Primary
& Early Years
Magazine 93

National Centre
for Excellence in the
Teaching of Mathematics

Welcome to another issue of our Primary Magazine, which has now been serving primary teachers for 93 issues with a varied collection of articles related to maths education and mathematics professional development - all of which are available in the Primary Magazine Archive.

Contents

In Digging Deeper each month we will explore an element of mathematics teaching linked to current developments and research: in this issue we look at some of the things we can learn about teaching for reasoning.

Aspects of… provides a number of bitesize ideas related to a specific element of mathematics; this month we have Aspects of triangles.

Seen and Heard provides a specific example of a child's response to mathematics in a classroom to stimulate thinking and provoke questions about how you would react to similar events in your own classroom. In this issue two children's understanding of rounding is explored.

First, as always, we have a News section, bringing news from the NCETM and beyond to keep you up to date with the fast-changing world of mathematics education.

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News

In a new blog entry, the NCETM Director, Charlie Stripp, shares his thoughts about how to use marking to have the maximum positive effect on pupils' learning.

Charlie's blog follows the publication this year of the NCETM's two marking guidance documents: one (in June) for primary school teachers, and, last month, one for secondary school teachers. You might also be interested to read a Schools Week profile of Charlie.

A selection of forthcoming maths events you might be interested in:

- A new round of NCETM CPD Providers' Network meetings starts in November - you can book your place now
- Mathematical Association (MA) (in cooperation with Bucks, Berks and Oxon Maths Hub) Primary Mathematics Professional Development Day, Saturday 12 November, High Wycombe
- British Society for Research into Learning Mathematics (BSRLM) Conference, Saturday 12 November, Brighton
- #christmaths16: Prosecco, mince pies and maths, Thursday 22 December, London.

Email us if you have an event that you think we should include here.

Booking is now open for two of the mathematics subject associations' 2017 annual conferences: the Mathematical Association (MA) conference takes place 7-9 April in Surrey, and the Association of Teachers of Mathematics (ATM) conference takes place 10-13 April at Stratford-upon-Avon.

The ATM is shortly moving offices, and is giving away publications, posters, software and other resources free of charge. You'll need to go to their (current) premises in Derby between 10am and 3pm on 4 and 5 November. Find out more.

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Digging Deeper

Teaching for Reasoning

Longitudinal research, Development of Maths Capabilities and Confidence in Primary School by Nunes et al (2009), identified the ability to reason mathematically as the most important factor in a pupil's success in mathematics.

Reasoning is about thinking mathematically. Whilst the three aims of fluency, reasoning and solving problems are set out separately in the National Curriculum, reasoning underpins both fluency and problem solving. They both involve pupils 'applying' their understanding and knowledge, i.e. thinking mathematically.

> *Reasoning about what is already known in order to work out what is unknown will improve fluency; for example if I know what 12 × 12 is, I can apply reasoning to work out 12 × 13. The ability to reason also supports the application of mathematics and an ability to solve problems set in unfamiliar contexts.*
>
> Progression in Reasoning NCETM National Curriculum microsite

In the classroom, supporting reasoning therefore involves supporting children to think mathematically. This means they need to be 'working on' the mathematics rather than 'working through' the mathematics:

> *The first describes the student who does a few questions, takes a break, does a bit more on the bus, copies a bit from a friend, and ends up with no overall sense of the exercises as examples of anything or what they are about. Contrast this with the student who in doing the exercises asks themself what is similar about the questions and what different, what it is about the context which enables the technique to work, what sorts of difficulties might the technique encounter in different situations, etc. That student is working on the exercises…The two states of working-through and working-on are completely different, and in particular they involve different energies. Working-through minimises effort through minimum involvement. It is unreflective and unmathematical. Working-on minimises effort mathematically, by trying to locate underlying structure and so reduce memory demands.*
>
> John Mason Asking Mathematical Questions Mathematically 1998

Children reasoning can be seen in the NCETM's suite of mastery videos. Examples include:

- Year 1 - at the end of the clip 'Moving pupils onto independent work' a child explains that 100 and 102 have a difference of two and that 602 and 604 have a difference of two; they are using what they know about single digit numbers to generate pairs of three digit numbers with a difference of two.
- Year 3 – during the lesson the children are asked to make the connection between the context, the image and the symbols and to explain the connection between multiplication of threes and multiplication of sixes.
- Year 4 – in the clip 'Concrete representation leading to multiplicative reasoning' two children use the image of 1.2m to explain the multiplication 0.2m × 6.
- Year 6 – the teacher uses devices such as 'true or false' in the clip 'Key numbers connected with time' and 'what's the same and what's different' in the clip 'Introduction to line graphs' to encourage the children to reason.

