EEF guidance report:

‘Improving Mathematics in Key Stages 2 & 3’

How Abacus supports the eight recommendations

On 3rd November 2017, the Education Endowment Foundation (EEF) released a guidance report entitled ***Improving Mathematics in Key Stages 2 & 3***. The report sets out eight evidence-based recommendations:

1. **Use assessment to build on pupils’ existing knowledge and understanding**
2. **Use manipulatives and representations**
3. **Teach pupils strategies for solving problems**
4. **Enable pupils to develop a rich network of mathematical knowledge**
5. **Develop pupils’ independence and motivation**
6. **Use tasks and resources to challenge and support pupils’ mathematics**
7. **Use structured interventions to provide additional support**
8. **Support pupils to make a successful transition between primary and secondary school**

In response to this report, we wanted to share our thoughts about the ways in which Abacus supports schools in meeting these aims.

Pearson is currently part-way through an ongoing study into the effectiveness of Abacus, in collaboration with the Institute of Education at UCL. In August we received a report on the findings of the first year of the study. We were delighted to see some very positive feedback about Abacus, lots of which helps us to demonstrate how Abacus is helping schools to meet the eight recommendations. Quotes from the Abacus efficacy report are shown in *italics* below.

1 *Recommendation 1*

Use assessment to build on pupils' existing knowledge and understanding

- Assessment should be used not only to track pupils' learning but also to provide teachers with information about what pupils do and do not know
- This should inform the planning of future lessons and the focus of targeted support
- Effective feedback will be an important element of teachers' response to assessment
- Feedback should be specific and clear, encourage and support further effort, and be given sparingly
- Teachers not only have to address misconceptions but also understand why pupils may persist with errors
- Knowledge of common misconceptions can be invaluable in planning lessons to address errors before they arise

We know how critical it is for assessment to support teachers in adapting their plans and teaching to meet the needs of pupils. Abacus contains a range of formative and summative assessment to give you all you need to assess whether or not pupils have mastered core concepts, and to identify gaps in learning.

Assessment points are built into the **Main Teaching** for each lesson. Some key questions are suggested, to help teachers assess which pupils have grasped the concepts. These are followed up by specific misconceptions or gaps in prior learning to watch out for, that may need to be addressed in order for some pupils to progress. The key prior learning for each lesson is stated at the start of the lesson plan.

There is a **Guided Activity** for nearly every lesson. These are intended for a small group of pupils, supported by an adult. The lesson notes include an Assessment Focus section, that gives the adult 'Can children...?' statements to help them assess whether pupils have mastered the concepts taught that day.

The **Mastery Checkpoints** provide regular formative assessment for mastery. Each checkpoint focuses on one key objective or a small set of

linked objectives and is designed to be used at the point at which the majority of pupils are expected to have mastered each objective. Each Mastery Checkpoint is linked to a key National Curriculum objective and comes with supportive teacher notes, which include suggestions for likely misconceptions and an activity that will help to address them.

The weekly **Quick Maths Driving Tests** and the **Individual Practice Games** (which are great for homework) provide further opportunities to check how pupils are doing.

Our summative **half-termly tests** provide a handy way to test whether pupils have mastered and retained the work from each half term, and entering results into the Assessment section of Abacus will show you which pupils are on track for meeting Age Related Expectations by the end of the school year. The marking guidance and progression maps support you in knowing what to do when pupils have not quite mastered all objectives.

> *"Yes, I've been doing those [assessment tools] and they're very handy as well. It's very easy to correlate those back to what you've been doing that term, find out where the gaps are. So I mean as a teacher it's great to know where your students are, but then also as a trainee it's really good to know what lessons have worked and what lessons haven't as well."*
>
> Abacus efficacy study, end-of-first-year report, Aug 2017

2 *Recommendation 2*

Use manipulatives and representations

- Manipulatives (physical objects used to teach maths) and representations (such as number lines and graphs) can help pupils engage with mathematical ideas
- However, manipulatives and representations are just tools: how they are used is essential
- They need to be used purposefully and appropriately to have an impact
- There must be a clear rationale for using a particular manipulative or representation to teach a specific mathematical concept
- Manipulatives should be temporary; they should act as a 'scaffold' that can be removed once independence is achieved

Abacus is underpinned by four 'pillars' - the things that the author team feel are absolutely crucial to good maths teaching and learning. One of those pillars is **a developmental and consistent approach to models and images**. You can watch a short video ***here*** of series editor, Ruth Merttens, talking about this.

Abacus makes frequent use of **physical objects** commonly found in primary classrooms, such as counters, cubes, bead strings, coins, dice, small toys, and so on. These are used to introduce pupils to concepts, to reinforce understanding, and to support pupils who are not yet ready to move on to the pictorial or abstract stages.

