
IMPROVING MATHEMATICS IN KEY STAGES TWO AND THREE

A self-assessment guide

This Red Amber Green (RAG) self-assessment guide accompanies the Education Endowment Foundation's report, *Improving Mathematics In Key Stages Two and Three*, which sets out eight evidence-based recommendations on the effective teaching of mathematics.

This guide describes what 'ineffective', 'improving' and 'exemplary' practice can look like in relation to each of the recommendations.

This guide can be used as part of an initial audit process to establish current practice (i.e. point of departure), as well as to monitor progress towards the development of more effective practice (i.e. direction of travel).

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The table 'Improving Mathematics in Key Stages Two and Three – Recommendations Summary' contains eight numbered recommendations. Recommendation 1, 'Use assessment to build on pupils' existing knowledge and understanding', is highlighted in red and is the focus of this document. Recommendations 2 through 8 are in various other colors (yellow, green, blue, purple, pink) and cover topics like 'Use assessment to monitor progress', 'Use assessment to identify misconceptions', 'Use assessment to plan future lessons', 'Use assessment to provide feedback', 'Use assessment to evaluate learning', 'Use assessment to support learning', and 'Use assessment to support learning'.

RECOMMENDATION 1

Use assessment to build on pupils' existing knowledge and understanding

INEFFECTIVE

Assessments are often set without careful consideration of their intended purpose.

Teachers collect summative data but rarely use assessment to collect information about pupils' mathematical strengths and weaknesses. Teaching does not respond to pupils' developing understanding.

Many teachers are not knowledgeable of the common misconceptions in mathematics. This has not been a focus of CPD.

When planning future lessons, teachers do not consider the misconceptions that are likely to arise.

Teachers' feedback is not specific, accurate or clear. It is often limited to empty praise.

Feedback is inefficient and creates a large workload for teachers. Teachers spend a large amount of time marking work. This is potentially distracting teachers from more beneficial activities.

IMPROVING

Assessments are sometimes set with consideration of their purpose, but this is inconsistent. Not all teachers are confident users of assessment for different purposes.

Teachers are able to achieve a good understanding of pupils' strengths and weaknesses, using a variety of data sources, but they do not adapt their teaching in response.

Teachers' knowledge of common misconceptions is patchy. Some teachers need support to improve their knowledge.

Some teachers plan to address likely misconceptions but this practice is not consistent throughout the school.

Some teachers can confidently and consistently provide effective feedback, but others do not.

There is a recognition that marking workload is a problem, but there is still work to be done to minimise the burden of marking.

EXEMPLARY

Careful consideration is given to how the results of an assessment will be used before an appropriate assessment is selected.

Teachers use a variety of types of assessment, as appropriate, to collect information about strengths and weaknesses. They adapt their teaching in response and use assessment information to inform planning.

Teachers have a good knowledge of the common misconceptions in maths and why they arise. They use this knowledge to inform their assessment.

Teachers use their knowledge of common misconceptions to plan future lessons.

Feedback is effective and generally resembles the principles outlined in the guidance.

Feedback is efficient and does not create a large workload for teachers. There is a healthy balance between oral and written feedback.

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Improving Mathematics in Key Stages Two and Three – Recommendations Summary

1	2	4	5	6	7	8
1	2 Use manipulatives and representations	4	5	6	7	8

RECOMMENDATION 2 Use manipulatives and representations

! INEFFECTIVE

Manipulatives are rarely or never used to teach maths.

Manipulatives are only used with younger children and when teaching simpler mathematics.

Pupils often become reliant on manipulatives to do a type of task or question. Teaching can tend to focus on 'getting them to the right answer' to a specific problem instead of developing understanding.

Number lines do not feature in teaching.

Teachers rarely introduce pupils to multiple representations.

IMPROVING

Manipulatives are often used, but without a clear rationale for how they will develop more sophisticated mathematics.

Manipulatives are used across the school. However, with older children they are only used as a tool in catch up interventions or to teach simpler mathematics.

Teachers' use of manipulatives to develop independent understanding is patchy. Some teachers do this consistently, but others do not.

Number lines are used, but teachers need more CPD to use them confidently and competently.

Teachers and pupils compare and discuss different representations. However, this discussion is not carefully orchestrated to introduce more abstract, diagrammatic representations. Teachers might introduce too many representations at once, causing confusion.

✓ EXEMPLARY

Teachers use manipulatives appropriately, and with a clear rationale for why the manipulative will support pupils to understand mathematics.