For reasoning to be at the heart of mathematics in the classroom, pupils need to understand that they are expected to:

- think before doing
- notice things
- make decisions based on what they notice, know and understand.

The NCETM Progression maps with reasoning offer ideas for supporting the development of reasoning and include strategies such as:

- True or false

  Are these number sentences true or false?

  6.17 + 0.4 = 6.57

  8.12 – 0.9 = 8.3

  Give your reasons.

- Convince me

  What digits could go in the boxes?

  7□ - 2□ = 46

  Try to find all of the possible answers.

  How do you know you have got them all?

  Convince me.

- Always, sometimes, never

  Is it always, sometimes or never true that an even number that is divisible by 3 is also divisible by 6?

- What's the same, what's different

  What is the same and what is different about the net of a cube and the net of a cuboid?

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Aspects of…

Triangles

There is more to a triangle than the label and there is more to understanding triangles than saying 'triangle' when asked to name a shape. To support development of understanding pupils need to experience a concept in a variety of ways so that they can identify the essential structure, what is generalisable, and then use this to build further understanding. Developing understanding of triangles and applying this understanding can be supported as follows:

- **Triangle hunt** – take a walk around the school, the local environment and a local shop, and find and photograph triangles. Compare them by asking 'What's the same and what's different?'.

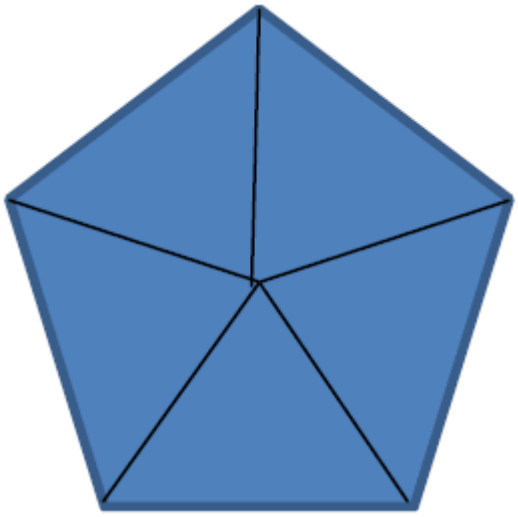
- **Take a walk** – draw large triangles on the playground and ask the children to walk around them. Ask them to think about how many times they turn, and why, before they get back to where they started, where they had to turn and how much they have turned in total on their journey around the shape.

- **Build triangles** – using bamboo canes of length 1.2m, 1m, 60cm and 40cm or straws of length 30cm, 20cm, 15cm and 10cm and explore how many different triangles can be created, what combinations of canes/straws don't work and why.

- **Imagine triangles** – for a given perimeter, for example 12cm, explore how many triangles you think can be drawn with integer sides. Ask:
    - Will they all make triangles?
    - How do you know you have found them all?
    - What do you notice?
    - What can you say about triangles with different perimeters?

- **Constructing with equilateral triangles** - using identical equilateral triangles build other shapes and identify the properties of each shape. For example, use two to make a rhombus and justify that it is a rhombus because the four sides are the same length as they are sides of the two equilateral triangles, identify that opposite angles are equal (in this case being 120° and 60°) and the angles add up to 360°.

- **Splitting into triangles** – explore other two dimensional shapes and how they can be split into triangles. Look at how quadrilaterals can be split into two triangles and what this means about the angles of quadrilaterals. For pentagons, hexagons etc. explore dividing them into triangles by splitting them from the centre (see below) and then considering how knowing about the angles of a triangle help you to work out and prove what the angles of a pentagon, hexagon etc. add up to



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Seen and Heard

Seen and Heard *shines a light, via photographs and conversations from classrooms, on a specific example of the mathematics learning experience, the aim being to stimulate thought and questions about how you would react to similar events in your own classroom*

At the start of a Y4 lesson, children were considering rounding to the nearest hundred with these numbers:

4652 **4520** **4052**

46 652 **4220**

One child said, *"The nearest hundred is nine hundred and ninety-nine and they are bigger than nine hundred and ninety-nine so you can't round them to the nearest hundred, they would go to nine hundred."*

During the same session another child asked, *"Would you round zero down or would you leave it as it is? I would round it down."*

- What do these children seem to understand about rounding?
- Why do you think they have these ideas?
- What images or contexts would you use to support understanding?
- What would you ask the children next?