MATHSHUBS
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Welcome to the Oracy Taster Session.
We will start promptly at 3.45.

Working with NCETM
NATIONAL CENTRE FOR EXCELLENCE IN THE TEACHING OF MATHEMATICS

Developing Mathematical Oracy to Support Reasoning

A Taster session to prompt your thinking

Brenda Robertson.

Professional Development Accredited Lead
National Centre for Excellence in the Teaching of Mathematics

The aim of this session is to share some information about the Primary Oracy Programme which has run within the BBO hub for the past two years. This has been part of the Maths Hubs Research and Innovation Programme, so the Maths Hub network has been on a “finding out” mission through these work groups – as part of its on-going research into areas that could potentially improve maths nationally.

The key focus has been to carry out classroom-based research with groups of practitioners to see how the development of oracy skills can impact on pupil’s ability to reason mathematically.

In this session, we will consider the skills needed to support pupils to reason mathematically, the expectations within the curriculum, and generally (hopefully) give you some things to consider in relation to developing reasoning skills in your school.

To Reason Mathematically – a key aim of the mathematics curriculum

The national curriculum for mathematics aims to ensure that all pupils:

become **fluent** in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils develop **conceptual understanding** and the ability to **recall and apply knowledge rapidly and accurately**.

reason mathematically by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof **using mathematical language**.

can **solve problems** by applying their mathematics to a variety of **routine and non-routine problems** with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions.

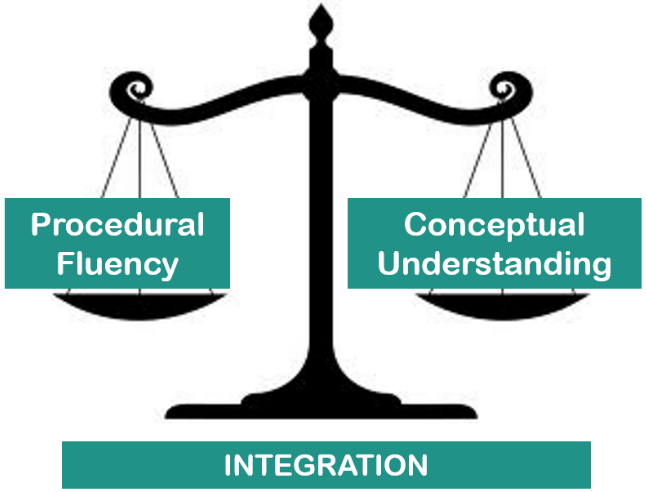
(from The National Curriculum Programme of Study for Mathematics)

Purpose of study

Mathematics is a creative and highly interconnected discipline that has been developed over centuries, providing the solution to some of history's most intriguing problems. It is essential to everyday life, critical to science, technology and engineering, and necessary for financial literacy and most forms of employment. **A high-quality mathematics education therefore provides** a foundation for understanding the world, **the ability to reason mathematically**, an appreciation of the beauty and power of mathematics, and a sense of enjoyment and curiosity about the subject.

(from The National Curriculum Mathematics Programme of Study)