Pictorial representations of mathematical objects and models are used throughout Abacus. The **Interactive Screens** and **Teaching Tools** allow teachers to share images with the class. For example, place-value grids onto which the teacher (or pupils) can place images of base-10 equipment to represent the structure of numbers. The textbooks and workbooks provide many examples of the pictorial stage, particularly in Key Stage 1.

The movement between concrete, pictorial and abstract is not always a linear progression; there is often a cyclical approach, with interplay between the three stages used to consolidate understanding. In Key Stage 2, suggestions for revisiting the concrete stage are often given in

the **Further Support** section. In the Key Stage 1 workbooks, each page has an **'Action'** section, which gives suggestions for using manipulatives to scaffold pupils' learning. In the Key Stage 2 textbooks, some pages have a **'Grab'** section, which serves the same purpose.

The Teaching Tools and some of the Interactive Screens can provide a useful **bridge between the concrete and the pictorial stages**, because of the way they allow pupils to physically manipulate them. For example, the bead string tool shows a pictorial representation of a bead string, but pupils can come to the screen and move the beads either individually or in groups. In this way, Abacus really helps pupils to transition between the stages: from the concrete stage (using a physical bead string), to a mid-way point (moving the beads on an interactive image of a bead string), and then to the pictorial stage (just looking at the image of the bead string on the Teaching Tool, or using images of bead strings on a workbook or textbook page).

> *"Yes, it is the visual, and where you can actually do things to it. You know, the octopus, you are taking his legs away. And the little monsters, we love the monsters that go into the cellar and we love those because we all sit there and wave at them. So that sort of side of it is brilliant, the visuals for that sort of thing are amazing, they love it."*
>
> Abacus efficacy study, end-of-first-year report, Aug 2017

The **'Overview of calculation methods and strategies at Key Stage 1/2'** documents might be useful in showing you the range of ways in which concrete and pictorial representations are used to help pupils understand different concepts. (Login to ActiveLearn Primary; go to Planning; then select either 'Key Stage 1 Area' or 'Key Stage 2 Area' in the left-hand menu.)

3 *Recommendation 3*

Teach pupils strategies for solving problems

- If pupils lack a well-rehearsed and readily available method to solve a problem they need to draw on problem-solving strategies to make sense of the unfamiliar situation
- Select problem-solving tasks for which pupils do not have ready-made solutions
- Teach them to use and compare different approaches
- Show them how to interrogate and use their existing knowledge to solve problems
- Use worked examples to enable them to analyse the use of different strategies
- Require pupils to monitor, reflect on, and communicate their problem solving

Abacus gives you access to a range of resources to help develop and practise problem solving and rich mathematical thinking skills.

The textbooks contain word problems, and nearly every page has a **'Think'** question that encourages pupils to apply their knowledge and understanding to different situations.

Roughly every fortnight you'll find a lesson focused around a **Problem Solving Activity** for the whole class. The lesson plans include notes for the teacher to guide them in supporting pupils' problem solving strategies. These notes are tailored for each group of pupils, so that teachers and other adults in the classroom can give appropriate input for each group.

Roughly one lesson a week has a link to an appropriate **NRICH activity**. These rich mathematical tasks are a great "next step" for developing a deep understanding of mathematical concepts before moving pupils on. They can be found in the 'Depth and Extension' section of the daily plan.

There are also weekly **Problem Solving Investigations** for Years 1–6. Each printable pupil sheet comes with an accompanying Teacher Guidance sheet, and they are all provided as Word documents, giving you the flexibility to tailor them for your pupils.

You also have access to additional unplanned resources, like the **Problem Solving Games** and **Speaking and Listening Games** which are great for challenging pupils to make sense of mathematics. These games are interactive and can be used by pupils individually, in pairs, in small groups or even with the whole class, to stimulate and challenge pupils to apply their knowledge to solve contextual problems. Each game has accompanying teacher notes, that suggest prompts to get pupils started, useful strategies, and questions you could ask to help pupils dig deeper.

> *"[...] also understanding that showing your working is fantastic and I don't care if your book looks messy as a result, because I can see that there's maths going on. I don't just want a perfect number sentence at the start. So they're kind of getting that idea which is helping with the problem-solving and looking at more of the possibilities."*
>
> Abacus efficacy study, end-of-first-year report, Aug 2017

4 *Recommendation 4*

Enable pupils to develop a rich network of mathematical knowledge

- Emphasise the many connections between mathematical facts, procedures, and concepts
- Ensure that pupils develop fluent recall of facts
- Teach pupils to understand procedures
- Teach pupils to consciously choose between mathematical strategies
- Build on pupils' informal understanding of sharing and proportionality to introduce procedures
- Teach pupils that fractions and decimals extend the number system beyond whole numbers
- Teach pupils to recognise and use mathematical structure

One of the four 'pillars' upon which Abacus is founded is **fluent recall of number facts**. You can see Ruth Merttens talking about Abacus's approach to this ***here***.