Manipulatives are used across the different year groups in the school. The decision to remove a manipulative is made in response to the pupils' improved knowledge and understanding, not their age.

Teachers enable pupils to understand the links between the manipulatives and the mathematical ideas they represent. Teachers use manipulatives to develop pupils' independent understanding of the mathematics.

Teachers are confident and competent in their use of number lines.

Teachers and pupils compare and discuss different representations. Teachers aim to support pupils to develop more abstract, diagrammatic representations. Teachers are careful to not overload pupils with too many representations at once.

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Improving Mathematics in Key Stages Two and Three – Recommendations Summary

1	2	3	4	5	6	7	8
Establish a school-wide approach to mathematics	Develop a school-wide approach to mathematics	Teach pupils strategies for solving problems	Engage pupils in problem solving	Develop pupils' problem-solving skills	Use problem-solving to develop mathematical understanding	Use problem-solving to develop mathematical understanding	Use problem-solving to develop mathematical understanding

RECOMMENDATION 3 Teach strategies for solving problems

! INEFFECTIVE

There is a lack of genuine problem solving tasks in teaching. Tasks tend to be routine and can be completed using a procedure that pupils know well.

Teachers lack knowledge and understanding of problem solving strategies. They do not feature in their teaching.

Teachers do not consciously vary the structure and context to problems.

Teachers rarely encourage pupils to use representations and manipulatives to represent problems mathematically.

continued...

📈 IMPROVING

Some teachers select non-routine problems, but other teachers do not. Teachers sometimes do not feel confident enough to work on genuine, non-routine problem solving.

Teachers effectively model a range of problem-solving strategies. However, they do not effectively support pupils to self-regulate their use of strategies.

Teachers do pay attention to context and structure when setting problems, but this is not systematic and does not support improved understanding.

Some teachers encourage pupils to use representations and manipulatives to represent problems mathematically. However, this practice is not consistently adopted by teachers throughout the school.

continued...

✅ EXEMPLARY

Most teachers confidently select genuine, non-routine problem-solving tasks.

Teachers know a range of strategies, which they can model effectively for pupils. They teach pupils to carefully and consciously choose the most appropriate strategy for the problem at hand.

Teaching is organised so that problems with similar structures and different contexts are presented together, and, likewise, that problems with the same context but different structures are presented together. Pupils are taught to identify similar mathematics that underlies different situations, and identify and interrogate multiple relationships between variables in one situation.

Teachers encourage pupils to use representations and manipulatives to represent problems mathematically.

continued...

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RECOMMENDATION 3 CONTINUED

Teach strategies for solving problems

! INEFFECTIVE

...continued

Worked examples rarely feature in teaching.

Teachers rarely use the following approaches to improve pupils' use of strategies:

- Encouraging pupils to share and discuss strategies
- Encouraging pupils to interrogate and use their mathematical knowledge to solve problems
- Encouraging pupils to communicate their reasoning about their choice of strategies
- Requiring pupils to compare and evaluate multiple strategies

📈 IMPROVING

...continued

Teachers deploy worked examples, but they are mainly used to consider steps in a procedure and are rarely used to examine problem-solving strategies.

Teachers are confident using only some of these approaches, or they could improve in some areas.

✅ EXEMPLARY

...continued

Teachers use worked examples to enable pupils to examine the use of different problem solving strategies.

Teachers are confident and capable when using all of these approaches to improving pupils' use of strategies.

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Improving Mathematics in Key Stages Two and Three – Recommendations Summary

1	2	3	4	5	6	7	8
1. Ensure that all pupils have sufficient content knowledge to understand the links between aspects of mathematics. However, they do not consistently make these links explicit when teaching pupils.	2. Teachers plan lessons that utilise pupils retrieving and using their previous learning of arithmetic facts.	3. Teachers' own understanding of procedures is sound. However, the teaching of this understanding is inconsistent. Sometimes teachers ensure that pupils develop understanding of procedures, but sometimes they do not.	4. Enable pupils to develop a rich network of mathematical knowledge.	5. Teachers teach a range of computational methods and approaches, including the use of a calculator. However, they do not teach pupils to reflect on when different methods are appropriate and efficient.	6. Teachers are able to emphasise the connections between different aspects of mathematics, and do this consistently.	7. Teachers ensure that pupils develop their understanding of how and why procedures work.	8. Teachers teach a range of mental, calculator, and pencil-and-paper methods, and encourage pupils to consider when different methods are appropriate and efficient.