NCETM Teaching for Mastery



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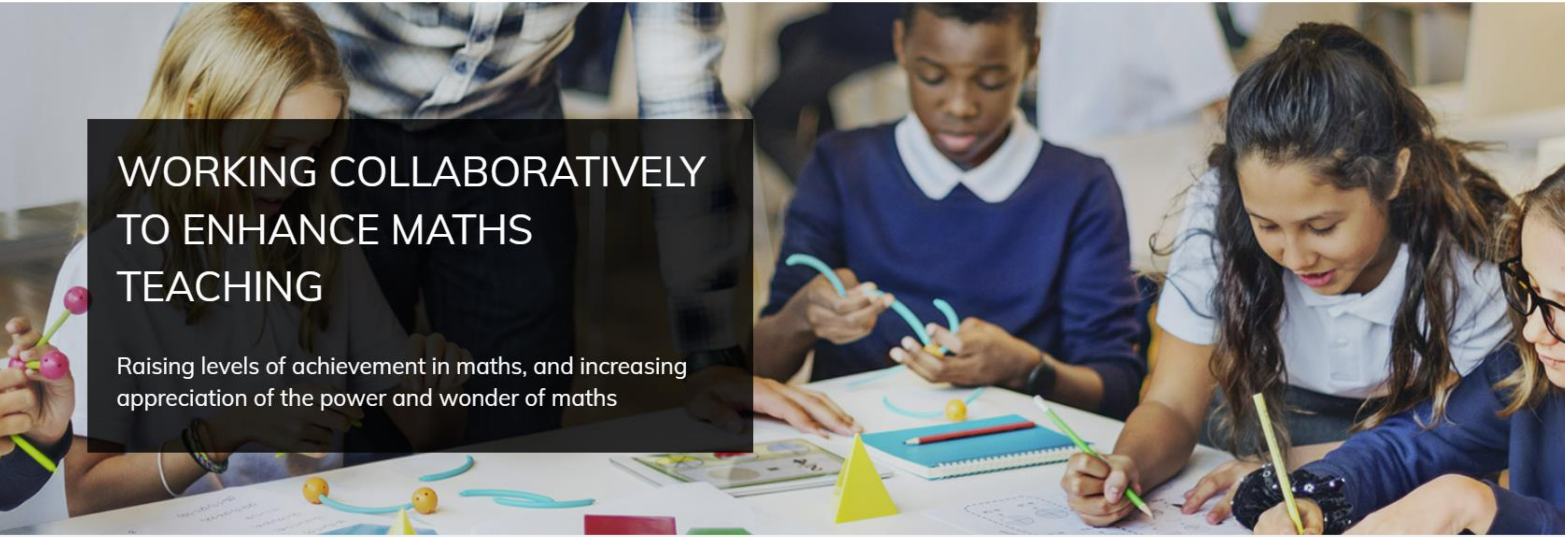


Using mathematical representations at KS3

Guidance for some of the most useful representations for Key Stage 3 mathematics.

KS3 | SECONDARY | MASTERY PD MATERIALS

Insights from experienced teachers

Pairs of teachers explore small sections of the mastery materials in depth

KS3 | SECONDARY | MASTERY PD MATERIALS

Primary ITE professional development materials

Six professional development units designed for ITE tutors to use with primary trainee teachers exploring maths

PRIMARY | MASTERY PD MATERIALS

Planning to teach secondary maths

Videos and resources for teaching Key Stage 3 maths topics

KS3 | SECONDARY | MASTERY PD MATERIALS

Primary Assessment Materials

Questions, tasks and activities supporting teaching for mastery.

KS1 | KS2 | PRIMARY | YEAR 1 | YEAR 2 | YEAR 3 | YEAR 4 | YEAR 5 | YEAR 6 | ASSESSMENT MATERIALS

Mathematical Prompts for Deeper Thinking videos

Videos showing a teacher working with small groups of students from her Year 8 class

KS3 | SECONDARY | MASTERY PD MATERIALS | CLASSROOM VIDEOS

A pupil **really understands** a mathematical concept, idea or technique if they can:

- ***describe it in their own words****;*
- *represent it in a variety of ways*
- ***explain it to someone else***
- *create examples and non-examples;*
- *see connections with other facts and ideas;*
- *recognise it in new situations and contexts;*
- *make use of it in various ways, including new situations.*

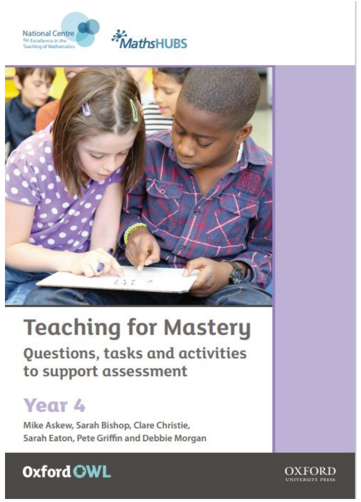
A pupil who has mastered the idea in **greater depth** can:

- *Solve problems of greater complexity (where the approach is not immediately obvious), showing creativity and imagination;*
- *Independently explore and investigate mathematical contexts and structures,*
- ***communicate results and generalise the mathematics.***

The questions, tasks, and activities that are offered in the materials are intended to be a useful vehicle for assessing whether pupils have mastered the mathematics taught.
However, the best forms of ongoing, formative assessment arise from **well-structured classroom activities involving interaction and dialogue (between teacher and pupils, and between pupils themselves).** The materials are not intended to be used as a set of written test questions which the pupils answer in silence. They are offered to indicate valuable learning activities to be used as an integral part of teaching, providing rich and meaningful assessment information concerning what pupils know, understand and can do.

