Teaching for mastery in mathematics in mixed-age classes

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Report of an action research project

Babcock LDP

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Contents

Acknowledgements Page 2

Summary of findings Page 3

Introduction Page 5

Mastery Page 6

Mixed-age classes Page 8

Overview of action research project Page 9

Research findings:

- Teaching for mastery in **mixed-age** classes Page 11
- Teaching for **mastery** in mixed-age classes Page 16

Conclusion Page 23

References Page 24

Appendix One – example lesson plans Page 25

Appendix Two – example tasks Page 29

Appendix Three – example feedback Page 31

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Summary of findings

This project explored teaching for mastery in mixed-age classes, focussing on how to teach so that children move through the programmes of study for their year group at 'broadly the same pace', a crucial issue when focussing on 'closing the gap'.

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.
- When the teachers 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
    - Separate teaching input on alternate days
    - Separate teaching input as needed
    - Separating the year groups and sending the older year group to join a matching single-age class
- 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.

- The focus on depth rather than acceleration meant the teachers developed a far better understanding of the expectations for each year group in their class.
- Children need to be able to work without adult support. Independent work means independent of an adult: supporting the children to work collaboratively with each other is one of the most effective ways to ensure they can work on mathematically worthwhile tasks without adult support.
- Elements of quality first teaching were highlighted during the project as having a particular part to play in supporting teaching for mastery in a mixed-age class. These 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, assigning competence
    - 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

  All of these elements of quality first teaching are also relevant to single-age classes.

Introduction

This project was set up in response to one of the aims of the National Curriculum, '*The expectation is that the majority of pupils will move through the programmes of study at broadly the same pace'* (DfE 2013 Page 99), and the link made, by the National Centre for the Excellence in Teaching Mathematics (NCETM), between this aim and teaching for mastery.

Government funding has been directed into projects exploring ways of implementing and embedding teaching for mastery in mathematics through the maths hubs and supported by NCETM. Two national projects have looked at what can be learnt from teachers in Shanghai and the use of 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, where the number of weeks spent on each area of maths does not match up across two 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 not addressed by national initiatives: the challenge of teaching for mastery in mixed-age classes.

The key research question for the project was therefore:

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

Mastery

The 'Teaching for Mastery: Questions, tasks and activities to support assessment' booklets, produced by NCETM (2015), state that: '*The essential idea behind mastery is that **all children** need a **deep** understanding of the mathematics they are learning*'.

This idea is underpinned by a number of related ideas and beliefs. The first of these is that in order to teach so that all children develop a deep understanding, teachers have a belief that all children **can** develop a deep understanding; in other words it requires teachers to have a growth mindset (Dweck 2006). This has implications for the way that mathematics lessons are set up, the way children are grouped, the activities that are given to children and the way that differentiation is used. It indicates that primary classrooms should be mathematical communities underpinned by equity.

Jo Boaler (2015) has written about how 'complex instruction' can be used to support equity in mathematics classrooms. There are four aspects to complex instruction:

- Multidimensionality
  "In a multidimensional math class, teachers think of all the ways to be mathematical. If we consider the work of mathematicians, for example, we know that they perform calculations at some times, but they also have to ask good questions, propose ideas, connect different methods, use many different representations, reason through different pathways and many other mathematical acts… In complex instruction classrooms, teachers value and assess students on the many different dimensions of maths" (page 121)
- Roles
  "…they give everybody a part to play and they encourage student responsibility" (page 133)
- Assigning competence
  "… raising the status of pupils who they think may be lower status in a group – by, for example, praising something they have said or done that has intellectual value and, bringing it to the group's or the whole class's attention." (page134)
- Student responsibility
  "…a central party of the CI approach is teaching students to be responsible for each other's learning." (page 135)

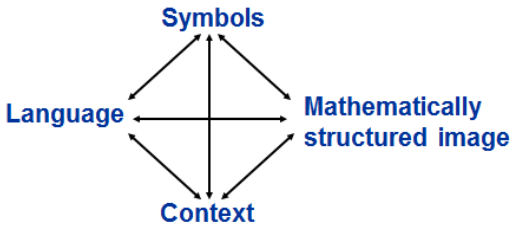
All of these elements support an approach which is focussed on all children achieving; all children understanding. This focus on understanding leads to the question: 'What does it mean to have a deep understanding of the mathematics?' The Teaching for Mastery booklets (NCETM 2015) provide some support with this, with the inclusion of the following section in the introduction:

A pupil really understands a mathematical concept, idea or technique if he or she can:

- *Describe it in his or her own words;*
- *Represent it in a variety of ways (e.g. using concrete materials, pictures and symbols)*
- *Explain it to someone else;*
- *Make up his or her own examples (and non-examples) of it;*
- *See connections between it and other facts or ideas;*
- *Recognise it in new situations and contexts;*
- *Make use of it in various ways, including in new situations*

NCETM (2015) adapted from John Holt (1964)

This idea, that there are different ways to be successful in mathematics and different ways to demonstrate understanding, is a key element of teaching for mastery. In order for children to appreciate the different ways of demonstrating understanding they need to be immersed in learning mathematics through a multi-representational approach. The connective model below, adapted from work by Haylock and Cockburn (1997), exemplifies this approach:



This model indicates different representations of mathematics which children need to understand and need to connect in order to develop conceptual understanding. The model can be used to support planning for teaching for mastery.

Making sense of the different representations and connecting them together relies on talk. It is not simply that children need to understand mathematical vocabulary - individual words - it is that they need to be able to communicate their mathematical thinking so that others understand, using the vocabulary to describe and explain how and why the mathematics works; this links back to the list of what a pupil can do when they understand.

Askew (2010) writes that "*The skill of the teaching of talking mathematics is giving children something mathematically worthwhile to talk about…*" The challenge of supporting the development of talk is therefore partly the challenge of providing something mathematically worthwhile to talk about and rich tasks provide such opportunities. Rich tasks, which are low threshold and high ceiling, can be accessed by all children and provide opportunities for all children to demonstrate fluency, to reason and to solve problems, thus fitting with the aims of the national curriculum,

…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.* DfE (2013)

Teaching for mastery is teaching for understanding, which has always been at the heart of quality first teaching. It is not a new concept but a new label; 'mastery' has allowed a renewed focus on teaching for understanding. All of the elements outlined above have a role to play in developing teaching for mastery and as the teachers explored these ideas they discovered how they have a particular part to play in their mixed-age classrooms.

Mixed-age classes

Mixed-age classes occur in schools of different sizes. For some schools there is no option; they are too small for single-age classes. For example, Beaford Community Primary and Nursery School, Devon has around 100 children on roll, split between four classes: foundation stage unit, Y1/2, Y3/4 and Y5/6. There are many small schools in rural areas; in Devon alone there are over 120 primary schools with fewer than 100 children.

Whilst some very small schools can have up to four year groups in a class (for example the whole of KS2) there are only a few of these schools and they are decreasing in number. The most commonly found mixed-age classes involve two year groups. Sometimes these can be cross phase (Y2/3) but most often they are year groups from within the same key stage.

It is also necessary to have mixed-age classes in some bigger schools; for example a school with a PAN (published admissions number) of 45 has the equivalent of one and a half classes for each year group and this necessitates at least some mixed-age classes. In these cases there are decisions to be made about how to form the classes and how to allocate children to these classes. Some schools decide to have three mixed classes for each age range, for example three Y3/4 classes. Other schools opt to have one class for each year group and one mixed-age class; for example one Y3, one Y4 and one Y3/4 class. Allocating children may be done randomly, based primarily on friendship groups or based on other factors identified by the school.

This variety of contexts for mixed-age classes means that whilst some issues are generic there may also be additional issues which result from the way the mixed-age class has been formed and how it fits in with the rest of the school structure. This means that some of the approaches for teaching for mastery in mixed-age classes will be generally applicable and others will be dependent on the context of the mixed-age class.

Overview of action research project

Project sample

For this project, seventeen teachers with mixed-age classes from eleven schools (see table 1) were invited to participate; sixteen of the teachers taught two age groups and one teacher taught a class with three age groups.

Table 1

Name of School	Location: City, town, village	Number on roll	Age range	Age range of classes involved in project	School Structure*
Beaford Community Primary & Nursery	Village	95	3-11	• Y1/2 • Y3/4 • Y5/6	O O O
Brampford Speke C of E Primary	Village	72	5-11	• Y4/5/6	O
Blackpool C of E Primary	Town(suburb)	323	5-11	• Y5/6	P
Dartington C of E Primary	Town	295	3-11	• Y1/2 • Y3/4	M P
East-the-Water Community Primary	Town	381	5-11	• Y3/4 • Y5/6	P P
Halberton Primary	Village	67	4-11	• Y3/4	O
High View Primary	City	350	3-11	• Y1/2 • Y5/6	M M
Holywell C of E Primary	Village	100	4-11	• Y3/4 • Y5/6	O O
Newton Ferrers C of E	Village	111	5-11	• Y3/4	O
Sticklepath Community School	Town	331	5-11	• Y3/4	M
West Down Primary	Village	90	4-11	• Y1/2	O

* O = only class in the school with this age range
P = three parallel classes in the school with this age range
M = mixed-age class in a school with two single age classes for the same age range

The teachers selected for the project had all expressed an interest in exploring the issue of teaching for mastery in the context of a mixed-age class. These were teachers who were prepared to try things out, share their experiences, good and bad, and reflect on their learning. They were also all supported by senior leadership teams who trusted them to take risks and find solutions in their classrooms.