Procedural fluency is supported by the spiral structure of the lesson plans, with concepts being revisited and consolidated regularly to ensure skills, knowledge and understanding are retained after initial teaching and built upon each time. This approach is supposed by resources such as **Five-Minute Fillers** at Key Stage 1, and **Quick Maths** and **Fluency Fitness** at Key Stage 2, which were designed specifically to keep those key ideas fresh in pupils' minds.

> *"I think the 'quick maths' helps with that because it targets things that we're not necessarily learning in the unit at the moment. But it keeps it fresh in their mind so that they're still looking at it, especially fractions... it kept on coming up in the quick maths and the driving test and things, so I think that was helpful. And obviously some of the units are repeated and taken on the next steps and things, and I like how they're spread out over the year rather than just doing it all in one go."*
>
> Abacus efficacy study, end-of-first-year report, Aug 2017

But one of the key aims of Abacus is that pupils should achieve not just procedural fluency but also deep **conceptual understanding**. We can see this in the **consistent use of models and images** to ensure pupils can see and understand the mathematical structures behind what they are doing.

> *"It revisits everything... They're using the same resources all the time with regards to number squares and number lines, the beaded lines, the money lines. So whether they're on the whiteboard or they're the printed-off copies, they're familiar with them, and the repetitiveness of the different concepts definitely helped with fluency."*
>
> Abacus efficacy study, end-of-first-year report, Aug 2017

Once pupils have a secure foundation in a concept, Abacus gives opportunities for pupils to demonstrate their ability to choose between mathematical strategies. For example, the **Problem Solving Games** and **Speaking and Listening Games** stimulate pupils' imaginations and challenge them to apply their knowledge to solve contextual problems.

5 *Recommendation 5*

Develop pupils' independence and motivation

- Encourage pupils to take responsibility for, and play an active role in, their own learning
- This requires pupils to develop metacognition – the ability to independently plan, monitor and evaluate their thinking and learning
- Initially, teachers may have to model metacognition by describing their own thinking
- Provide regular opportunities for pupils to develop metacognition by encouraging them to explain their thinking to themselves and others
- Avoid doing too much too early
- Positive attitudes are important, but there is scant evidence on the most effective ways to foster them
- School leaders should ensure that all staff, including non-teaching staff, encourage enjoyment in maths

The Abacus efficacy study report found that the majority of class teachers gave a positive response regarding how much the confidence in maths had grown among the pupils. Teachers spoke about how much the variety of approach and the interactive, colourful and lively presentation, **enhance children's confidence, motivation and enjoyment of maths**.

> *"They tended to be a bit disengaged, I mean, less interested as a group of children, particularly this class, but it's really kind of pumped them up and made them want to engage with maths and they kind of almost, like, eager to get off of the carpet and go to the activity, so that's how excited they are to go and have a go."*
>
> Abacus efficacy study, end-of-first-year report, Aug 2017

There are opportunities for **self-assessment** on the workbook and textbook pages, and on the homework sheets. The interactive games **(Individual Practice Games, Problem Solving Games, Speaking and Listening Games)** can be useful tools in helping to develop pupils'

confidence in working independently or in pairs; their structure gives support, and the interactive nature of the games allows pupils to try again as many times as they like, testing out different approaches without feeling 'put on the spot'.

Teachers can allocate **Pupil Videos** and accompanying worksheets, for pupils to work on at home. The videos give a walkthrough of the concept, helping pupils to then feel confident in completing the worksheet independently.

> *"Thinking of some of the number work, how it progresses each time and they see their own progress and they can see how they're starting things a little bit more simply and we'll say to them, right this is kind of the next step and when they're able to achieve it they do, they really love it and it does make them feel good about themselves, it does make them feel confident about their abilities."*
>
> Abacus efficacy study, end-of-first-year report, Aug 2017

6 *Recommendation 6*

Use tasks and resources to challenge and support pupils' mathematics

- Tasks and resources are just tools – they will not be effective if they are used inappropriately by the teacher
- Use assessment of pupils' strengths and weaknesses to inform your choice of task
- Use tasks to address pupil misconceptions
- Provide examples and non-examples of concepts
- Use stories and problems to help pupils understand mathematics
- Use tasks to build conceptual knowledge in tandem with procedural knowledge
- Technology is not a silver bullet – it has to be used judiciously and less costly resources may be just as effective for all children

As the guidance report says, 'tasks and resources are tools which need to be deployed effectively to have a positive impact on learning'. I.e. the teacher is key here, and a maths programme can only do so much. But Abacus provides a wide range of activity and resource types, with plenty of options for each lesson / week.