- The tasks and activities need not necessarily be offered to pupils in written form. They may be presented orally, using equipment and/or as part of a group activity. **The encouragement of discussion, debate and the sharing of ideas and strategies will often add to both the quality of the assessment information gained and the richness of the teaching and learning situation**

(From the introduction of all NCETM Mastery books P. 5)



If each peg on the coat hanger has a value of 10, find three ways to partition the pegs to make the number sentences complete.

□ + □ = □

□ + □ = □

□ + □ = □

What is the total of each addition sentence?
Will the total always be the same?
Explain your reasoning.

If each peg on the coat hanger has a value of 10, find three ways to partition the pegs to make the number sentences complete.

□ + □ + □ = □

□ + □ + □ = □

□ + □ + □ = □

What is the total of each addition sentence?
Will the total always be the same?
Explain your reasoning.

8 girls share 6 bars of chocolate equally.
12 boys share 9 bars of chocolate equally.
Who gets more chocolate to eat, each boy or each girl? How do you know?

Draw a diagram to explain your reasoning.

8 girls share 6 bars of chocolate equally.
12 boys share 9 bars of chocolate equally.

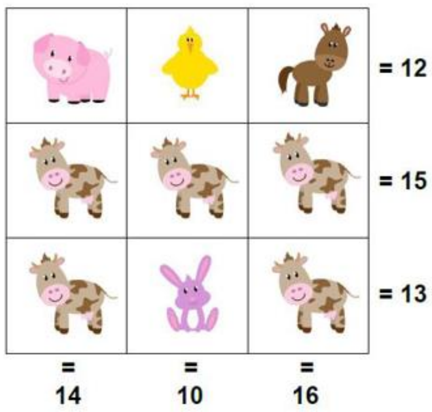
Clare says each girl got more to eat as there were fewer of them.
Rob says each boy got more to eat as they had more chocolate to share.

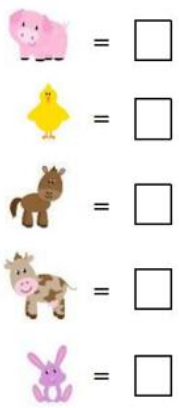
Explain why Clare and Rob are both wrong.

Tasks for you to discuss.....

24 Write a digit in each box to make the sum correct.

$$7\square + \square = 83$$





Which value could be found first, next and last, and why?

Which value cannot be found second and why?

9 The list below shows the years in which the Cricket World Cup was held since 1992:

1992, 1996, 1999, 2003, 2007, 2011, 2015

Adam says,

> The Cricket World Cup has been held every four years since 1992.

Adam is **not** correct.

Explain how you know.

1 mark

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Fluency…Reasoning…Problem-solving

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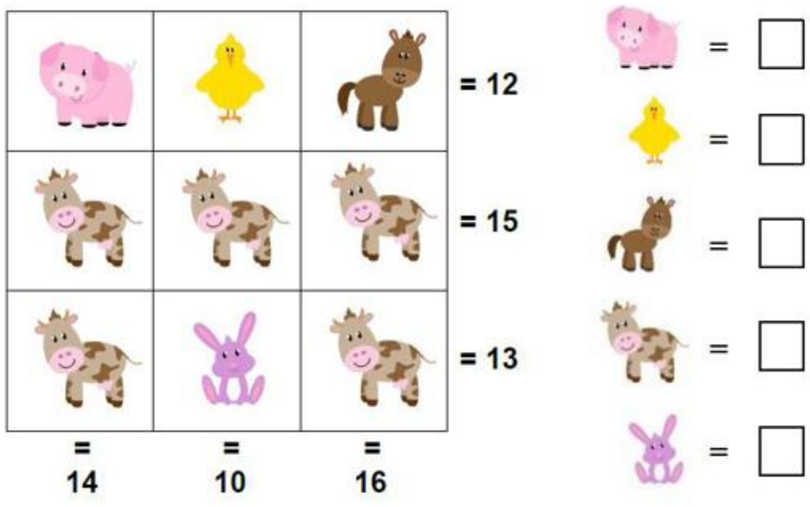


Which value could be found first, next and last, and why?