RECOMMENDATION 4

Enable pupils to develop a rich network of mathematical knowledge

! INEFFECTIVE

Teachers do not make connections between different aspects of mathematics. They might themselves lack the content knowledge to do this confidently.

Pupils struggle to recall basic number facts. This is affecting their progress elsewhere in mathematics.

Pupils are taught the steps behind a procedure, but teachers do not support pupils to develop their understanding of why a procedure works. The focus is on “getting the pupils to the right answer”. Teachers might themselves lack confidence when explaining how and why procedures work.

Teaching does not provide a range of different methods and strategies. Pupils are generally taught one procedure, and are not taught to reflect on when different methods might be appropriate. Pupils are not taught to use calculators.

continued...

📈 IMPROVING

Teachers do have sufficient content knowledge to understand the links between aspects of mathematics. However, they do not consistently make these links explicit when teaching pupils.

Teachers plan lessons that utilise pupils retrieving and using their previous learning of arithmetic facts.

Teachers' own understanding of procedures is sound. However, the teaching of this understanding is inconsistent. Sometimes teachers ensure that pupils develop understanding of procedures, but sometimes they do not.

Teachers teach a range of computational methods and approaches, including the use of a calculator. However, they do not teach pupils to reflect on when different methods are appropriate and efficient.

continued...

✅ EXEMPLARY

Teachers are able to emphasise the connections between different aspects of mathematics, and do this consistently.

Teachers plan lessons that utilise pupils quickly and consistently retrieving and using their previous learning of arithmetic facts. Pupils are confident in their quick retrieval of addition, subtraction, multiplication and division facts.

Teachers ensure that pupils develop their understanding of how and why procedures work.

Teachers teach a range of mental, calculator, and pencil-and-paper methods, and encourage pupils to consider when different methods are appropriate and efficient.

continued...

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RECOMMENDATION 4 CONTINUED

Enable pupils to develop a rich network of mathematical knowledge

1	2	3	4	5	6	7	8
			Enable pupils to develop a rich network of mathematical knowledge				

! INEFFECTIVE

...continued

Pupils do not understand that fractions are numbers that can be put on a number line. Teaching does not seek to address this misconception.

Teachers and pupils often fail to recognise mathematical structure. Teachers might themselves struggle to identify the mathematical structure in a particular context, and might often use vague non-mathematical language themselves.

IMPROVING

...continued

Teachers are aware of this common misconception, but do not respond effectively.

Teachers are able to recognise mathematical structure, but do not always successfully communicate this to pupils.

✓ EXEMPLARY

...continued

Teachers understand this key misconception and seek to address it. They consider using the number line to represent fractions.

Teachers use precise mathematical language themselves. Teachers support pupils to recognise mathematical structure, for example by rephrasing pupils' responses that use vague, non-mathematical language with appropriate mathematical language.

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Improving Mathematics in Key Stages Two and Three – Recommendations Summary

1	2	3	4	5	6	7	8
Develop pupils' independence and motivation	Develop pupils' independence and motivation	Develop pupils' independence and motivation	Develop pupils' independence and motivation	Develop pupils' independence and motivation			

RECOMMENDATION 5 Develop pupils' independence and motivation

! INEFFECTIVE

Pupils have limited opportunities to practise and develop metacognition.

Teachers struggle to orchestrate productive classroom discussions.

Pupils are often unmotivated and disengaged when learning mathematics. Pupils demonstrate limited persistence and resilience in their learning.

There is a general perception among staff and pupils that some people are naturally 'good' at maths, whilst others are not. Staff often complain about their own difficulties with maths.

📈 IMPROVING

Teachers provide frequent opportunities to practise and develop metacognition. Pupils are taught to plan, monitor and evaluate the approaches they take to mathematics.

Teachers can sometimes struggle to orchestrate productive classroom discussions. Some pupils refrain from participating in discussion or actively listening to other pupils' ideas.

Pupils demonstrate increasing persistence and resilience. A minority of pupils struggle with motivation.

Maths teachers model confidence and interest in maths, but many other staff do not. Some staff and pupils believe that some people are naturally 'good' at maths, whilst others are not.

✅ EXEMPLARY

Teachers provide extensive opportunities to practise and develop metacognition. This includes regular opportunities for pupils to explain their approaches to mathematical tasks to themselves, the teacher and other pupils. Teachers carefully increase their expectations regarding pupils' independence as the pupils gain competence and fluency.

Teachers are able to orchestrate productive classroom discussions. Pupils actively take part in discussions.

Nearly all pupils are motivated and engaged during lessons. Pupils get enjoyment and satisfaction from learning mathematics.

