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Effective approaches to teaching mathematics in Key Stages 3 and 4: Protocol for a systematic review and meta-analysis

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ADMINISTRATIVE INFORMATION

Support - Education Endowment Foundation.

Review Stage at time of this submission - Formal screening of search results against eligibility criteria.

Conflicts of interest - The work described in this protocol is being undertaken by researchers at the IOE, UCL's Faculty of Education and Society and funded by the EEF. The views expressed are those of the authors and not necessarily those of the EEF. Laurie Jacques is also working as part of the Sheffield Hallam University team leading the EEF Practice Review for KS3 and KS4 Mathematics. She also works as an independent mathematics education consultant for her own business SmartPD Limited. UCL provides education and other services relating to mathematics education in return for fees or grant income. None of the authors are shareholders or otherwise directly financially benefit (beyond their ongoing employment) from their employers' activity. All authors declare no other conflicts of interest.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 07 May 2024 and was last updated on 24 April 2025.

INTRODUCTION

Review question / Objective The objective of this review is to synthesise the existing literature to identify effective interventions, approaches and strategies to teaching mathematics in Key Stages 3 and 4 in England, including the transitions KS2àKS3 and KS4àKS5 and within this to identify key research gaps that could influence EEF funding rounds in 2024 and beyond.

[RQ1]. What is the evidence on the effectiveness of different approaches for teaching mathematics in Key Stages 3 and 4?
[RQ2]. What are the key features of successful approaches for teaching mathematics in Key Stages 3 and 4?
[RQ3]. Do mathematics approaches have differential effects on outcomes for socioeconomically disadvantaged pupils (for example, those eligible for free school meals)? If

so, what are the key features of successful approaches?
[RQ4]. What is the evidence on the effectiveness of approaches that support the transition between Year 6 and Year 7 and between Year 11 and Year 12?
[RQ5]. What is the evidence on the effectiveness of non-specialist teachers teaching mathematics, and on support for non-specialist teachers?
For futher information, see full protocol in Supplementary Materials.

Rationale See full protocol in Supplementary Materials.

Condition being studied Attainment in secondary school mathematics.

METHODS

Search strategy See full protocol in Supplementary Materials. Amendment 6: Addition to "Forward citation searches of full-text includes" to include process developed to identify the highest quality and important studies which may have been missed in previous searches.

Participant or population Secondary school pupils aged 11-16. See full protocol in Supplementary Materials for further information.

Intervention Interventions for teaching mathematics in secondary schools (Key Stages 3 and 4 in England, ages 11-16). For the purposes of this review, we follow Simms et al. (2019) in defining approaches, or interventions, as a clearly described change from, or difference to, existing, or usual, teaching practice. This covers a broad range of interventions that are mathematical in focus, from relatively 'small-scale' strategies, such as the use of representations, to 'large-scale' programmes that are intended to cover a large part of the curriculum offer in mathematics for a term or more. The critical characteristic is that the intervention is sufficiently well-described and could be implemented in KS3 and/or KS4 mathematics classrooms by schools and/or teachers in England (perhaps with some modification and in some cases with substantial costs).Thus, we exclude approaches that are not stable in definition (for example, studies where the intervention changes and develops over time, such as design research projects) and approaches that are not clearly and unambiguously distinct from usual practice. We also exclude studies where the focus is on understanding how pupils learn rather than on examining the efficacy of teaching approaches that enable pupils to learn. The terms interventions, approaches and strategies are used interchangeably. We define effectiveness in terms of mathematical attainment and, to be included in our review, studies of interventions are required to have a mathematical attainment outcome (although, in some cases, this may not be the outcome identified as primary by the study authors). Hence, we exclude studies where the focus is only on attitudinal, dispositional or behavioural changes (even where these are largely mathematical in focus) and studies where only measures of teaching practice, behaviours or competence are collected.
Simms, V., McKeaveney, C., Sloan, S., & Gilmore, C. (2019). Interventions to improve mathematical achievement in primary school-aged children: A Systematic Review. Nuffield Foundation.

Comparator Business as usual teaching of mathematics.

Study designs to be included RCTs and QEDs, See full protocol in Supplementary Materials for further information.

Eligibility criteria See full protocol in Supplementary Materials for eligibility criteria and links to PICOS. Amendment 1: Changed (to avoid contradictory uses of the term quality) "1. A full systematic search (detailed below) for RCTs and high-quality QED studies across all Research Questions and topics. High quality here refers only to the study design of the QED, with all QEDs with a concurrent 'Business as Usual' or active control group and a pre-test categorised as of sufficient quality. 2. A systematic search for wider experimental and other quantitative studies (including QEDs not classified as 'high quality' such as those without a pre-test)." to "1. A full systematic search (detailed below) for RCTs and QED studies of sufficient quality across all Research Questions and topics. Sufficient quality here refers only to the study design of the QED, with all QEDs with a concurrent 'Business as Usual' or active control group and a pre-test categorised as of sufficient quality. 2. A systematic search for wider experimental and other quantitative studies (including QEDs not classified as 'high quality' such as those without a pre-test)." Similar change made on p.25.
Amendment 4: Addition to the study exclusion criteria under "setting", namely: The intervention setting has a smaller granularity than a class, e.g., we will exclude studies with <15 in each group allocation. [Excluded as a small sample size is one element of deciding that the study is about learning not teaching.]

Amendment 5: Addition to the study exclusion criteria under "intervention type", namely: The intervention is well-described and could be operationalised by a teacher.

Information sources See full protocol in Supplementary Materials.

Main outcome(s) Attainment in mathematics. See full protocol in Supplementary Materials for further information.

Data management See full protocol in Supplementary Materials.

Quality assessment / Risk of bias analysis See full protocol in Supplementary Materials.
Amendment 7: Double-coding changed from a proportion of at least 10% of studies to a threshold of at least 25 studies.
Amendment 8: Clarifications made to the "Assessment of risks of bias" approach and tool, predominantly to account for the use of the more appropriate and rigorous WWC standards for study attrition.
Amendment 12: Clarified that potential bias for imbalance at baseline is relevant only for QEDs.
Amendment 13: Addition to "Modular Reporting" to add quality of individual studies assessment process to the overall quality assessment process (see also additional Appendix 4).
Amendment 14: Thresholds for assessing the quality and relevance of overall evidence (including Tables 8 and 9) updated.
Amendment 15: Addition to "Modular Reporting" to add extended and piloted relevance assessment (see also additional Appendix 5) as a measure within itself and as a tool to identify the most important studies within each topic.
Amendment 19: Appendix 4 (Quality Assessment for Individual Studies) added as per amendment #13
Amendment 20: Appendix 5 (Relevance Assessment for Individual Studies) added as per amendment #15.

Strategy of data synthesis See full protocol in Supplementary Materials.

Subgroup analysis See full protocol in Supplementary Materials.

Sensitivity analysis See full protocol in Supplementary Materials.

Language restriction Studies must be published in English language.

Country(ies) involved United Kingdom.

Other relevant information See full protocol in Supplementary Materials. Revised review protocol with amendments described in detail (see p.36 of revised protocol).
Other amendments: Clarifications, including to language, topic coding, team information and timeline. See protocol for full details.

Keywords mathematics teaching; secondary mathematics; England.

Dissemination plans See full protocol in Supplementary Materials.

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