Which value cannot be found second and why?

Did you find that talking and discussing helped?

You were probably “thinking out loud”…

Could you articulate your reasoning… in answer to the questions at the bottom?

Do we give children sufficient time to discuss, and think through their reasoning

Do we get the correct answer… then move on without focusing on the reasoning?

Fluency…Reasoning…Problem-solving

24 Write a digit in each box to make the sum correct.

$\boxed{7}\boxed{} + \boxed{} = \boxed{8}\boxed{3}$

A chain of reasoning…

- I understand that "=" means the total must be equivalent on both sides.
- At the moment I have 70 on one side and 83 on the other.
- The difference between 70 and 83 is 13.
- I can only put one digit in each empty box.
- Therefore, I need two digits with a total of 13
- I could use 7 and 6, 9 and 4 or 8 and 5

How could you use this as a task for children to work on in pairs / groups?

Trial and improvement…have a larger version of the task and give digit cards.

How could you vary the task to extend the challenge?

Do we give children time to talk about their reasoning chain?

Or do we get the correct answer and move on?

9 The list below shows the years in which the Cricket World Cup was held since 1992:

1992, 1996, 1999, 2003, 2007, 2011, 2015

Adam says,

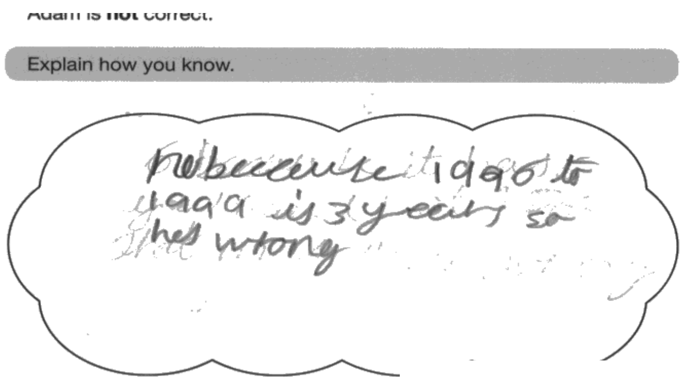
Adam is **not** correct.

Explain how you know.

1 mark

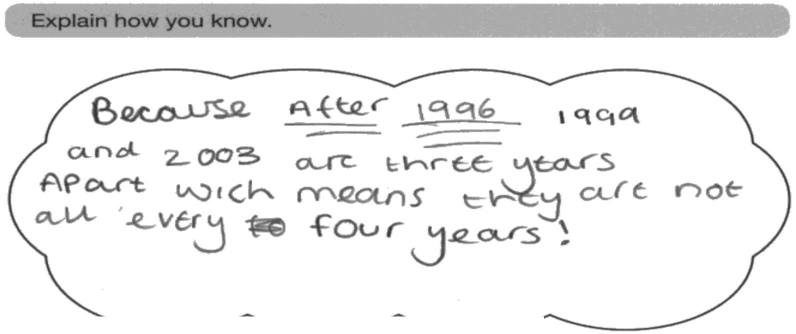
The difference between 1996 and 1999 is three years, not four so it is not always every four years	It should be 2000.
It doesn't always increase by four.	It would be 2000 if it was every four years.
The cricket world cup was sometimes three years apart instead of four years apart.	Not all of the years have four years difference.
1992 + 4 = 1996 + 3 = 1999	It should have ended in 2016
The difference can be 3, 4 or 5 years at different times	

9	Explanation that recognises that the sequence does not always increase by four, with clear reference to the data, e.g. • The difference between 1996 and 1999 is three years, not four so it is not always every four years • It would be 2000 if it was every 4 years • It should have ended in 2016 **OR** Explanation that demonstrates that the sequence does not always increase by 4, but does not reference specific years from the data, e.g. • The cricket world cup was sometimes 3 years apart instead of 4 years apart • Not all of the years have 4 years difference between.	1m	**Do not** accept vague or incomplete explanations, e.g. • It does not always increase by four • It should be 2000 • The difference can be 3, 4 or 5 years at different times. **Do not** accept explanations which include incorrect mathematics or incorrect information that is relevant to the explanation, e.g. • 1992 + 4 = 1996 + 3 = 1999

