zeb Friedman. Originated from work done with Helen Hindle

This strategy was developed by Zebedee Friedman and Helen Hindle when Zebedee was an AST at a secondary school and Helen was Head of Department at a community academy. It has been published in Julia Strong’s book **‘Talk For Writing In Secondary Schools: How To Achieve Effective Reading, Writing And Communication Across The Curriculum’ 2013.**

Activity 2

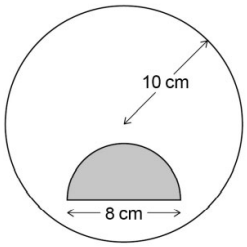
- Attempt to answer one of the AO3 questions using ‘boxing up’.
- What strategies do you currently use in your classroom to support students to independently answer multistep questions?

Example question 1

Q9, Paper 1 (Higher), June 2019

A shaded semicircle is inside a circle as shown.

Not drawn accurately



The **radius** of the circle is 10 cm

The **diameter** of the semicircle is 8 cm

How many times bigger is the unshaded area than the shaded area?

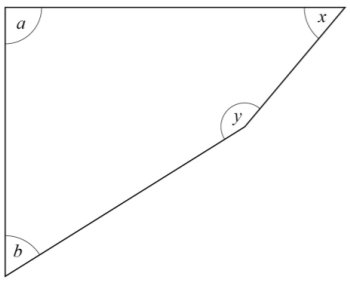
[4 marks]

This is a Question 9 from AQA Paper 1 (Higher) June 2019.
When attempting to answer the question using boxing up, consider what barriers a student might face when first reading this question.
How might boxing up help the student to overcome these barriers?
A set of questions with the boxing up template for use in the classroom has been provided in the facilitation booklet.

Example question 2

Q14, Paper 1 (Higher), June 2019

Here is a quadrilateral.



Not drawn accurately

$a = 90°$ and $a : b = 5 : 3$

$x : y = 1 : 3$

Show that $b = x$

[3 marks]

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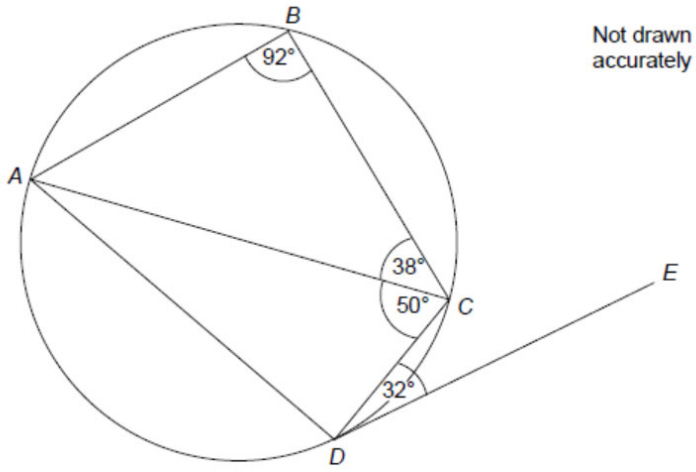
This is a Question 14 from AQA Paper 1 Higher June 2019.
When attempting to answer the question using boxing up consider what barriers a student might face when first reading this question.
How might boxing up help the student to overcome these barriers?

Knowledge range

Ask a question/make a comment – ‘do now’



You could start every lesson with an open ‘do now’, which leads to a class discussion that is designed to help students to understand which task to choose each lesson and which also provides them with the information/explanation that they need to begin working on that task.
These 'do now' activities also help to overcome maths anxiety/fixed mindset by creating a classroom culture in which students questions and comments are both common place and valued.
They also help students to engage with problem solving as they are ‘goal free’ so students aren’t faced with a problem which they feel is beyond their capabilities, instead they are encouraged to start thinking about which problem they can solve using the information provided.
This diagram is taken from AQA Practice Paper 1, Paper 3 (Higher) Question 24.

The role of learning journeys in promoting a growth mindset

Learning journeys/progress maps:

- give students a sense of purpose
- give students a strong voice in the learning process
- take students out of their comfort zone
- encourage students to challenge themselves
- place an emphasis on progress rather than attainment
- indicate to students what skills students need to work on in the future
- support differentiation in a class with a range of prior attainment without placing limits on learning.