All staff, regardless of their subject area specialism or level of responsibility, model confidence and interest in maths. Staff and pupils believe that everyone can succeed in maths if they work hard.

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RECOMMENDATION 6

Use tasks and resources to challenge and support pupils' mathematics

Improving Mathematics in Key Stages Two and Three – Recommendations Summary

1	2	3	4	5	6	7	8
1. Use tasks and resources to challenge and support pupils' mathematics	2. Use tasks and resources to challenge and support pupils' mathematics	3. Use tasks and resources to challenge and support pupils' mathematics	4. Use tasks and resources to challenge and support pupils' mathematics	5. Use tasks and resources to challenge and support pupils' mathematics	6. Use tasks and resources to challenge and support pupils' mathematics	7. Use tasks and resources to challenge and support pupils' mathematics	8. Use tasks and resources to challenge and support pupils' mathematics

! INEFFECTIVE

Tasks are selected without proper consideration of pupils' strengths and weaknesses. Tasks fail to provide sufficient challenge.

Teachers do not give careful consideration to how they use tasks to develop pupils' understanding. Tasks are often used without careful consideration of how they can:

- provide examples and non-examples of concepts;
- provide opportunities to discuss and compare different solution approaches;
- provide opportunities to investigate mathematical structure;
- build conceptual knowledge in tandem with procedural knowledge.

Technology and other resources, including textbooks, are frequently adopted without careful consideration of how they will be used to improve teaching and learning. The school has purchased many technological devices and resources which are no longer used.

📈 IMPROVING

Teachers use appropriately challenging tasks, which address weaknesses in pupils' understanding.

Some teachers give careful consideration to how they use tasks, but this practice is inconsistent across the school.

Staff provide a clear rationale for how new resources will support improved teaching and learning. However this is not followed by careful implementation. Resources are regularly introduced without concurrent CPD to support teachers to use them effectively.

✅ EXEMPLARY

Assessment of pupils' strengths and weaknesses is used to inform the selection of tasks. The selection of tasks is also designed to address common misconceptions.

Teachers consistently use tasks to support pupils' developing understanding. Careful consideration is given to how tasks:

- provide examples and non-examples of concepts;
- provide opportunities to discuss and compare different solution approaches;
- provide opportunities to investigate mathematical structure;
- build conceptual knowledge in tandem with procedural knowledge.

Before purchasing new resources, staff have a clear rationale for why they will support improved teaching and learning. There is also a clear plan for implementation. Teachers receive training on how the resources can support improved teaching and learning.

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Improving Mathematics in Key Stages Two and Three – Recommendations Summary

1	2	3	4	5	6	7
Use structured interventions to provide additional support						

RECOMMENDATION 7

Use structured interventions to provide additional support

INEFFECTIVE

Identification of struggling pupils is often slow and action taken to support them is limited.

Interventions are restricted to extra classes with an exam focus towards the end of Year 6 (Primary) or Year 11 (Secondary).

Teaching is not systematic and lacks the key features which evidence suggests are common to effective interventions.

Staff are over-burdened and do not have sufficient time to effectively plan interventions. Interventions are not prioritised, meaning staff are often unavailable to deliver the sessions.

Teachers and teaching assistants have received inconsistent training in the delivery of interventions. Many staff involved in delivering interventions do not have strong pedagogical skills or knowledge of mathematics.

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IMPROVING

When a pupil is identified as struggling with their mathematics they are given extra support, but this may not be effectively matched to their specific needs.

Gaps in pupils' knowledge and understanding may be identified early, but interventions may not happen quickly and effectively.

Some of the strategies suggested in the guidance report (explicit teaching, models of proficient problem-solving, verbalisation of thought processes, guided practice, corrective feedback, and frequent cumulative review) are beginning to be included in intervention teaching.

Staff are usually available for interventions, but are not given specific or sufficient time for the planning of sessions and review of pupils' work.

Staff's preparedness for interventions is mixed. Some teaching staff may need updated training on the programme or may need to develop their pedagogical skills or content knowledge.

continued...

EXEMPLARY

When a pupil is identified as struggling teachers quickly identify the specific reason(s) why. Teachers use this information to intervene and address the aspect of maths that the pupils is struggling with.

Interventions happen as soon as weaknesses are identified, and are classroom based where possible. This reduces the risk of children developing negative attitudes and anxiety about mathematics.

Interventions include explicit teaching, models of proficient problem-solving, verbalisation of thought processes, guided practice, corrective feedback, and frequent cumulative review.