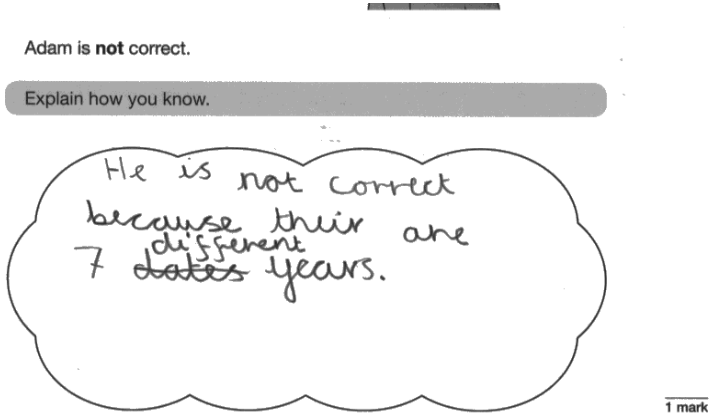

Adam is not correct.

Explain how you know.

~~No~~ because it 1996 to 1999 is 3 years so hes wrong


Explain how you know.

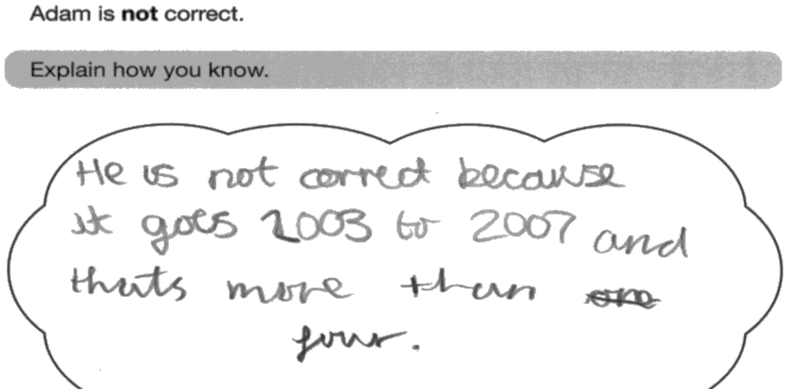
Because After 1996 1999 and 2003 are three years Apart wich means they are not all every ~~to~~ four years!


Adam is **not** correct.

Explain how you know.

He is not correct because their are 7 ~~dates~~ different years.

1 mark


Adam is **not** correct.

Explain how you know.

He is not correct because it goes 2003 to 2007 and thats more than ~~one~~ four.

How will the development of oracy across the school prepare pupils to confidently be able to write accurate and precise responses by the time they are in Year 6?

Think about the skills they need to develop over the primary years to enable pupils to confidently tackle reasoning questions such as these.

Mathematical talk and discussion will support the development of reasoning. If they can articulate it clearly, they will go on to be able to write it clearly and succinctly.

Malcolm Swan – Improving Reasoning: Analysing Alternative Approaches (2011 – revised 2016)

- Most of the attention is on ‘answer getting’, not on improving the quality of the reasoning.
- As soon as pupils get the answer, they are moved on to a fresh problem, they don’t reflect much on the process they went through.
- Reasoning is not improved because it does not become **the object of attention.**
- Most reasoning remains invisible - **it stays inside people’s heads.**
- In order for pupils to improve their reasoning, it needs to be made **visible and audible ,** through oral and written explanations

Reasoning: the Journey from Novice to Expert (Article)
Age 5 to 11
Article by The NRICH Primary TeamPublished 2014 *Revised 2021*

At NRICH we see a five-step progression in reasoning: a spectrum that shows us whether children are moving on in their reasoning from novice to expert. Children are unlikely to move fluidly from one step to the other, rather flow up and down the spectrum settling on a particular step that best describes their reasoning skills at any one time.

Nrich progression in reasoning..

- *Step one*: Describing: simply tells what they did.

  Step two: Explaining: offers some reasons for what they did. These may or may not be correct. The argument may yet not hang together coherently. This is the beginning of inductive reasoning.

  Step three: Convincing: confident that their chain of reasoning is right and may use words such as, 'I reckon' or 'without doubt'. The underlying mathematical argument may or may not be accurate yet is likely to have more coherence and completeness than the explaining stage. This is called inductive reasoning.