Knowledge learning journeys/progress maps

	Foundation	Developing	Secure	Expert
Y10 Knowledge Progress Map – Angle Facts & Circle Theorems	**a) Acute, Reflex, Obtuse and Right Angle** I know the definitions of **acute, obtuse, reflex** and **right angles**. I know how to use a **protractor** to measure and draw angles. ***HM 455-459*** **b) Properties** I know the properties and definitions of: special types of **triangles**, of special types of **quadrilaterals** and other 2D shapes. ***HM 823, 824*** **c) Sum** I know the sum of the angles at a point, on a straight line, in a triangle and in a quadrilateral. ***HM 477 – 479 and HM 485 - 487***	**d) Parallel lines** I know the definition of **vertically opposite, corresponding, alternate** and **co-interior** angles on **parallel** lines and I know the related angle facts. ***HM 480 – 483*** **e) Regular Polygon and Irregular Polygon** I know the formulae to calculate the **interior** and **exterior angles** in regular and irregular **polygons**. ***HM 560-564***	**f) Circle Theorems** I know the different angle properties described by different **circle theorems**. ***HM 592-604***	**g) Proof** I know that angle facts can be used to prove geometrical results. ***HM 603-604***

A knowledge progress map shows students the facts/rules/procedures that they need to know for a unit of work.

Skills learning journeys/progress maps

Y10 Skills Progress Map – Angle Facts & Circle Theorems		Foundation	Developing	Secure	Expert
	Problem Solving – **Construct Solutions / Solve**	I can solve **single-step** angle problems using my knowledge of angle facts.	I can solve **multi-step** problems using my knowledge of angle facts.	I can use my knowledge of **circle theorems** to solve **single step** problems.	I can use my knowledge of **circle theorems** to solve **multi- step** problems.
	Reasoning - **Prove**	I can justify and give reasons by stating the **simple angle facts** I have used, when finding missing angles.	I can justify and give reasons by **stating the angle facts** I have used, when finding: - Missing interior and exterior angles of regular and irregular polygons. - Missing angles on parallel lines.	I can justify and give reasons by **stating circle theorems** used to calculate missing angles in shapes inscribed (drawn) in circles.	I can use my knowledge of angle facts to **algebraically prove circle theorems.**

A skills progress map shows students how they will use this knowledge when problem solving and reasoning.

How we use learning journeys

	Foundation	Developing	Secure	Expert
Y10 Knowledge Progress Map – Angle Facts & Circle Theorems	**a) Acute, Reflex, Obtuse and Right Angle** I know the definitions of **acute, obtuse, reflex** and **right angles**. I know how to use a **protractor** to measure and draw angles. Task 1 ***HM 455-459*** **b) Properties** I know the properties and definitions of: special types of **triangles**, of special types of **quadrilaterals** and other 2D shapes. Task 2 and Task 3 ***HM 823, 824*** **c) Sum** I know the sum of the angles at a point, on a straight line, in a triangle and in a quadrilateral. Task 2 and Task 3 ***HM 477 – 479 and HM 485 - 487***	**d) Parallel lines** I know the definition of **vertically opposite, corresponding, alternate** and **co-interior** angles on **parallel** lines and I know the related angle facts. Task 4 ***HM 480 – 483*** **e) Regular Polygon and Irregular Polygon** I know the formulae to calculate the **interior** and **exterior angles** in regular and irregular **polygons**. Task 5 and Task 6 ***HM 560-564***	**f) Circle Theorems** I know the different angle properties described by different **circle theorems**. Task 7 and Task 8 ***HM 592-604***	**g) Proof** I know that angle facts can be used to prove geometrical results. Task 9 ***HM 603-604***

How we use learning journeys continued

- Pre-teaching mini assessment.
- Students select their task each lesson in reference to the learning journey.
- There are no limits on learning.
- An end of unit, full assessment is used to track progress through the unit.
- A ‘think pink go green’ feedback sheet is used to provide students an opportunity to learn from feedback.

In lessons students regulate their learning in reference to their learning journeys/progress maps. The use of learning journeys is fundamental to ensure that all students are supported and challenged. Students complete a mini assessment at the start of a unit of work to identify their start point on the learning journey. Students then choose their task each lesson based upon what they need to learn next in order to make progress (it is very important that students do not all start on task one and work their way through the easier tasks in order to reach the harder tasks). The teachers encourage students to select tasks for themselves and foster a classroom culture in which students seek challenge.It remains the teacher's responsibility to monitor task choice and redirect students who have selected inappropriately. Students are assessed again at the end of each unit of work, with a full hour long assessment which includes AO1, AO2 and AO3 questions. The end of unit assessment has a copy of the learning journey on the front cover so that the teacher and the student can compare the start of unit and end of unit learning journeys to track progress across the unit of work.

Resources

Take advantage of our extra resources in the ‘Plan’, ‘Teach’ and ‘Assess’ sections of our website.

Here is the specific subject page on the main AQA website, https://www.aqa.org.uk/subjects/mathematics/gcse/mathematics-8300

Get in touch

Our friendly team will be happy to support you between 8am and 5pm, Monday to Friday.

Tel: 0161 957 3852
Email: maths@aqa.org.uk
Twitter: @AQAMaths

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Our relevant Twitter accounts are:
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@AQAMaths (Maths subjects)
@AQA (Any other subjects).

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Thank you