Project structure

The project was set up with a lesson study approach, supported by five maths advisers from Babcock LDP. For the maths advisers the project was part of a focus on closing the gap, a priority for Devon and funded by Devon County Council. The funding for the teachers was provided by two maths hubs, Jurassic and Cornwall and West Devon.

Teachers formed pairs or trios as learning partners, either within the same school or across two schools. These pairs/trios were then linked to form four learning partner groups who met with a maths adviser three times during the autumn term to discuss and reflect on experiences and plan next steps. The project was structured as shown in table 2.

Table 2

Mid-September	Project launch meeting
Late September	Learning partners – lesson study model of plan and teach a maths lesson using one of the approaches, review together, teach in second class, review, reteach if a trio. Continue to try the approach in class.
October	Learning partner groups meet with adviser
Later in October	Learning partners – repeat lesson study model
November	Learning partners groups meet with adviser
Late November	Learning partners – repeat lesson study model
December	Learning partners groups meet with adviser
Late December	Continue to work on approaches
Late January	Project conclusion meeting

Research Findings

The research findings have been organised into two sets. The first set explores actions which focus on adjusting the structure of lessons in order to cater for a mixed-age class and the second outlines aspects of teaching for mastery which have a particular part to play in supporting teaching for mastery in mixed-age classes.

Teaching for mastery in **mixed-age** classes

At the beginning of the project, all the teachers identified that the challenge presented was how to focus on the age group specific curriculum content for two or three year groups at the same time, expecting all children in each year group to achieve the relevant expected standard by the end of the year. The teachers were experienced in organising their classes to meet the needs of the children but this often meant that there were some children in the older year group working on mathematics from the curriculum for the younger year group. Consequently there needed to be a shift to ensure that all children were working towards relevant age-related expectations.

All the teachers therefore decided that their first action would be to trial a different structure within their lessons, which allowed them to focus on each year group separately. There were two main ways they did this:

- Separate teaching input to each year group on alternate days
- Separate teaching input to each year group in the same lesson

The teachers identified a number of issues arising from following either of these structures rigidly. They included:

- Working independently was problematic for some children
- Children were sometimes separated into year groups when the content was very similar.
- Ending up with as many as ten different activities going on in the classroom at any one time which was both unmanageable and reduced the amount of quality talk between pupils
- Time wasted for one group of children while activities or tasks were explained to the other year group.
- Rushing through explanations to ensure that children got to their tasks meant that depth of understanding was not achieved
- Noisy classrooms
- Limited activities for independent groups
- Not enough progress for pupils due to reduced direct teaching with each group
- Focus on one year group meant misconceptions in the other year group were not addressed
- Opportunities missed to deepen or reshape learning due to lack of teacher time to observe learning

The teachers focussed on the curriculum and identified where the maths was aligned across their age range and where it was significantly different. Most of the teachers then decided that where the curriculum matched, they would start with the whole class together and attend to the individual programmes of study through a variety of strategies including differentiating tasks and questions.

It was found that for two-year classes the curriculum is often easy to align and quite closely matched. The biggest gap is between the expectations in Y1 and Y2, whereas Y5 and Y6 programmes of study are the closest and therefore the easiest to align.

Where there were significant differences in the curriculum, the teachers used a variety of approaches including two inputs in a lesson, guided groups and alternating input across several days. A few teachers continued to regularly give separate inputs to the individual year groups. The key for all the teachers was flexibility; choosing the model that was best suited to the area of maths, to the needs of the children and to the expectations of the curriculum for the different year groups in the class.

Case Study: Newton Ferrers Primary School

The Y3/4 teacher uses an elicitation task at the start of a sequence, linked to the objectives for each year group. This allows her to identify the learning required of all the learners. She considers whether the objectives are transferrable across the year groups, deciding whether she can keep the class together for the teacher input or if she needs to stagger her input.

Where possible she provides input to the whole class; she will identify, through assessment for learning, if there are some children who need a more focussed small group input and children who do not need the input and so work independently.

When teaching the children together, the teacher ensures that ALL learners access the curriculum relevant to their year group; questioning is differentiated and tasks are set to year group objectives. For example, the teacher kept the class together when focussing on understanding place value and, in particular, exploring the objectives:

- Y3 Recognising the place value of each digit in a three-digit number
- Y4 Recognising the place value of each digit in a four-digit number

Where the learning objectives do not align across Y3 and Y4, the teacher provides input to each year group separately, allowing the teacher to target learning to specific year groups. For example, the year 4 curriculum includes

- round any number to the nearest 10, 100 or 1000
- count backwards through zero to include negative numbers

Rounding does not appear in Y3; the teacher identified that this builds on being able to position numbers so made this the focus for the matching Y3 work. Negative numbers do not appear in Y3 either. When teaching negatives to Y4, the Y3 children joined in with the counting. When the Y4 children positioned temperatures which included temperatures with negative values, the Y3 children worked with temperatures above zero.

Case Study: West Down Primary

"I look at the objectives for both year groups and decide whether it would be best to teach them separately or together. After the elicitation task, I think about the resources I will need to scaffold the activities for each year group and extension activities to promote deeper understanding. For low threshold high ceiling tasks, I usually input both year groups together. For mental maths, such as counting in 2's, 5's and 10's, I teach the year groups together so that the year ones can learn from the year twos. When teaching a specific year group objective, I carry out a double input e.g. I input to year ones while year twos carry out a challenging, independent activity, then swap over." Y1/2 teacher

Case Study: East-the-Water Primary School

"Before I begin a new sequence, I compare the objectives in the curriculum for year five and year six. Where they are similar, I teach the same lesson to both year groups and will differentiate the activity slightly to meet the objectives. However, where the objectives are very different, I make a decision on the way I will teach them using a variety of different ideas used in the project such as teaching the year groups separately or pitching my input to alternate year groups throughout the week." Y5/6 teacher

"…when learning objectives for the two year groups are similar I will teach pupils for each year group together as a whole class in a more traditional way. This will involve the same 'I can' statements for each year group but my year threes will receive additional scaffolding where appropriate by me or another member of staff. However, when the outcomes for the year groups differ greatly, meaning it would not serve as beneficial to the learning of each to be exposed to the other, I will teach each year group separately and allow the other group independent learning time supported by the other adults in the class. This will work on a rotational basis, ensuring each year group has sufficient teacher-led time to accelerate their learning towards their objective. I make decisions on when to teach them separately based upon the area of mathematics they are working on and whether the outcomes they need to work towards are different. There have also been occasions where, after starting a strand of mathematics together, I have needed to change my approach due to assessment of the children's learning indicating that some children need to go back to the previous outcomes to consolidate these." Y3/4 teacher

Case Study: High View Primary School

The school has three classes across two year groups throughout key stage 1 and key stage 2. In Y1/2, there is one Y1 class, one Y2 class and a mixed Y1/2 class. The pattern is the same in Y5/6. This provides the teachers with an option to take a slightly different approach when the curriculum differs for the two year groups and new areas are introduced for their older year group.

"There are some instances where the objectives for each year group are separate...In these instances, we have been able to use either a team teacher/HLTA (of which there is one in both teams), or utilise the single year group class within each team."

This means that the teachers sometimes plan for their older year group to join the single year group class; for example, when introducing algebra in Y6 the teachers might plan for the Y6 children in the Y5/6 class to join the Y6 class. This is only possible because of the physical space available in the classrooms and the additional adults available to support learning.

At the end of the project, many of the teachers observed that they were now paying much more attention to the curriculum for each of the year groups they were teaching:
"*I now think a lot more carefully about how I am going to ensure that I am teaching Y5s and Y6s the correct objectives. Many of the Y6 children I have are still working towards the Y5 objectives; however they need to be exposed to new areas of learning in the year 6 curriculum (such as percentages, algebra etc.*)" East-the-Water Primary

By the end of the project, only two teachers were regularly separating their input for the two year groups in their classes; the rest were starting with the whole class together, wherever possible, as described above. Where the separate inputs were being used each day, there were additional strategies which had been put in place in order to make the structure work.

Case Study: Halberton Primary School

The Y3/4 teacher separates her focussed teaching input her two year groups, providing it on alternate days. To manage this she has structured her lessons to ensure that the group working independently does get some input. She gives one year group a ten minute task to work on, usually involving mental maths which consolidates or practices pre-requisite skills, whilst she introduces the independent task to the second year group. This task builds on their learning from the previous day, often involving them in applying their understanding in new contexts. This group then goes to work on their task and the other group joins the teacher for a focussed guided session. There is flexibility in that the teacher can send some children off from this guided group, when they have understood the mathematics, and keep working with others as necessary.