  Step four: Justifying: a correct logical argument that has a complete chain of reasoning to it and uses words such as 'because', 'therefore', 'and so', 'that leads to'...

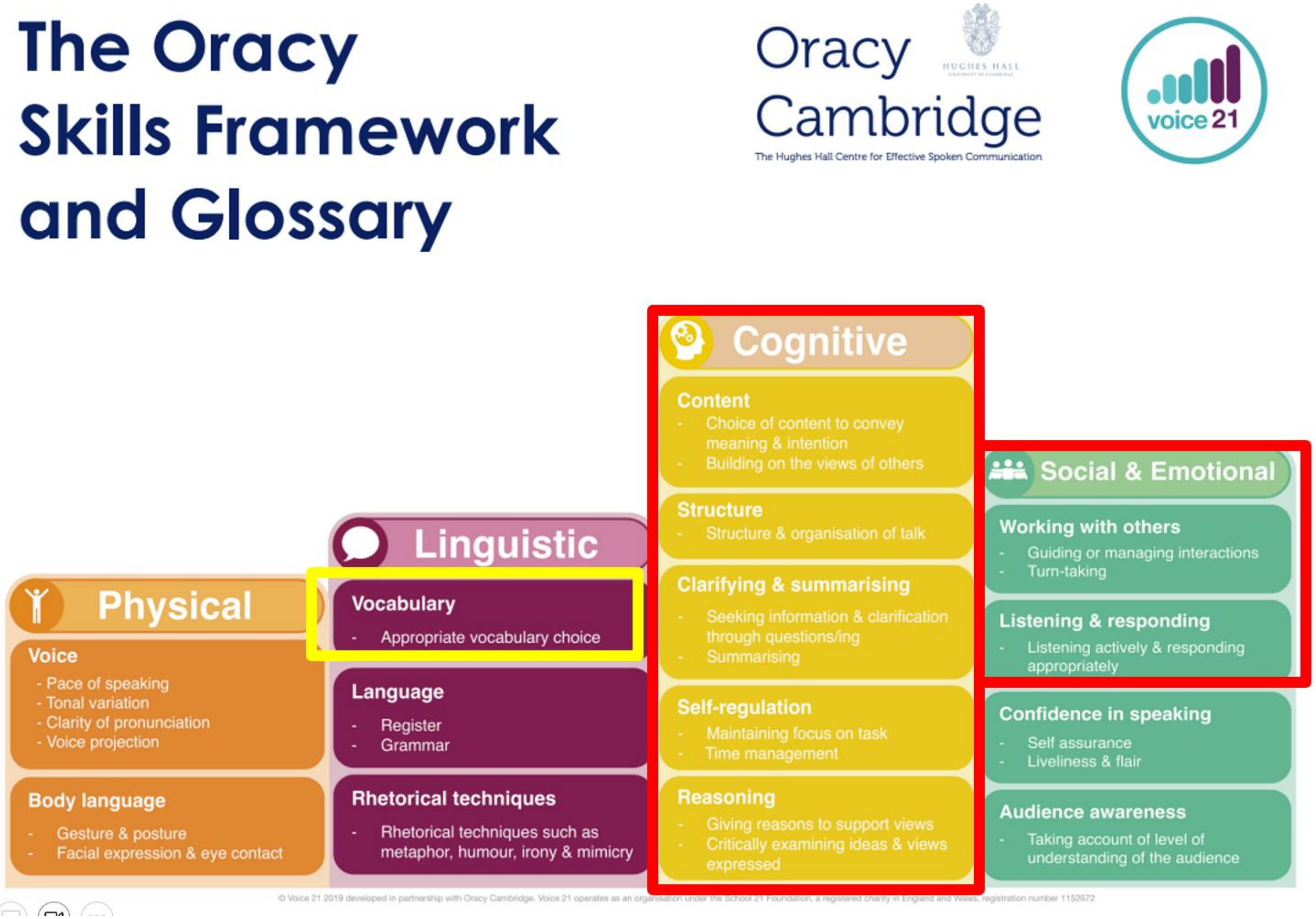
  Step five: Proving: a watertight argument that is mathematically sound, often based on generalisations and underlying structure. This is also called deductive reasoning.

