Welcome to another issue of our Primary Magazine, which has now been serving primary teachers for 85 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

This month, in our National Curriculum article, we look at some of the findings from a small-scale research project focussed on the challenges of teaching for mastery in mixed-age classes.

Maths in the Staff Room suggests ways in which collective teacher discussions - both formal and informal - can form part of the ongoing process of professional learning, and help increase the effectiveness of maths teaching across the school. This month's article looks at how understanding equivalent calculations can be used as an efficient mental strategy.

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, a child in a Year 1 class describes how the hundred square shows what happens when counting in tens, prompting us to think about how a resource can influence the language used by a child and can lead to misconceptions.

If you have a photograph, or an account of a classroom conversation, that might stimulate similar thought, please email it to us. If we publish your suggestion, we'll put a £20 voucher in the post.

But 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

There's still a fortnight left for primary schools to apply to take part in a research project focusing on mathematical reasoning in year 2. It is being run in eight Maths Hubs areas and coordinated by the NCETM.

A report on a project, partly funded by two Maths Hubs, on teaching for mastery in mixed-age classes has just been published. A summary of the report's findings is included in the National Curriculum section of this magazine.

Since our last magazine came out, in early March, the Standards & Testing Agency (part of the DfE) have produced more updates on their guidance relating to this summer's KS1 and KS2 tests. This page lists numerous documents that came out on 24 March, two of which relate specifically to mathematics. The same page also carries three documents relating to the recent announcement by the DfE that the so-called baseline assessments will not now be used to measures primary pupils' progress from the start of their Reception year. This is also explained in a press release from the DfE.

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National Curriculum in Focus

National Curriculum in Focus is dedicated to unpicking the new curriculum and how to understand and develop the requirements of the new programmes of study for mathematics. You can find previous features in this series here

A focus on mixed-age classes

The aims of the National Curriculum are of vital importance to the whole curriculum, and in the NCETM booklets Teaching for Mastery: questions, tasks and activities to support assessment, a direct line is drawn between teaching for mastery and one of the aims of the National Curriculum:

> 'In line with the curricula of many high performing jurisdictions, the National Curriculum emphasises the importance of all pupils mastering the content taught each year and discourages the acceleration of pupils into content from subsequent years. The current National Curriculum document says:
> *The expectation is that the majority of pupils will move through the programmes of study at broadly the same pace...'* (National Curriculum page 3)
> Progress in mathematics learning each year should be assessed according to the extent to which pupils are gaining a deep understanding of the content taught for that year…'

The challenge to move all children through at 'broadly the same pace' is a challenge for all teachers but mixed-age classes bring an additional dimension to the challenge. Some support for schools and teachers, as they explore this idea and seek to make sense of 'teaching for mastery', is available through the work of the Maths Hubs programme. Two national projects have been working in this area since early in the last school year: one exploring what can be learnt from teachers in Shanghai, and a second using adapted textbooks from Singapore. Both these projects focus exclusively on single-age classes; teachers in Shanghai work only in single-age classes and the textbooks are written for single year groups.

The structure of single-age classes fits neatly with the aim of moving pupils through the programmes of study at broadly the same pace, especially when the curriculum has been set out on a year by year basis, as it has with the mathematics curriculum. However, many schools do not have the option of this structure and this presents a challenge: the challenge of teaching for mastery in mixed-age classes. In response to this, two Maths Hubs in the South-West, Jurassic and Cornwall and West Devon, have contributed funding to a small scale action research project, with a Lesson Study structure, involving eighteen teachers from across Devon, including the city of Plymouth. The project was led by the maths team of Babcock LDP, who support school education in Devon.

The key research question for the project was:

> **What does teaching for mastery look like in a mixed-age class?**

The full final report from the project, which contains case studies exemplifying the findings, along with video clips of teachers talking about aspects of their findings from the project can be found here.