Managing transitions has been an important part of making this structure work; simple things such as the children bringing their maths books to the carpet rather than spending time getting white boards and pens out; this also means that all of the children's thinking is captured and available for the teacher to view after the session.

The teacher has started to use this structure successfully in other areas of the curriculum, for example teaching grammar, but does not use the arrangement exclusively; she also has whole class maths sessions each week, using low-threshold, high-ceiling activities.

Pupils have responded positively to the structure. It currently relies on the independent group being supported by a teaching assistant, but the teacher is planning to develop independent working further so that this is not necessary and the teaching assistant can be deployed for targeted support.

Case Study: Holywell Primary School

The Y3/4 teacher identified that there was a big difference in terms of experience between her Y3 cohort, who were new to her class, and her Y4 cohort, who she had taught for one year. This difference was particularly apparent when considering their ability to work independently and make decisions: the teacher decided that teaching them together would not be the best option. She decided to do a separate input for each year group in each maths lesson, in effect teaching two maths lessons within one. She tailors each lesson to the needs of the children and the content ensures that coverage of the age appropriate curriculum is possible for all children in that year group.

The structure of the lesson tends to follow the pattern below:

- Starter – whole class, mental/oral mathematics with the number content and skill level pitched to the developing needs of the children
- Teaching input/guided session for one year group whilst the other year group engage with an investigation based on learning from earlier in the teaching sequence or revisit prerequisite skills needed for the mathematics later in the lesson. The independent tasks will often involve paired work and use rich, low threshold, high ceiling activities.
- Children move onto independent work when the teaching input/guided session is completed. Coloured cups are used to indicate levels of understanding and a teaching assistant supports children who are struggling to understand or have misconceptions in the independent group. The first independent group now joins the teacher for input/guided work.

Working **without** adult support

The one issue which all the teachers had to deal with was the struggle some children faced with working independently. In some classrooms teachers relied on other adults but this was not always possible. One teacher observed that this was creating another kind of dependency. Supporting children to work without an adult became a focus for some of the teachers. This was essential when teachers needed to focus on one of the year groups and was of benefit to all learners. Some teachers talked about the need to think very carefully about the groupings for independent work.

"I tried to split the class for objectives which didn't match up but it was very challenging. Year four children were more able to work independently... The year three children were not able to work without adult support independently. This is I feel is mainly down to their learning behaviours and their lack of maturity/age difference." Dartington Primary

"Next step: to generate a bank of year one and year two independent activities which will challenge children, yet not be too noisy as to distract the other year group from their input." West Down Primary

Teaching for **mastery** in mixed-age classes

The teachers grappled with and reflected on the aspects of quality first teaching which contribute to teaching for mastery in mixed-age classes, implementing different strategies and approaches. In particular, these were: elicitation tasks, pre-teaching, rapid support and intervention, questioning, talk for learning, models and images, rich tasks and feedback and marking

- Elicitation tasks

"Elicitation tasks can be a valuable part of any teaching sequence in mathematics. They can provide the teacher with evidence of each child's understanding at the start of a sequence, indicate gaps and misconceptions to focus on during the sequence and provide a reference for assessing progress at the end of the sequence." Babcock LDP (2015)

Many of the teachers in the project used elicitation tasks at the start of teaching sequences in order to identify what the children already knew and understood and where the teaching in the sequence needed to focus. This allowed them to shape the learning journey for all the year groups in their class and prompted decisions, such as whether pre-teaching was necessary for some children:

"We have developed the use of elicitation tasks to gain an understanding of the children's existing knowledge prior to starting units, and this obviously has then informed our planning and teaching requirements. We have then been able to make decisions as to whether or not any pre-teaching will be necessary, and also what gaps we need to fill in order to ensure that the children achieve in line with their relevant age expectations." High View Primary

In mixed-age classes, elicitation tasks support the teacher in deciding which elements of the teaching sequence can be taught together and which need to be taught separately.

- Pre-teaching

Pre-teaching was one strategy used to support children who might otherwise struggle to access the mathematics in a lesson. Several of the teachers in the project used this for particular groups and individuals, in order to help the children work towards age-related expectations and support them to 'move through…at broadly the same pace'.

Case Study: Holywell Primary

"There is quite a large divide between the girls and boys in Y3, which is where the pre-teach element of the project has been best used. The girls have a pre-teach daily in preparation for the content of the lesson. This can sometimes be revision or practise of the independent task in preparation or a key skill which they will be taught, but struggle to engage with when we are altogether. We have also used this as some revision of skills in preparation for the next steps they will be taught by the whole year group teacher input/guided." Y3/4 teacher

"I decide which children I might include in a pre-teach group and when the pre-teach session will take place… I have mostly selected Y6 children who often take longer to grasp the maths ideas we are working with." Y5/6 teacher

Sometimes pre-teaching revealed issues which required a rethinking of the planning for the maths lessons in a teaching sequence:

"*Often a half hour session wasn't enough for these children to fill the gaps. Regularly the struggles were down to a lack of number sense rather than a lack of understanding of the lessons being taught in that sequence."* Sticklepath Primary

- Rapid support and intervention

A second strategy for supporting children to 'move through…at broadly the same pace' is the use of rapid support and intervention. This includes identifying issues during a lesson or series of lessons and putting in additional support during the teaching sequence; identifying issues at the end of a teaching sequence; and, providing additional support immediately. For one school, a reshaping of the structure of the school day allowed space for support and intervention each day.

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

Continued overleaf

*For examples of lessons and tasks see appendices one and two

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Case Study: Beaford Primary School (continued)

. The teachers identified the following impact of this approach:

- Provides more opportunities for children to work collaboratively and to talk meaningfully about maths as the whole class are now working on the same mathematical idea
- Provides the opportunity for teachers to give immediate feedback and support to children who need it; talking to focus children this was identified, “If I am finding it hard, now I can get help from my teacher straight away.”
- Time now provided in the school day for practise of key maths facts (times tables, number bonds to ten etc.); this has raised the profile of learning these facts.

There are also challenges presented by this structure, which include:

- More timetabled time for maths means other areas can feel squeezed
- High expectations of teachers as they are not really getting any break for the whole morning and no break between teaching maths and teaching English
- Short first session for maths means it isn’t always possible to get as much as intended done in the first session, so children don’t always get to complete the tasks in that session
- Supporting children who are not able to access the expectations of their year group; finding a balance between using the group time to do this and using it for deepening understanding.

- Questioning

Within lessons, the use of questions to probe understanding and encourage children to think about their mathematics, explain their thinking, reason and justify their decisions is a key element of teaching for understanding. In mixed-age classes, questions can be adjusted to reflect the expectations for the different year groups in the class and it was one of the strategies used by teachers particularly when they were keeping their whole class together.

Case Study: High View Primary

The teachers have found that the objectives for the two different year groups in their classes, both Y1/2 and Y5/6, are very closely linked, with only small explicit differences. This has meant that they have been able to keep the whole class together by aligning learning intentions and using a range of effective teaching strategies including a focus on questioning:

- Split screen questioning to target individual children (i.e. year group specific).
- Where appropriate, differentiated questioning within independent tasks, according to the year group specific objectives.
- Rich reasoning questions to further deepen understanding of objectives

The teachers have access to experienced, well-trained additional adults who also use questioning to support and deepen understanding and this is a key factor in how the teachers address the needs of a mixed-age class.

The focus on children working independently, which was part of the project, brought into focus the role of talk in mathematics lessons. Teachers identified that children needed support to talk meaningfully about their mathematics and that this was an essential part of mastery.

Case Study: Dartington Primary

The teachers in both Y1/2 and Y3/4 found that the children were struggling to work without adult support and that they needed to develop collaborative work. One of the strategies they used for this was to focus on supporting meaningful mathematical talk. In both classes sentence starters were modelled and then used by the children. These included 'I agree…' and 'I disagree…' to focus the children on what other children were saying and to reflect on their own thinking, providing reasons for this thinking. Other sentence starters were used to support children in explaining their thinking and to support writing following talk. These starters included:

- I know that
- I notice that
- I think that
- I wonder if

Sometimes, the talk was a device for dealing with mixed age classes when the children are all working together:

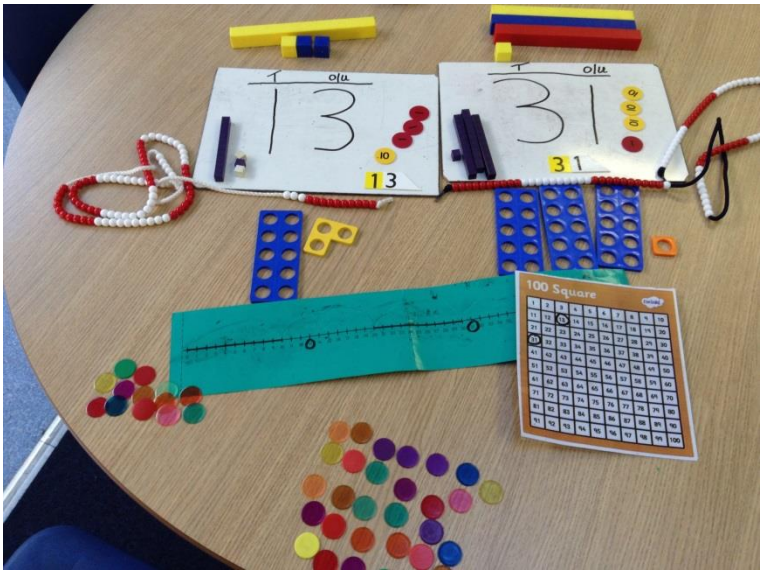
"I use the year twos to model, explain and teach and have had a few lessons where the job of the year twos is to explain and teach the year ones." West Down Primary

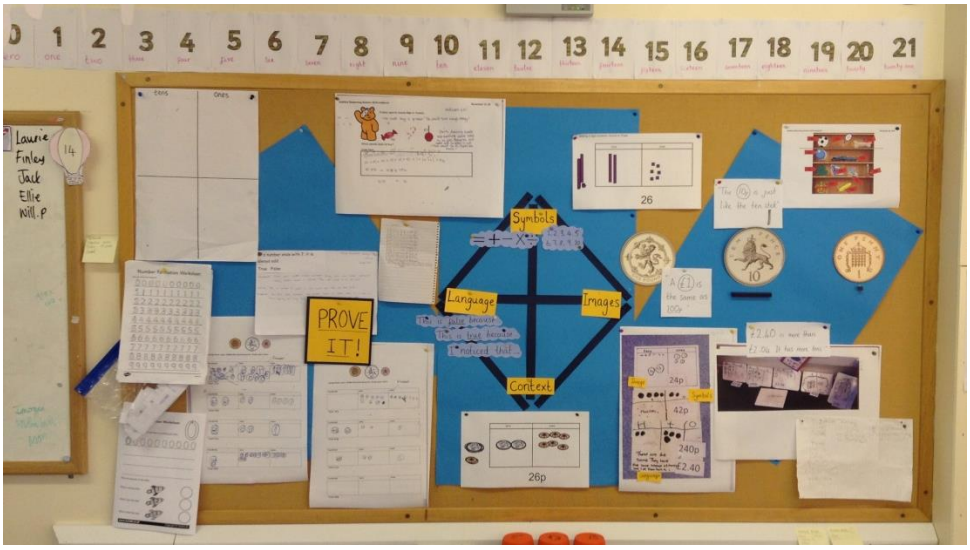
- Models and images

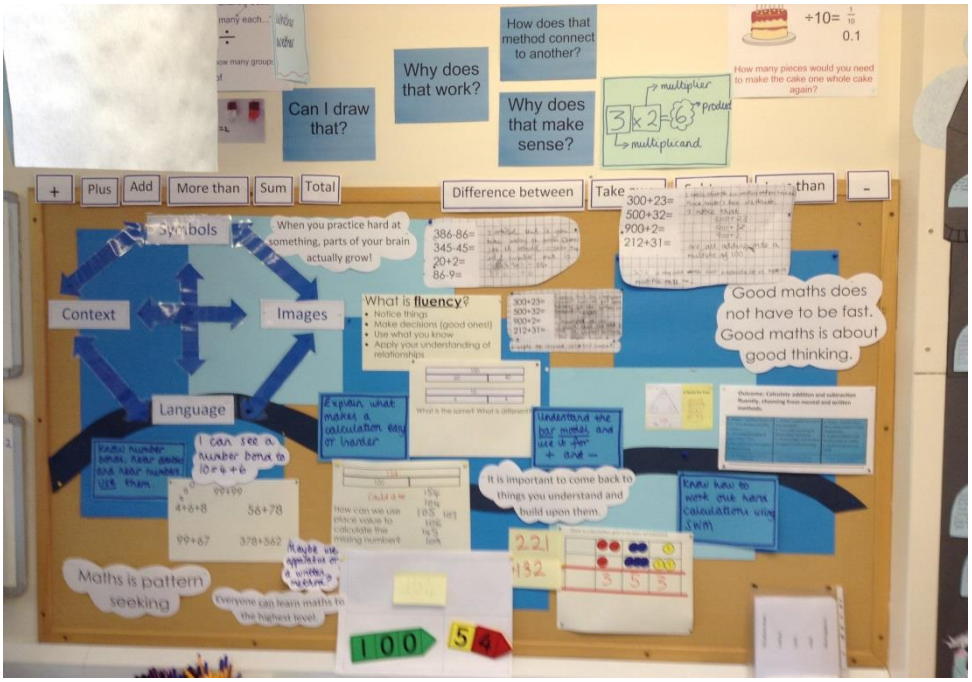
Many of the teachers expected the children to use models and images to demonstrate their understanding, often as part of independent work, and used this as a way to challenge the children and for the children to challenge themselves.

Case Study: Beaford Primary

"…what can we give them to do if they feel that they have completely finished and we said 'Show using models and images your understanding' and that brought to our attention that they weren't as skilled at using models and images to show their understanding independently as we thought they were. So we spent some time focussing on models and images through the school…one child just said 'I don't need models and images because I'm not stupid'. So it came about that they thought that, in year five and six in particular, that using images was only there for support and actually it wasn't there to show their understanding. So we had to completely turn that on its head, that actually using models and images meant that you were in greater depth and could show greater understanding…Even down in key stage one that came across as 'No, I don't use that'…you might not need something to calculate in your head but to explain it you do need to use it…We reinforced that with our working walls, we have the connective model and that also helped with challenging children, we'd say 'Look at the board, what else could we do, give me a context, give me an image'…All of it was in my head but it made it so that they could access it."


13
31
100 Square


Laurie
Finley
Jack
Ellie
Will.P
Symbols
Language
Images
Context
PROVE IT!


Why does that work?
How does that method connect to another?
Why does that make sense?
Can I draw that?
multiplier
multiplicand
Product
Plus
Add
More than
Sum
Total
Difference between
Symbols
When you practice hard at something, parts of your brain actually grow!
Context
Images
Language
What is fluency?
Notice things
Make decisions (good ones!)
Use what you know
Apply your understanding of relationships
Good maths does not have to be fast. Good maths is about good thinking.
It is important to come back to things you understand and build upon them.
Maths is pattern seeking
Everyone can learn maths to the highest level.

- Rich tasks

In order to work with a mixed-age class together, teachers often made use of low threshold, high ceiling tasks. One pair of teachers summed up the reasons for this as follows:

'High threshold low ceiling tasks allow children to access learning at different levels whilst keeping the class together on the same area of learning. Lessons provide greater opportunity for mastery in depth for high attainers, whilst others consolidate key ideas.' Newton Ferrers and Blackpool Schools

The challenge for some teachers was finding rich tasks that explored the relevant mathematics and could be linked to other areas of learning.

Case Study: Dartington Primary

The teachers have made use of rich open tasks, where they have differentiated for the two year groups through their expectations of the outcomes and through questioning during the task, based on their knowledge of the objectives for the two year groups. This has allowed them to direct questions linked to the relevant curriculum. Linking these activities to a familiar context from another part of the curriculum has supported the children:

"Children seem to prefer doing these tasks especially when there is a clear context or link with curriculum learning e.g. Rivers, The Iron Man."

The teachers found that the tasks encourage children to explain, reason and prove their thinking which in turn has improved independent learning and collaborative learning. Children are less scared to make mistakes and instead see it as a valuable learning tool. They have also been able to use the children's questions in a lesson. For example, one child said "I wonder if you can draw a triangle with two right angles" and this became the question which the whole class investigated in the lesson the next day. The children were expected to show evidence, in different ways, to prove their hypothesis. This use of the children's questions then encourages them to wonder and share their thinking; they like it when their suggestions are used with the rest of the class.

- Feedback and marking

Independent working and meeting the needs of individuals are both enhanced by effective feedback and marking. For one school in particular, where there were three year groups in the class, the teacher found that supporting children to engage with marking and feedback was essential.

Case Study: Brampford Speke Primary

In the Y4/5/6 class an elicitation task completed independently or in a group at the start of a teaching sequence allows the teacher to find out what the children know and what they need to learn. She then groups them according to their learning journey and plans a sequence of lessons keeping a 'Big Idea' in mind for the whole class. When teaching the whole class, the teacher keeps her teaching input short; there is a lot of partner talk and discussion. Whole class lessons usually involve a low-threshold, high-ceiling activity where all the children can engage in the task and it allows the high attainers to be creative. The teacher teaches the year groups separately in guided sessions, finding this is more manageable and that it allows the children to learn at their own pace. They make mistakes, learn from them and move on. The class is also supported by an experienced HLTA; this is crucial to the way the teacher plans for the class.