> *"I like it because there are loads of resources available on Abacus and it gives you lots of different ways of being able to teach maths."*
>
> Abacus efficacy study, end-of-first-year report, Aug 2017

As noted under Recommendation 1 above, Abacus provides lots of opportunities for teachers to assess prior learning and identify misconceptions, allowing them to make informed decisions about which of the available activities or resources will have the most impact on their pupils at that time.

> *A strong message that came across from the interviews was the flexibility and adaptability of the planning materials: every single teacher mentioned this in their interviews. [one] teacher commented, "I like that it is broken down to 'core', 'support'*

and 'extend' but sometimes I change that up because you have to go on where the children are." The teachers commented that they could easily adapt and shape the plans to meet their requirements.

Abacus efficacy study, end-of-first-year report, Aug 2017

The Abacus **Professional Development course** will help teachers get to grips with the full range of activities and resources on offer, and understand when each type might be most effectively brought into play.

7 *Recommendation 7*

Use structured interventions to provide additional support

- Selection should be guided by pupil assessment
- Interventions should start early, be evidence-based and be carefully planned
- Interventions should include explicit and systematic instruction
- Even the best-designed intervention will not work if implementation is poor
- Support pupils to understand how interventions are connected to whole-class instruction
- Interventions should motivate pupils – not bore them or cause them to be anxious
- If interventions cause pupils to miss activities they enjoy, or content they need to learn, teachers should ask if the interventions are really necessary
- Avoid 'intervention fatigue'
- Interventions do not always need to be time-consuming or intensive to be effective

Abacus is not an intervention programme; it is a core mathematics service that is aimed at pupils who are broadly able to access the curriculum content for their age group. However, it does provide support for lower attainers, to try to help them **keep up with the rest of the class**.

> *Importantly, teachers of particularly weak children or classes, while often deviating from existing Abacus plans, were all confident that over the year, use of Abacus had supported them in closing the gap somewhat.*
>
> Abacus efficacy study, end-of-first-year report, Aug 2017

Every lesson is **differentiated** at three levels: **Core**, **Support** and **Extend**. Often, the differentiation focuses more on the level of support / scaffolding given, rather than the tasks being completely different. Abacus provides one **Guided Activity** each day which allows

the teacher to sit with one of these three groups and give targeted teaching appropriate to the level of that group. The Guided Activity gives assessment prompts/key questions that the teacher can use to support the assessment of that group and with moving them on in their learning. This gives the teacher a couple of opportunities each week to do some focused work with the Support group.

Each lesson plan includes a **Further Support** section, which suggests ways to scaffold learning for lower attainers, usually involving the use of manipulatives or pictorial representations to try to increase conceptual understanding and build confidence. The **'Action'** sections on the workbook pages, and the **'Grab'** sections on the textbook pages, also suggest additional resources to help make the work more tangible.

Children in the Support group aren't excluded from the engaging interactive games that many children find very motivating. The **Individual Practice Games** and **Speaking and Listening Games** are both differentiated for different attainment levels, meaning there is a version of each game that should be accessible for lower attainers. The lower levels of the games are often based on prerequisite skills, so that pupils can gain confidence and become ready to access the core lesson objective.

> *"I have a dedicated Maths ICT lesson and I always go in [to Active Learn], and I love the fact that the games are differentiated. Because the children think they're all playing the same but they don't realise that actually it's not quite, it looks like the same game, but it's very subtly different."*
>
> Abacus efficacy study, end-of-first-year report, Aug 2017

The frequent assessment opportunities in Abacus should give teachers support in identifying pupils who are in need of a structured intervention programme.

8 *Recommendation 8*

Support pupils to make a successful transition between primary and secondary school

- There is a large dip in mathematical attainment and attitudes towards maths as children move from primary to secondary school
- Primary and secondary schools should develop shared understandings of curriculum, teaching and learning
- When pupils arrive in Year 7, quickly attain a good understanding of their strengths and weaknesses
- Structured intervention support may be required for Year 7 pupils who are struggling to make progress
- Carefully consider how pupils are allocated to maths classes
- Setting is likely to lead to a widening of the attainment gap between disadvantaged pupils and their peers, because the former are more likely to be assigned to lower groups

There is nothing specific within Abacus that is designed to help with this transition. As the guidance report says, 'Unfortunately, there is very little evidence concerning the effectiveness of particular interventions that specifically address this dip.'

However, the ways in which Abacus might be seen to help are: by helping children to **develop and sustain a secure understanding of mathematical concepts** (see the notes about Recommendation 4 above); and by helping to **identify areas for improvement** (see the notes about Recommendation 1 above), so that this information could be passed to secondary schools where appropriate.

The spiral structure of Abacus supports children in developing a secure understanding of mathematical concepts taught at primary school, which will stand them in good stead as they embark on their secondary education.

> *[Key Stage 2] teachers especially seem confident that Abacus supports key aspects of number to appropriate levels for transfer to secondary school.*
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> Abacus efficacy study, end-of-first-year report, Aug 2017