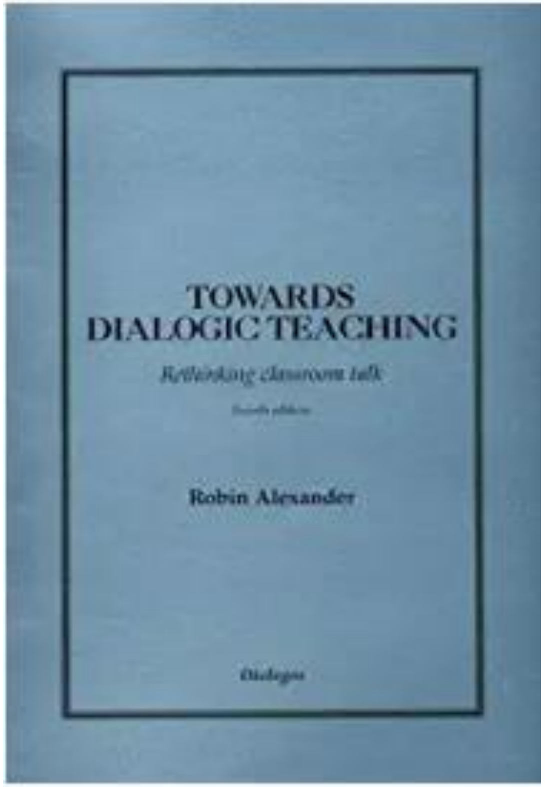
- Developing reasoning skills with young learners is a complex business. They need to learn to become systematic thinkers and also acquire the ability to articulate such thinking in a clear, succinct and logical manner. In many classrooms more progress is being made with **developing the systematic thinking** than with the **elegant communication**. There needs to be equal emphasis on both these aspects of reasoning and in both we need to consider progression. What would we expect from a novice reasoner as opposed to an expert reasoner? How can we help young learners to progress to expert level?
  [Reasoning: the Journey from Novice to Expert (Article) (maths.org)]

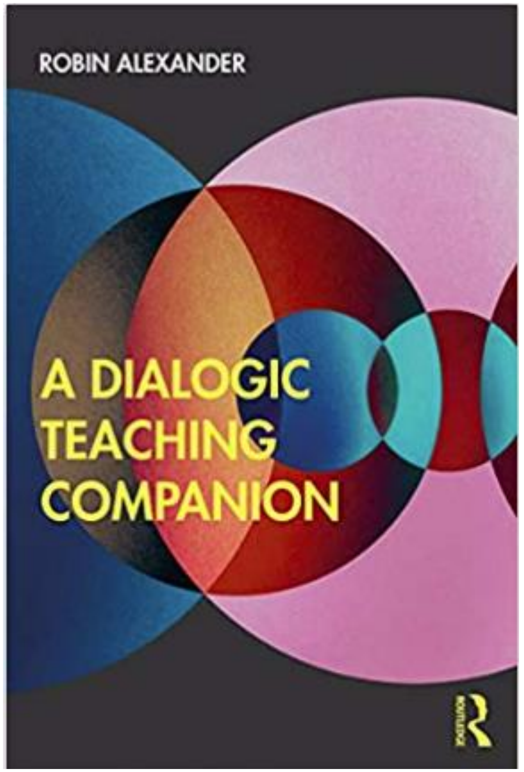
- **Communicating reasoning**
  We now turn our attention to the other aspect of reasoning - that of communicating reasoning in a succinct, elegant and mathematical way. Here strategies that we use in Literacy will prove helpful to us in developing this mathematical communication with children. It is helpful to model the communication ourselves (both as articulating our own thought processes and also staging conversations with other adults in the room), give sentence starters to help children construct their argument and also give time in lessons to improving children's expression of their reasoning processes. Children need to understand how to refine their sentences and chains of reasoning, and how to use appropriate mathematical language. A working wall is a great place for examples of superb reasoning that children can refer to when improving their own chain of reasoning to become more succinct and elegant. They also could collect good examples in the back of their mathematics books with annotations to explain what makes them 'good'.