One of the challenges has been the importance of marking so children know their next steps and of expecting children to engage with the marking so that they can move forward. The teacher has supported this by introducing response starters for the children to use when they are reflecting on their learning and responding to marking. These are displayed in the classroom:

- To improve my work I need to…
- Next time I will…
- I am ready to move on to…
- I wonder why…
- Can you help me...?
- Today I learned…
- Today I got better at…
- I remembered…

The children are encouraged to respond* honestly and take control of their learning by responding to marking and feedback, correcting their work as necessary.

*For examples of children's response see appendix three

Implications, limitations and challenges

This has been a small project and the sample has been limited; only one teacher had three year groups in a class and none of the teachers involved taught a class with four year groups. In addition, not all age combinations were included; for example the study did not include a Y2/3 class. It is hoped that teachers with classes that are not represented in the project will feel that they can try the different approaches and adapt them as necessary.

Some of the strategies used could be adapted for mixed-age classes structured in different ways, which has not been possible within this project. For example, the strategy of separating the year groups and sending the older year group to join a matching single-age class, when the curriculum for the two age groups is significantly different, could be adapted for a school with three parallel mixed age classes, separating the children into year groups, when the curriculum differs, and teaching them separately. There was no opportunity to explore this and it is for other schools to consider the different approaches shared here and adapt them to see if they can be used effectively

All of the elements of quality first teaching which have been part of this project are relevant to single-age classes. The need for children to work without adult support raised the question of whether there is the same need in single-age classes and if not, whether some children are allowed to remain dependent on adults.

There are three further challenges which schools may need to consider:

- Ensuring children who are involved in pre-teaching and rapid intervention do not feel stigmatised
- Some of the approaches relied on the availability of skilled additional adults. Where these are not available, options are greatly limited.
- Managing an approach as described in this research within the SATs dominated environment of Y6.

Conclusion

Focussing on teaching for mastery has focussed teachers on quality first teaching and teaching for understanding, neither of which are new concepts. The main shift in focus is on children moving through the programmes of study at the same pace and in order to do this, different lesson structures and different strategies can be deployed with a clear focus on year group expectations.