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Summary of the findings

- Mixed-age classes occur in different schools for different reasons, but mainly fall into one of the following four categories:
    - Only class in the school with this age range – could be two, three or four year groups in the class (small school)
    - One age group split between two classes, one with an older year group and one with a younger year group
    - Three parallel classes in the school with this age range – two year groups in each class (one and a half form entry)
    - Mixed-age class (two year groups) in a school with two single age classes for the same age range (one and a half form entry)
- Some of the approaches for teaching for mastery in mixed-age classes are generally applicable whilst others are dependent on the context of the mixed-age class. For all schools, teaching for mastery requires teachers both to believe that all the children can learn the mathematics for their year group and to create equitable classrooms where this belief can be realised.
- Teachers in the project focussed on adjusting the structure of lessons in order to cater for a mixed-age class and found the following:
    - For two-year age groups, the curriculum is closely matched and it is often possible to start with the class together and then attend to the specific year group objectives through a number of different strategies including questioning, the use of different numbers in tasks and the use of rich tasks with different expectations related to outcomes.
    - One school chose to restructure the school day and split maths between two sessions, either side of morning break, so that the children could all work on the same rich task in the first session and then specific needs could be addressed after break (Beaford video clip 2) – see the case study below
- When the teachers participating in the research project decided they needed to teach the year groups separately, they chose to do this in one of four ways:
    - Separate teaching input on the same day – different strategies were used to support this, such as a ten minute task for one age group so that the teacher could set up the independent work with the other age group before focussing her teaching for the lesson back on the first age group.
    - Separate teaching input on alternate days
    - Separate teaching input as needed – this was used in the class with three age groups
    - Separating the year groups and sending the older year group to join a matching single-age class – this was an option in some of the bigger schools.
- Different approaches have different benefits, different challenges and require additional strategies to be used to ensure they are successful. Flexibility is crucial; decisions about how to structure the lessons can depend on the different age groups in the class, the structure of the school, the mathematical learning behaviours and current attainment of the children in the class and the maths being taught. Whilst some teachers preferred to provide a separate input on a regular basis, many of the teachers preferred to start with the whole class together wherever possible, but for all the teachers they were prepared to work in different ways when they decided it was necessary.
- One of the things all the teachers commented on was that they had developed a far better understanding of the expectations for each year group in their class as a result of the project.
- In all classes, children needed to be able to work without adult support. Independent work means independent of an adult: supporting the children to work collaboratively with each other was one of the most effective ways to ensure they could work on mathematically worthwhile tasks without adult support. This was one of the aspects of quality first teaching highlighted during the project

as having a particular part to play in supporting teaching for mastery in a mixed-age class. Others were:

- Elicitation tasks used at the start of a teaching sequence
- Pre-teaching used to support children so they could engage with the mathematics in a sequence.
- Rapid support used to intervene when misconceptions and gaps in understanding were identified
- Questioning targeted to reflect the year-group expectations
- Models and images to demonstrate understanding
- Talk for learning and rich tasks to support independent work and allowing different age groups to start together
- Feedback and marking to support the learning of different age groups in a class.

Whilst these were identified as important in mixed-age classes, all of these elements of quality first teaching are also relevant to single-age classes and so the findings in the report have a relevance to all teachers.

The report contains case studies detailing different approaches, such as the one below:

Case Study: Beaford Primary School

The three teachers who teach Y1/2, Y3/4 and Y5/6 worked together on the project and came to the conclusion that they needed to restructure the timetable. This was agreed with the head teacher after much discussion.

They now run two maths sessions each day. The first session focuses on a high quality first teach and takes place for 35 - 40 minutes before morning break and the second runs after break lasting about 30 minutes. This second session allows for the teacher and teaching assistant (if available) to identify needs and to provide immediate intervention and support for deepening of understanding. This operates for four days a week; on Fridays only the first session takes place in order to allow time for other areas of the curriculum.

It is a flexible model; break time is used to look at work and reflect upon formative assessment from the first session, so that groups of children can be identified for support/deepening. Decisions made about the second session could be:

- Whole class continue with task started in the first session - teacher observes learning and supports/challenges individuals or makes formative assessments
- Some of the class continue with the same task - groups identified from formative assessment in the first session are taught by the class teacher and/or teaching assistant
- Some of class continue with the same task - groups identified from formative assessment in previous sessions are taught by the teacher/ teaching assistant to address misconceptions or gaps
- Children, who do not require support/extension/more time linked to the initial task, practise key maths skills: multiplication tables, number bonds, playing games to develop fluency.
- Teacher/teaching assistant pre-teach to ensure children will be able to access learning on the following day.

The NCETM and both Maths Hubs participating in this project are keen to hear from other schools who have experience of teaching for mastery approaches in mixed-age classes. There is a discussion currently running in the Maths Café. You can also email the project researchers directly.