[Reasoning: the Journey from Novice to Expert (Article) (maths.org)]

Developed in 2019 by Voice 21 in conjunction with Oracy Cambridge







“Dialogic teaching is good for students. It harnesses the power of talk to engage their interests, stimulate thinking, advance understanding expand ideas and build and evaluate arguments, empowering them for lifelong learning and democratic engagement. Being collaborative and supportive, it confers social and emotional benefits too.
Dialogic teaching helps teachers. By encouraging students to share their thinking, it enables teachers to diagnose needs, devise learning tasks, enhance understanding, assess progress and assist students through the challenges they encounter.”

John Hattie: “What is important is that the teaching is visible to The student and the learning is visible to the teacher”.

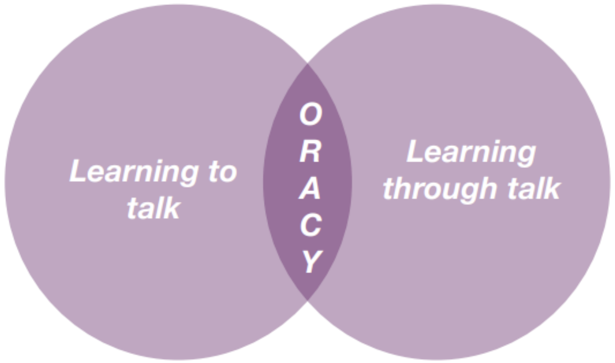
In summary…

- Reasoning is fundamental to knowing and doing mathematics. Some would call it systematic thinking. Reasoning enables children to make use of all their other mathematical skills and so reasoning could be thought of as the 'glue' which helps mathematics makes sense. (Reasoning: Identifying Opportunities – Nrich)

- Reasoning needs to be the object of attention and become visible and audible – not “stay inside people’s heads”

- Developing and embedding Oracy will focus on communicating reasoning in a “succinct, elegant and mathematical way”.

- Being able to describe mathematical concepts in their own words and explain it to others is part of deep understanding – mastery of mathematics.



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BBO Maths Hubs 2023/24

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Maths Hubs bring together mathematics education professionals in a collaborative national network, to develop and spread excellent practice, for the benefit of all pupils and students.

We offer high quality professional development, fully funded by the DfE and free for schools to participate.

https://bbomathshub.org.uk/ info@Bbomathshub.org.uk 01494 897331 https://www.ncetm.org.uk/

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Preparatory optional phase

For schools not yet ready to join the main development phase (eligibility criteria apply).

Mastery Readiness Work Groups

Schools identified as suitable to take part in this phase are supported by their Maths Hub's Mastery Readiness Lead to strengthen five key areas:

- Vision and culture underpinning maths learning
- Mathematical mindsets
- Subject expertise
- School systems
- Arithmetical proficiency.

Development phase

All schools complete this phase, which lasts a whole school year.

Development Work Groups

These groups are sometimes referred to as TRGs as they incorporate Teacher Research Groups.

- Two lead participant teachers from each of six or seven schools meet every half term as a group. The meetings involve shared lesson observations and discussion.
- Each school gets a termly bespoke support visit by the Mastery Specialist.
- The group keep in contact and share experiences from their classroom and school settings. The ongoing work between the participating teachers creates a whole year of school-to-school collaborative professional development.

Building phase

All schools build on previous phase through ongoing Work Group activity.

Embedding Work Groups – continued small group collaboration.

- Schools who have worked on estalishing teaching for mastery become part of an Embedding Work Group, staying in touch with their Development Work Group colleagues.
- Focus is on systems and culture to support mastery, subject knowledge, lesson design and continued support for school and subject leadership.

Refinement phase

All schools continue their mastery journey through continued participation and collaboration.

Sustaining Work Groups – further continuous participation to sustain, improve and refine whole school teaching for mastery approaches.

- Open to all schools who entered the main Teaching for Mastery Programme between 2015 and 2018.
- Year-on-year participation in a Sustaining Work Group becomes an ongoing aspect of professional development for the school
- Building on work done previously, schools will use mastery approaches consistently and improve learning in maths by strengthening leadership, refining systems and designing curriculum and lessons which allow all children to achieve.

November 2020

Teaching for mastery in maths
the primary school pathway

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The Teaching for Mastery programme

Join our groups for September 2023

Applications open now on the website

bbomathshub.org.uk

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Explore all of the projects on offer on our website

Keep in touch

https://bbomathshub.org.uk/get-involved/

info@bbomathshub.org.uk

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