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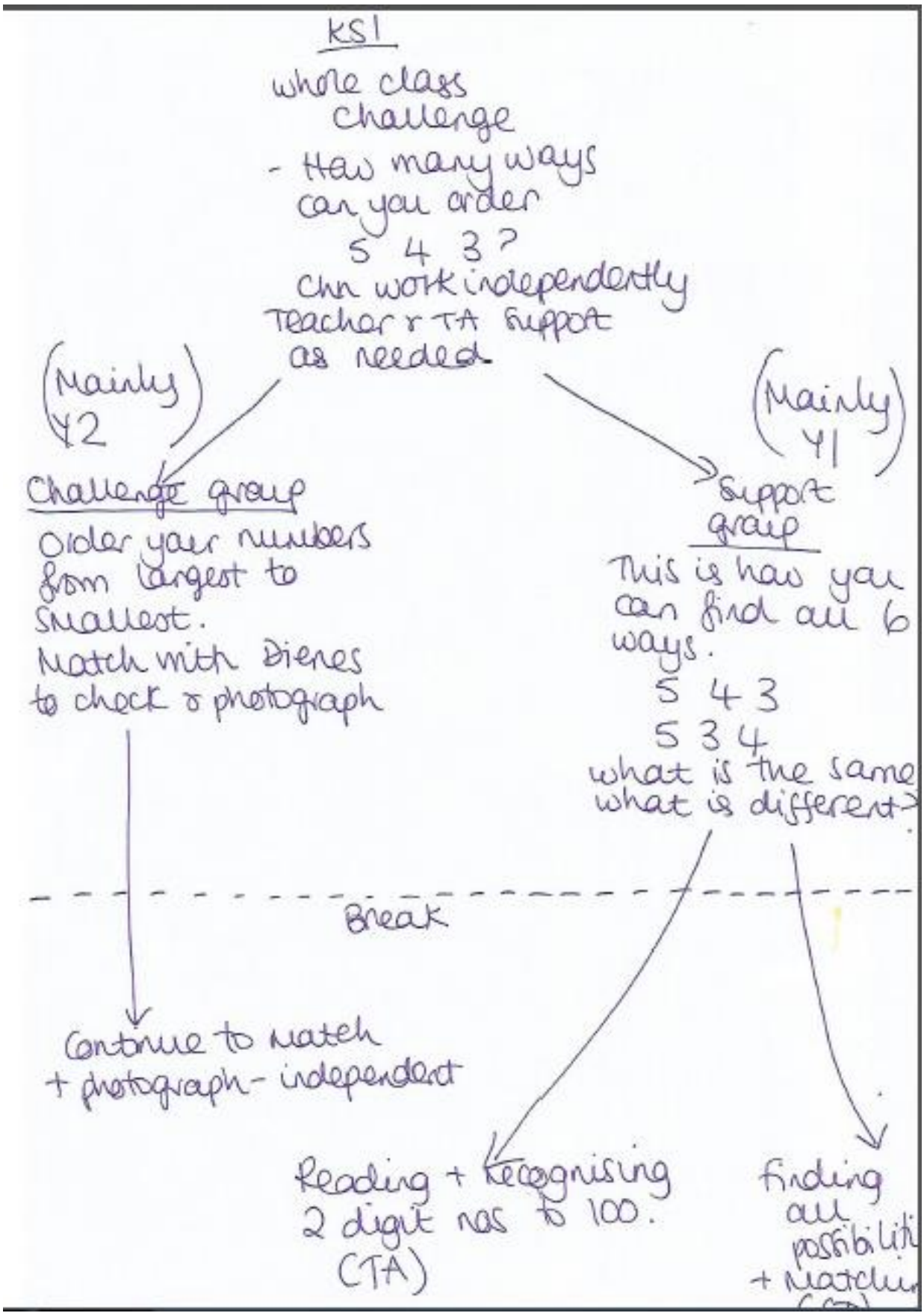
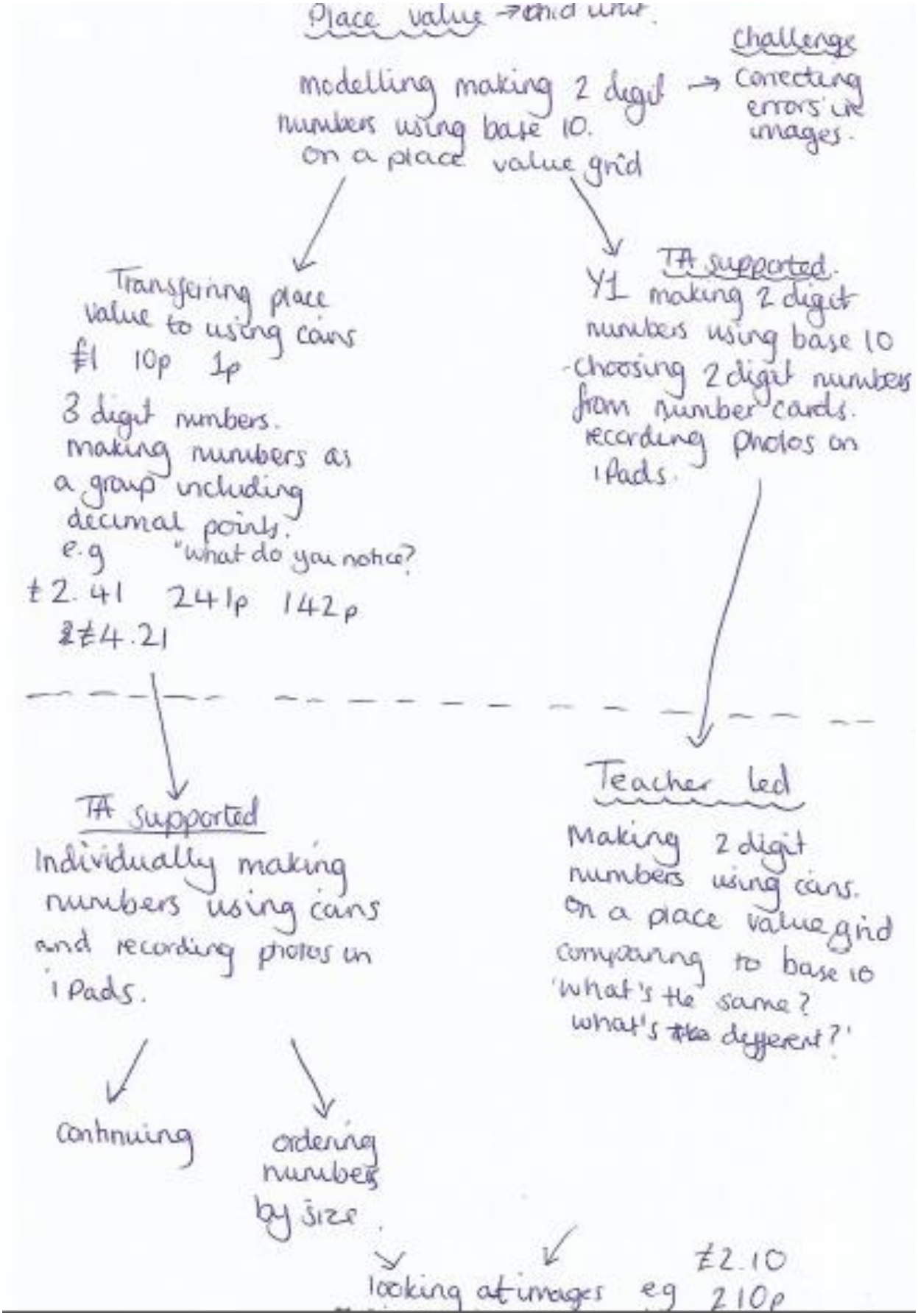
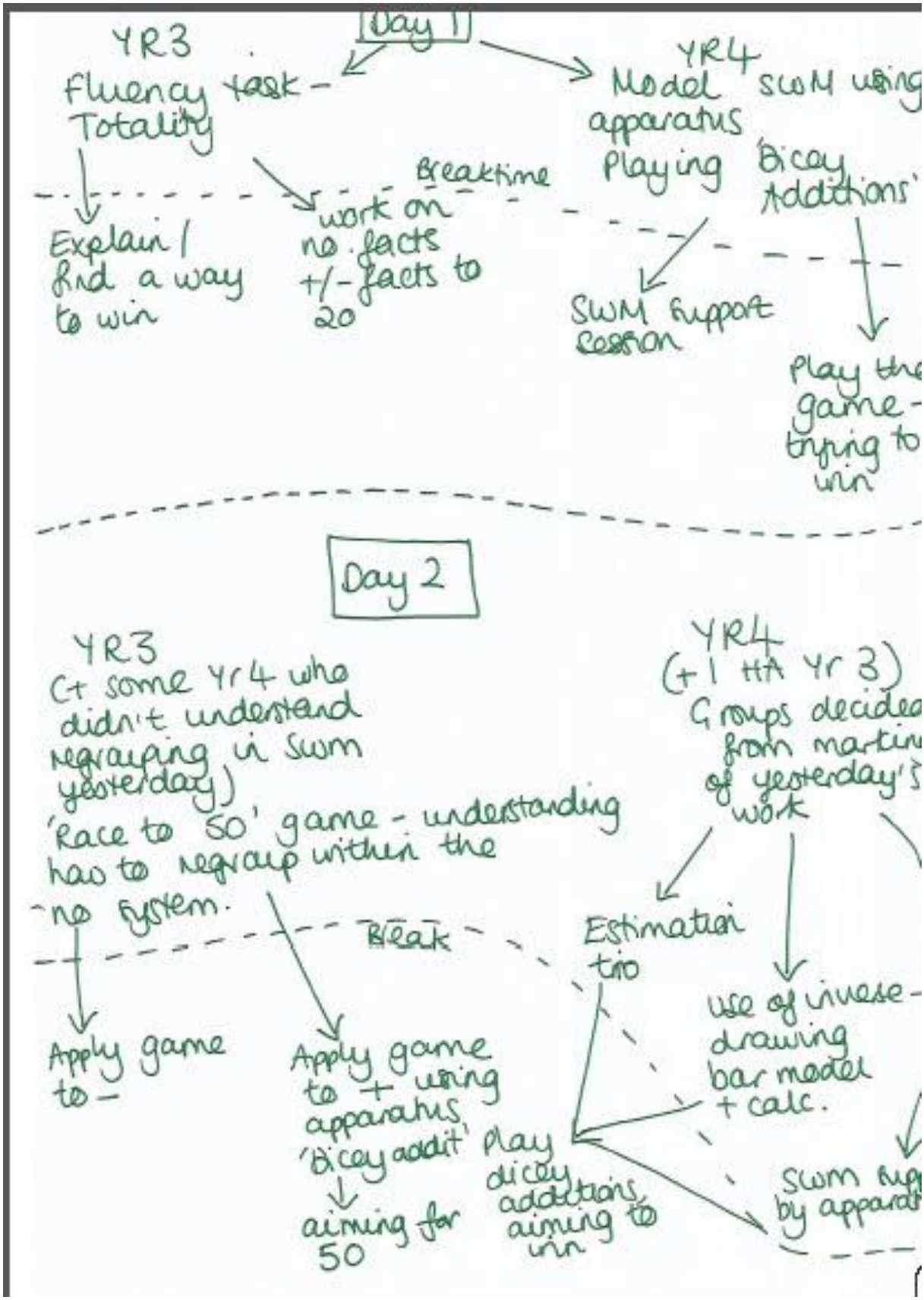
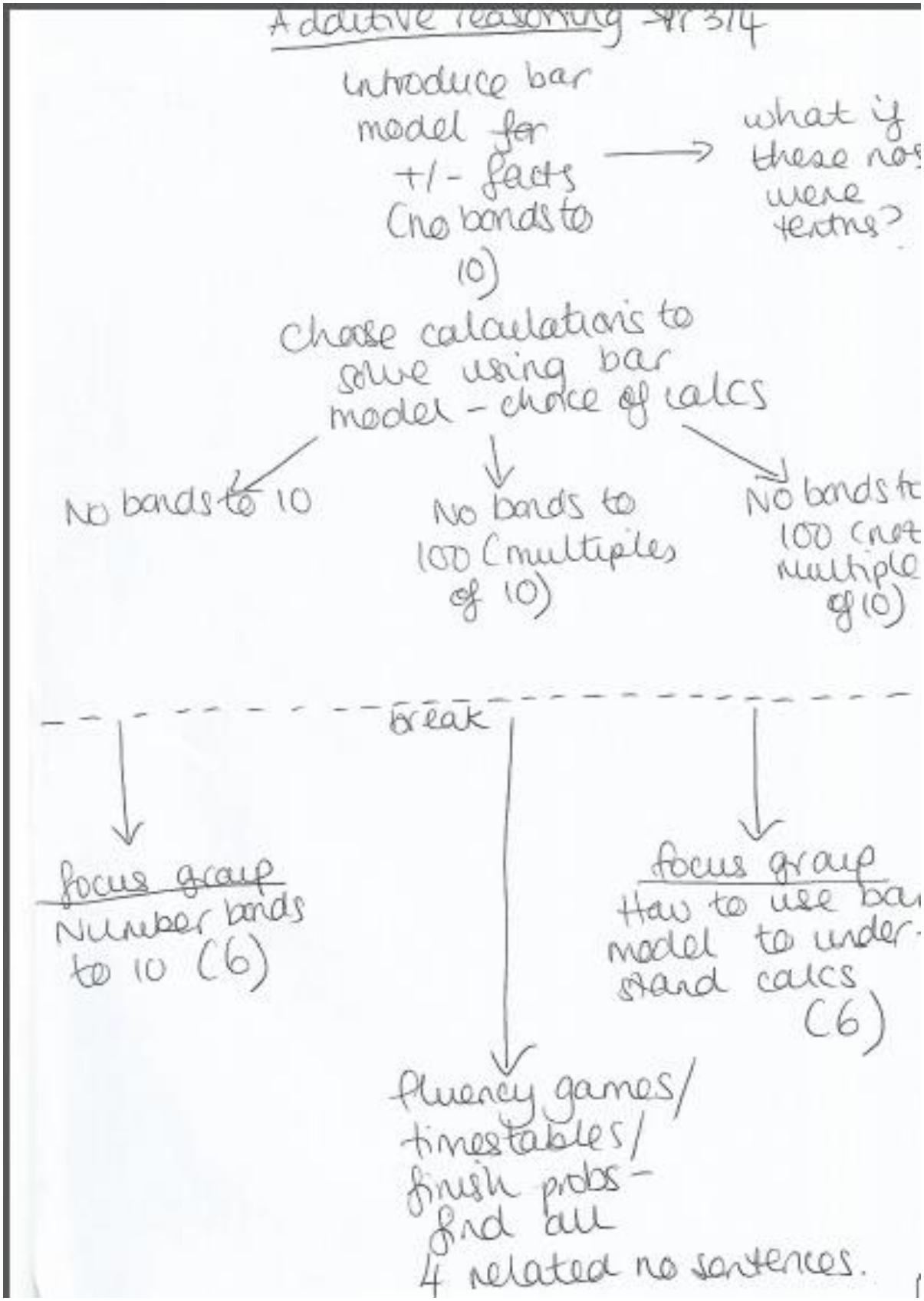
Appendix One

