Evaluation of the Specialist Knowledge for Teaching Mathematics Programme: Randomised Control Trial Evaluation Protocol

Education Endowment Foundation

Evaluator (institution): Sheffield Hallam University (SHU)
Principal investigator(s): Mark Boylan, Anna Stevens (until April 2025), Martin Culliney (from April 2025)

Evaluation summary

Project title	Evaluation of the Specialist Knowledge for Teaching Mathematics (Secondary Non-Specialist Teachers) Programme: Randomised Control Trial
Developer	National Centre for Excellence in the Teaching of Mathematics (NCETM)
Evaluator	Sheffield Hallam University (SHU)
Principal investigator(s)	Mark Boylan, Anna Stevens (until April 2025), Martin Culliney (from April 2025)
Protocol author(s)	Mark Boylan, Anna Stevens, Panagiota Blouchou, Martin Culliney
Trial design	Three-level multisite Cluster Randomised Trial design with school level randomisation (within each of the cohorts*) (two-arm)
Trial type	Efficacy
Pupil age range and Key stage	12-13, KS3
Number of schools *(at design stage)*	180
Number of pupils *(at design stage)*	4500
Primary outcome measure and source	GL assessment Progress Test in Mathematics 12 (PTM12)
Secondary outcome measure and source	• The Teacher of Mathematics Identity Scale (ToMI) (Willis et al., 2023) • Cognitive Activation Scale *(CAS)* (Zhang, Wang & Yang, 2021) (pupil outcome) • Mathematics self-efficacy (Toland and Usher 2016) (pupil outcome)

- please see glossary for definition of cohort

Protocol version history

Version	Date	Reason for revision
1.0	26/06/25	N/A

Contents

Tables

Figures

Glossary and acronyms

CACE	Compliers Average Causal Effect
CAS	Cognitive Activation Scale
Cohort	Group approximately six SKTM teacher participants undertaking training together
CL	Cohort lead, professional development leader of a cohort
DfE	Department for Education
FSM	Free School Meals
GL PTM12	GL Assessment Progress Test in Mathematics 12
ICCs	Intracluster correlations
IPE	Implementation and Process Evaluation
ITT	Intention to Treat
KS3	Key Stage 3, the National Curriculum Key Stage for 11-14 years old pupils

LLME	Local Leader of Mathematics Education (Maths Hub based professional development leader
Maths Hub	Geographical, school or trust led maths professional development organisation
MDES	Minimum Detectable Effect Size
MDPT	Mathematics Development Programme for Teachers
MoU	Memorandum of Understanding
MSCRT	Multisite Cluster-Randomised Trial Design
NCETM	The National Centre for Excellence in Teaching of Mathematics
NPD	National Pupil Database
NSTs	Non-Specialist Teachers
PD	Professional Development
QTS	Qualified Teacher Status
SAS	Standard Age Score
SKTM	Specialist Knowledge for Teaching Mathematics
TfM	Teaching for Mastery
ToMI	The Teacher of Mathematics Identity Scale
UPN	Unique Pupil Numbers
Y8	Year 8 (12–13-year-old pupils)

Study rationale and background

The evaluation of the Specialist Knowledge for Teaching Mathematics (SKTM): Secondary Non-specialist Maths Teachers programme will generate evidence on the impact of professional development for secondary phase non-specialist teachers of mathematics. The SKTM programme was developed and is delivered by The National Centre for Excellence in the Teaching of Mathematics (NCETM) through the national network of Maths Hubs.

The NCETM, funded by the Department for Education, was established in 2006. Maths Hubs were established in 2014 and are led by one or two Lead Schools or colleges. Each Maths Hub is a partnership of schools, colleges and other organisations working together to improve maths education in an area. Together the NCETM and the Maths Hubs offer a programme of professional development aimed at improving mathematics teaching. Since 2014, a core aspect of NCETM and Maths Hub activity is developing and embedding the Teaching for Mastery (TfM) programme in schools.

The SKTM programme enhances subject knowledge and pedagogical skills, aligned with Teaching for Mastery (TfM) principles and the Department for Education's (DfE) non-statutory KS3 guidance.

For the purposes of the programme the NCETM defines non-specialist teachers (NSTs) of mathematics as:

> a teacher in a state-funded school or college that is currently teaching some mathematics or has commitment from a headteacher or executive head to teach some mathematics within the next year, who has not undertaken Initial Teacher Training (ITT) in mathematics.

Most NSTs are teachers with Qualified Teacher Status (QTS) but in another subject (e.g., secondary PE teacher) or other specialist qualification or a general primary teacher). Other NSTs eligible to participate are overseas trained mathematics teachers and other teachers without QTS. To participate in the SKTM programme, teachers must be employed in a state funded school.

Given the importance of secondary mathematics for pupils, to schools and in policy, the rationale for this study arises from the consequences of teacher recruitment and retention challenges in mathematics (Long and Denachi, 2021). Almost half of all 2016 maths teaching (43%) was undertaken by those with six or fewer years of experience (Allen and Sims, 2018) and there are a significant number of non-specialist teachers with 45% of surveyed senior leaders reporting that at least some lessons in their schools are taught by non-specialist teachers (Worth, 2023). Secondary maths teachers are less likely to have a degree in maths than teachers holding relevant qualifications to teach non-shortage subjects (Allen and Sims, 2018).

