Summary of recommendations

Improving mathematics in upper primary and lower secondary

1 Use assessment to build on students' existing knowledge and understanding

- Assessment should be used not only to track students' learning but also to provide teachers with information about what students 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 students may persist with errors
- Knowledge of common misconceptions can be invaluable in planning lessons to address errors before they arise

2 Use manipulatives and representations

- Manipulatives (physical objects used to teach maths) and representations (such as number lines and graphs) can help students 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

3 Teach strategies for solving problems

- If students 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 students do not have ready-made solutions
- Teach students to use and compare different approaches
- Show students how to interrogate and use their existing knowledge to solve problems
- Use worked examples to enable students to analyse the use of different strategies
- Require students to monitor, reflect on, and communicate their problem solving

4 Enable students to develop a rich network of mathematical knowledge

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

5 Develop students' independence and motivation

- Encourage students to take responsibility for, and play an active role in, their own learning
- This requires students 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 students 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 for all children

6 Use tasks and resources to challenge and support students' mathematics

- Tasks and resources are just tools –they will not be effective if they are used inappropriately by the teacher
- Use assessment of students' strengths and weaknesses to inform your choice of task
- Use tasks to address student misconceptions
- Provide examples and non-examples of concepts
- Use stories and problems to help students 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

7 Use structured interventions to provide additional support

- Selection should be guided by student 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 students to understand how interventions are connected to whole-class instruction
- Interventions should motivate students – not bore them or cause them to be anxious
- If interventions cause students 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

8 Support students 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 students arrive in Year 7, quickly attain a good understanding of their strengths and weaknesses
- Structured intervention support may be required for Year 7 students who are struggling to make progress
- Carefully consider how students are allocated to maths classes
- Setting is likely to lead to a widening of the attainment gap between disadvantaged students and their peers, because the former are more likely to be assigned to lower groups