Examples of planning for lessons incorporating rapid intervention



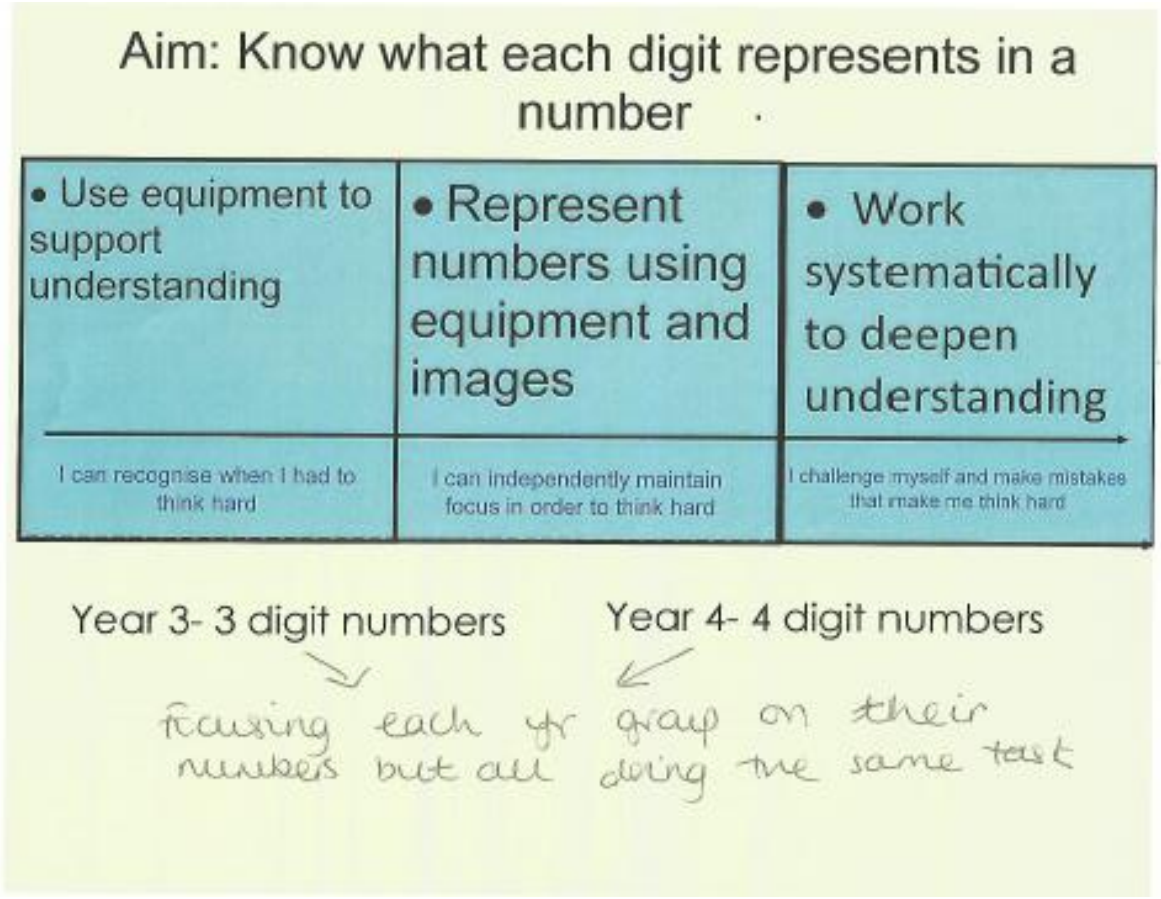

Place value → and unit.
Challenge
Modelling making 2 digit numbers using base 10. on a place value grid → Correcting errors in images.
Transferring place value to using coins
£1 10p 1p
3 digit numbers.
making numbers as a group including decimal points.
e.g "what do you notice?
£2.41 241p 142p
2£4.21
TA supported.
Y1 making 2 digit numbers using base 10
-choosing 2 digit numbers from number cards.
recording photos on iPads.
TA supported
Individually making numbers using coins and recording photos on iPads.
Teacher led
Making 2 digit numbers using coins. on a place value grid
comparing to base 10
'what's the same?
what's the different?'
Continuing
ordering numbers by size
looking at images eg £2.10 210p

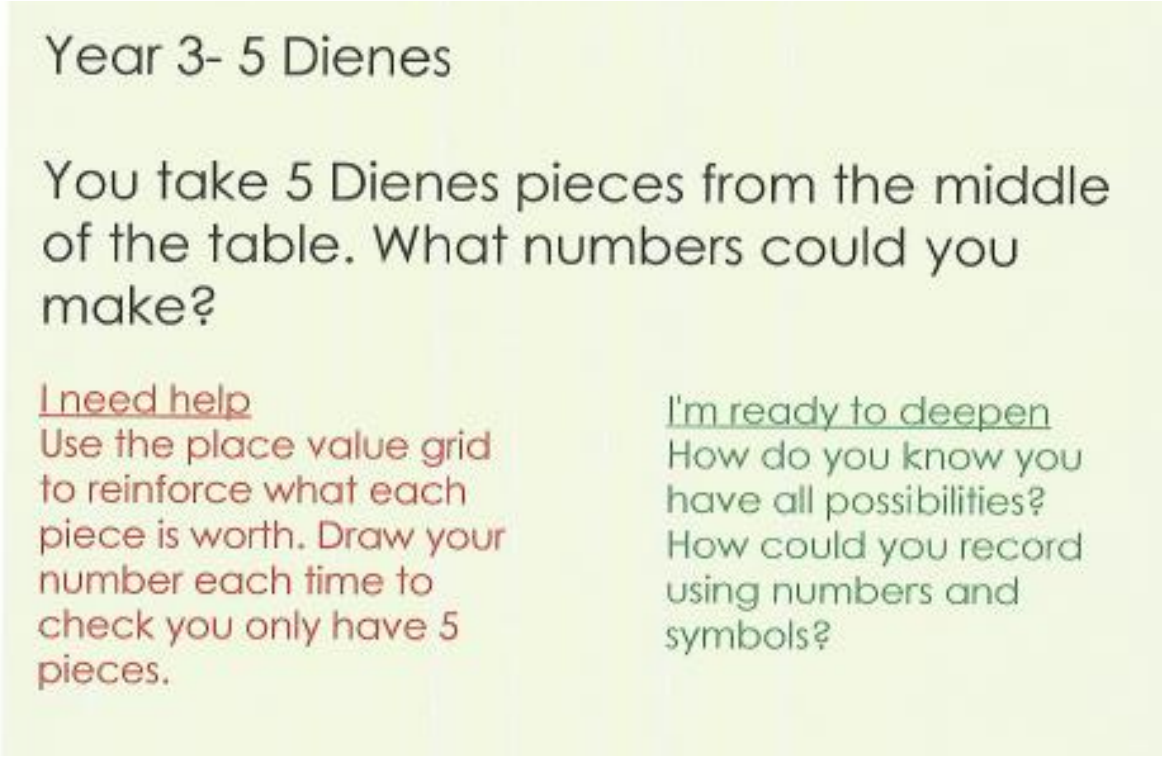

Day 1
YR3
fluency task -
Totality
YR4
Model SWM using
apparatus
Playing 'Dicey Additions'
Breaktime
Explain / find a way to win
work on no. facts +/- facts to 20
SWM support session
Play the game - trying to win
Day 2
YR3
(+ some Yr 4 who didn't understand regrouping in SWM yesterday)
'Race to 50' game - understanding has to regroup within the no system.
YR4
(+1 HA Yr 3)
Groups decided from marking of yesterday's work
Break
Estimation trio
Use of inverse - drawing bar model + calc.
Apply game to -
Apply game to + using apparatus, 'Dicey addit' aiming for 50
Play dicey additions aiming to win
SWM sup by apparat


Additive reasoning - Yr 3/4
Introduce bar model for +/- facts (no bonds to 10)
what if these nos were tenths?
Choose calculations to solve using bar model - choice of calcs
No bonds to 10
No bonds to 100 (multiples of 10)
NO bonds to 100 (not multiple of 10)
break
focus group
Number bonds to 10 (6)
focus group
How to use bar model to understand calcs (6)
fluency games/ timestables/ finish probs - find all 4 related no sentences.

Appendix Two

Examples of tasks planned for mixed-age classes





Year 4- in pairs of your choice

Play the 4-digit target game.
I expect both of you to be able to justify your solutions and explain how and why you decided upon your number

You **both** need to understand why the numbers you have meet the criteria on the sheet

I need help
Use numicon to check your ones digit is odd or even.
Use the digital root trick to check your multiples of 3
Talk to your partner and listen carefully to see if they can help you.

I'm ready to deepen
How can you play in a way that makes it more likely you will win?
Are any of the numbers harder to make choices about? Why?