Teaching staff are always available for the intervention sessions and the sessions are well planned with time set aside for this purpose.

Teachers and teaching assistants are appropriately trained for interventions that they deliver. This training is kept up-to-date and new staff are always appropriately trained.

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Improving Mathematics in Key Stages Two and Three – Recommendations Summary

1	2	3	4	5	6	7
1	2	3	4	5	6	7

RECOMMENDATION 7 CONTINUED

Use structured interventions to provide additional support

INEFFECTIVE

...continued

Interventions take place with little or no link to the teaching in the classroom. Intervention deliverers and class teachers do not work together to ensure consistency. It is left largely to pupils to make the links between what is covered in interventions and their learning in general classroom teaching.

Interventions do not motivate pupils, leading to boredom or maths anxiety.

Pupils are removed from lessons for intervention without any consideration as to what they might be missing in the classroom. This means they can often miss lessons in which they might subsequently fall behind, or may come to resent intervention sessions due to missing lessons they enjoy or excel in.

Interventions lack focus and an end point. This leads to pupils staying in intervention classes longer than is necessary and developing 'intervention fatigue' as a consequence. This can increase a pupil's dislike of, and feelings of resentment towards, mathematics.

IMPROVING

...continued

Intervention teachers have begun to plan their work around what is happening in the classroom (e.g. by reference to the scheme of learning or brief conversations with classroom teachers) but this is not yet common practice.

Some work is done to improve motivation of pupils, but this is not seen as a priority.

Some consideration is given to what a pupil misses whilst in intervention sessions, but this is limited.

Interventions are targeted and have a defined time scale but can be inflexible in their planning. The ongoing and inevitable nature of these interventions can have a fatiguing effect on staff, if not necessarily on pupils.

EXEMPLARY

...continued

Intervention lessons are consistent with, and an extension of, work done in the classroom, and pupils understand (with support from their teachers) the links between them. Intervention and classroom teachers ensure that there is a mutual understanding of each others' work.

Interventions motivate pupils, potentially using games where appropriate to counteract the association of mathematics with boredom or anxiety.

The school ensures that interventions taking place outside of the classroom are more effective than the instruction pupils would otherwise receive. Intervention timetabling is done carefully so intervention sessions avoid removing pupils from lessons they enjoy or lessons where they will miss significant amounts of curriculum content.

Interventions are planned to take the shortest amount of time needed to get the pupil back on track. They are well targeted.

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RECOMMENDATION 8

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

Improving Mathematics in Key Stages Two and Three – Recommendations Summary

1	2	3	4	5	6	7	8
Support pupils to make a successful transition between primary and secondary school	Support pupils to make a successful transition between primary and secondary school	Support pupils to make a successful transition between primary and secondary school	Support pupils to make a successful transition between primary and secondary school	Support pupils to make a successful transition between primary and secondary school	Support pupils to make a successful transition between primary and secondary school	Support pupils to make a successful transition between primary and secondary school	Support pupils to make a successful transition between primary and secondary school

! INEFFECTIVE

Teachers are unaware of both the curriculum and teaching approaches used in other key stages.

Year 7 teachers have no knowledge of pupils' strengths and weaknesses beyond the scaled score from the key stage 2 SATs.

Pupils are placed in maths classes according to their prior attainment, and teachers often have different expectations of children according to their assigned set. Disadvantaged pupils are more likely to be assigned to lower sets, which can lead to a widening of the attainment gap between disadvantaged pupils and their peers.

📈 IMPROVING

Whilst there is some awareness of subject content across the different key stages, little is done to develop a shared pedagogy or to develop a cross-phase curriculum.

Year 7 teachers have limited knowledge of pupils' strengths and weaknesses, either through baseline assessment or a thorough analysis of information from key stage 2. However, this is not used to build on pupils' prior understanding, resulting in too much repetition or in work which is not pitched at the appropriate level.

Pupils are set by prior attainment, and the curriculum is designed in such a way as to meet their individual needs. There is still some evidence of teachers having different expectations of children according to their assigned set.

✅ EXEMPLARY

Teachers across both key stages are familiar with and have an understanding of the mathematics curriculum and teaching methods outside of their key stage. Mathematics teaching and learning is seen as a continuous journey, rather than fitting into discrete key stages, and this is planned for.

Prior attainment data is used to build on key aspects of the primary mathematics curriculum in ways that are engaging, relevant, and not simply repetitive.

The school is moving away from rigid setting by prior attainment, perhaps adopting mixed attainment or more flexible grouping.