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Maths in the Staff Room – Short Professional Development Meetings

Maths in the Staff Room provides suggestions and resources for a professional development meeting for teachers that can be led by the maths subject leader or another person with responsibility for developing mathematics teaching and learning in the school. You can find previous features in this series here

Equivalent Calculations

Meeting aims

- To explore understanding of equivalent calculations as a mental strategy
- To develop ideas about how to support understanding of equivalent calculations
- To consider when using the strategy of equivalent calculations is particularly efficient.
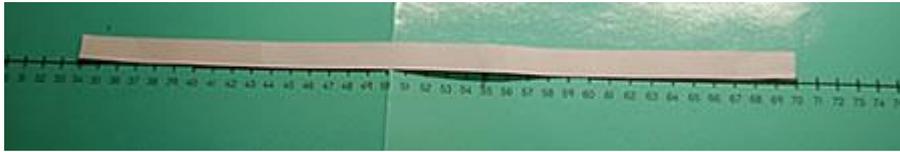
Timings

- 45 to 60 minute meeting.

Resources

- Copies of the article Equivalent calculations: one teacher's experience
- The video clip from 32:27 to 36:10.

The Meeting

- Start by writing up the calculation 70 – 34 and ask everyone to solve it and then to share how they solved it. Look to see if anyone used an equivalent calculation to solve it.
- Show the short video clip and ask everyone to listen for any strategies which the children use which were not used by any staff. Make sure everyone notes the one using an equivalent calculation. Explain that you are going to look at working out calculations mentally and focus on one particular idea, that of creating equivalent calculations. (If someone did use an equivalent calculation to solve the subtraction, say that this is the one on which you want to focus)
- Ask everyone to consider how they might model for children, using a resource, why 70 – 34 = 76 – 40. Share the different ways and discuss how this relies on understanding that subtraction can be about finding the difference and that you can create a subtraction with the same difference if you add or subtract the same to/from each number in the original calculation. Model this with physical resources, such as comparing 70 and 34 on two bead strings

and then adding six to each bead string, put it in a relevant context (for example two children have saved some money, one has saved £70 and the other has saved £34 and then they are both given £6) and show it using a number line and a piece of card which goes from 34 to 70

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and can then be moved up and down the number line, to find numbers with the same difference

- Discuss whether you think the calculation 70 – 34 was a good one for using this strategy and ask everyone to suggest subtractions relevant to their age group for which this would be a really good strategy. Examples could include 2567 – 998, 18.64 – 7.8 and $7\frac{1}{4}$ - $3\frac{7}{8}$ Discuss the advantages of this over rounding and adjusting.
- Explain that this is a strategy that could be used in other calculations, not just subtractions. Give everybody the article Equivalent calculations: one teacher's experience to read. Ask them to suggest additions which are appropriate to the age group they teach which could be solved using this method and to discuss whether or not this is something they have explored with their current class.
- Split into at least two groups and ask some people to consider multiplication and the others to consider division, using the following questions:
  - o How can equivalent calculations be used to solve multiplication/division problems?
  - o What mathematical images would support understanding of these strategies?
  - o When is finding an equivalent calculation a useful strategy?
- Share ideas – be prepared to support both groups, using the following calculations as a starting point if necessary: 868 x 5 = 434 x 10, 41.2 x 20 = 41.2 x 10 x 2, 960 ÷ 30 = 96 ÷ 3 and 816 ÷ 24 = 816 ÷ 8 ÷ 3.
- To have a greater impact, ask teachers to use this strategy in one area of calculation with a group of children and then share what worked well and issues arising at a further meeting.

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Seen and Heard

Seen and Heard *will shine 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*

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	97	99	100

During a maths lesson in Y1 some children are using a hundred square to support their counting in tens and one child says:

"If you count downwards the zero numbers stay the same but the tens change".

- What does this child understand about counting in tens?
- How has the resource influenced what the child has said? What misconception or confusion might this lead to for this child and for other children listening to this child?
- What other mathematical resource might you use to support the child's understanding of what happens when counting in tens?
- What might you ask them next?

If you have a thought-inducing picture, please send a copy (ideally, about 1-2Mb) to us at info@ncetm.org.uk with 'Primary Magazine: Seen and Heard feature' in the email subject line. Include a note of where and when it was taken, and any comments on it you may have. If your picture is published, we'll send you a £20 voucher.

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