Aim: To understand the relationship between addition and subtraction

27.11.15

$y = 456 + 178.56$

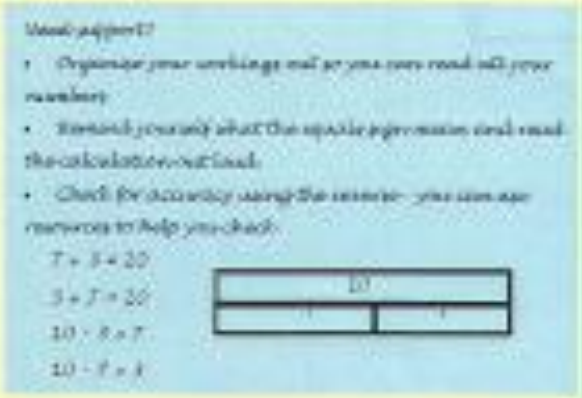
$357 + y = 7643$

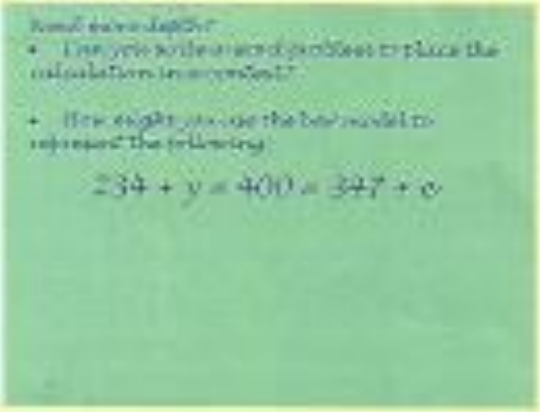
$y = 1249.5 - 786$

$y - 53.67 = 1245.7$

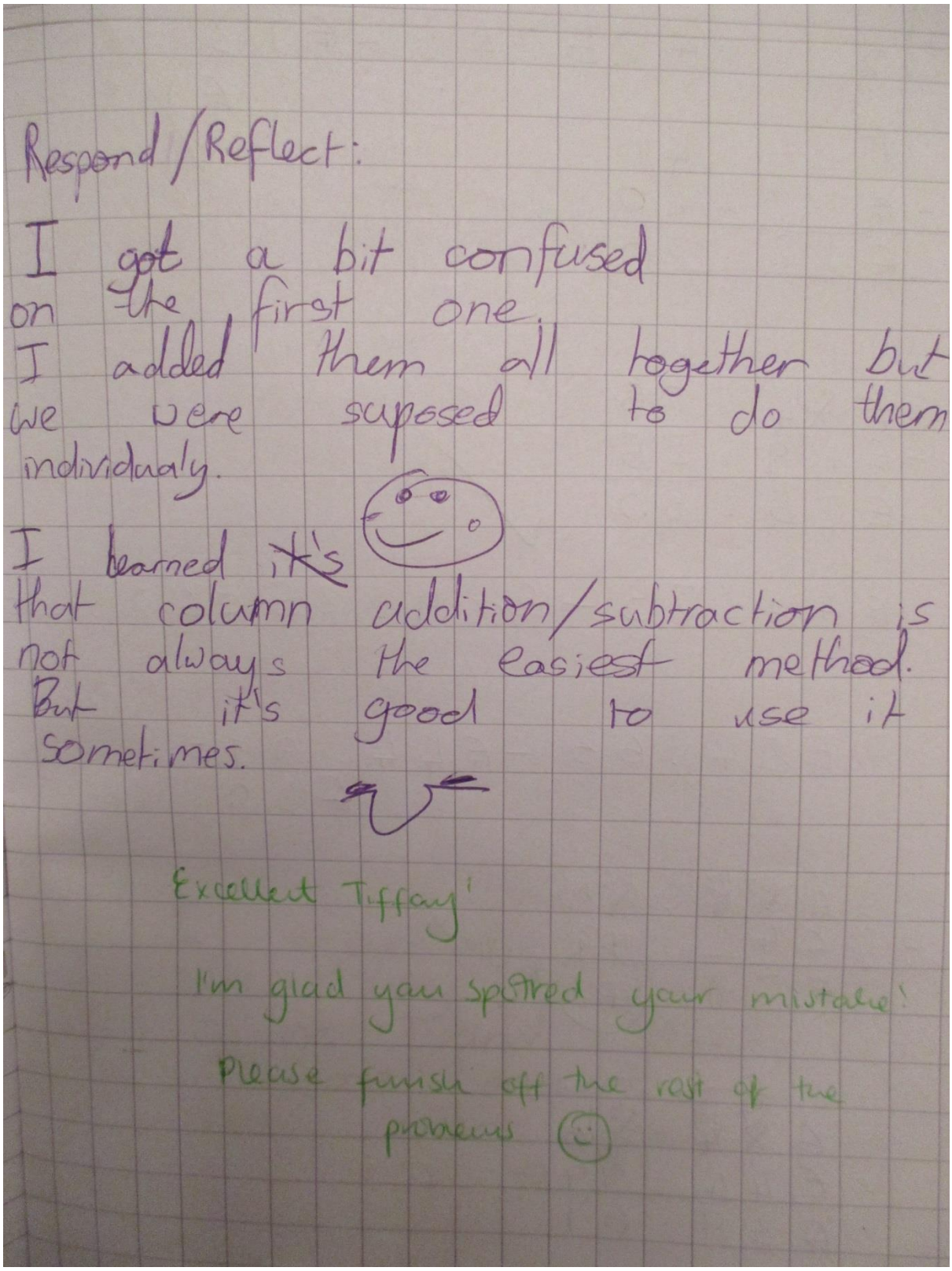
Write the calculation question first

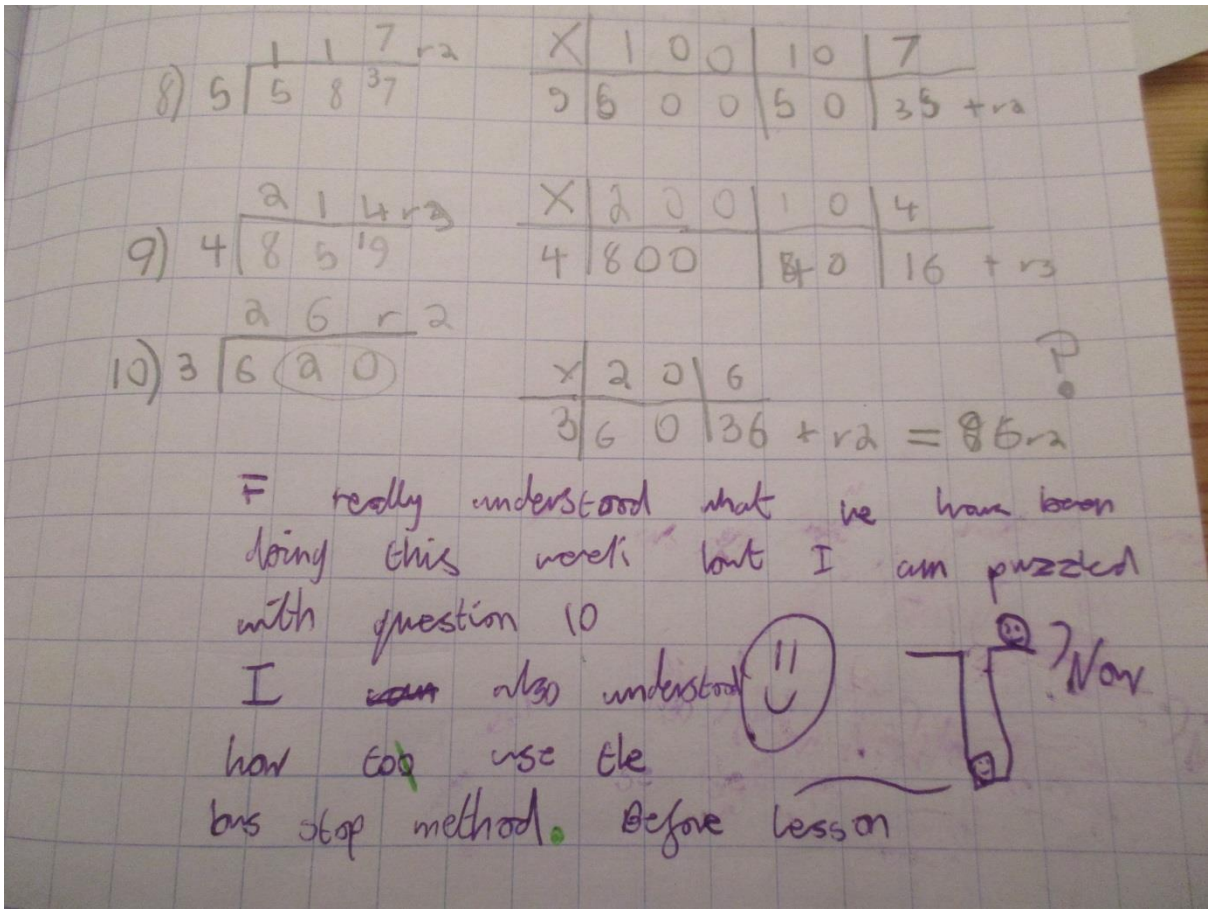
1) Bar model
2) Workings
3) Clear answer
4) Checking using the inverse





Appendix Three




8) 5 | 5 8 37 = 117 r2
X | 100 | 10 | 7
5 | 500 | 50 | 35 + r2
9) 4 | 8 5 19 = 214 r3
X | 200 | 10 | 4
4 | 800 | 80 | 16 + r3
10) 3 | 6 20 = 206 r2
X | 200 | 6
3 | 600 | 36 + r2 = 86 r2
?
I really understood what we have been doing this week but I am puzzled with question 10
I also understood how to use the bus stop method. Before lesson
?Now

January 2016

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