Teachers who have not received mathematics specific teacher training or professional development may be missing subject as well as pedagogical content knowledge. This is concerning given that teacher subject knowledge, including pedagogic content knowledge, is a key factor in high quality teaching and raising attainment of pupils (Barra and Boccia, 2022;

Hodgen et al., 2018).There is also evidence from the USA that being taught by a teacher with a mathematics subject certification is associated with higher pupil attainment than being taught by a teacher without mathematics subject certification (Dee and Cohodes, 2008).

The deployment of non-specialist teachers may particularly impact outcomes for disadvantaged pupils because non-specialists are more likely to teach:

- in schools serving disadvantaged pupils and, in all schools, there is evidence suggesting that they are more likely to teach classes with higher numbers of disadvantaged pupils (Allen and Sims, 2018)
- KS3 (11–14-year-old) maths classes, a time where attainment gaps between advantaged and disadvantaged pupils widen (Andrews et al., 2017)
- classes with lower prior attainment, where classes are grouped by attainment (Boylan et al., 2024), and so have a disproportionate number of disadvantaged pupils (Taylor et al., 2019).

This is against the background of the persistent attainment gap between disadvantaged pupils and their peers (Benyon and Kenyon, 2022; Burgess and Thomson, 2019; Andrews, et al. 2017; Tuckett et al., 2024).

Non-specialists teaching mathematics

Non-specialists are not a homogeneous group, and differences may moderate programme engagement and outcomes. In one study, 75% of non-specialist mathematics teachers had a relevant post-A level qualification (e.g., engineering or science). Reasons for NSTs teaching mathematics vary in whether it is a choice or a direction. Some non-specialists enjoy teaching mathematics more than their own subjects (Darlington, 2017). Non-specialists may share classes with specialist mathematics teachers.

There are three possible differences between non-specialists and specialist teachers of mathematics particularly relevant to the SKTM programme. These are:

- differences in mathematical content or subject knowledge due to differences in prior study of mathematics as evidenced by maths qualifications
- differences in pedagogical content or pedagogical subject knowledge – that is knowledge for teaching mathematics (Depaepe et al., 2013)
- differences in teacher identity with specialists likely to have a more developed mathematics teacher identity (Willis et al., 2023).

Professional development for non-specialists

There is very little evidence on the impact of professional development for non-specialist teachers. Previous research in England has tended to focus on subject knowledge development for graduates of non-mathematics or mathematics related degrees (e.g., Stevenson, 2020). The Mathematics Development Programme for Teachers (MDPT), a four-term programme for non-specialists, was funded from 2007-2011 (Crisan and Rodd, 2011). The MDPT was a part-time, funded course for qualified teachers but who had no mathematics qualifications at degree level. It included 30 taught days and 10 school-based development days over four terms (Boylan and Hardy, 2010; Boylan, Adams and Birkhead, 2023; Crisan and Rodd, 2011; Stevenson, 2016). In 2011, this was replaced by a subject knowledge enhancement programme branded as SKE+ (Crisan and Rodd, 2011). From 2016-2021, Teacher Subject Specialist Training (TSST) developed on the work on SKE+ by providing maths subject and pedagogical content knowledge for NSTs and specialists returning to the classroom after a career break.

From April 2021, the National Centre of Excellence in the Teaching of Mathematics (NCETM) worked with maths hubs to deliver a programme aimed at non-maths teachers currently teaching maths: specialist knowledge for teaching mathematics - secondary. The current SKTM programme is one aspect of this. Thus far, only case study evidence is available for potential influences of the SKTM programme on professional learning and practice (see, Sani and Burghes, 2021).

Internationally, non-specialist teachers are often referred to as 'out of field' teachers and other countries have similar issues to England with teacher recruitment, leading to significant numbers of out of field teachers (Hobbs and Porsch, 2021). Elsewhere, as in England, this issue has persisted over time. For example, Ingersoll (1998) examined the prevalence of out of field teaching in the USA more than 15 years ago. Research and evaluation of programmes have been undertaken in Ireland (Goos et al., 2020, 2021), and Australia (Kenny et al., 2021). In so far that evaluation has examined the impact, this has focused on teacher outcomes and longitudinal observation of effects; for example, the impact of a long-term, large-scale, government-funded, university-led Professional Diploma in Mathematics for Teaching in Ireland (Goos et al., 2021). There does not yet appear to be any experimental evidence on the impact of professional development for non-specialist teachers, or more generally evaluation of programmes like the SKTM where delivery is through school-led professional development organisation such as Maths Hubs.

The SKTM trial helps to address the need for more evidence about the deployment and professional learning needs of non-specialist teachers who are of increasing importance in the teaching workforce in England. It will generate evidence about the impact of professional development for NSTs on their subject knowledge, teaching and identity, and how this in turn impacts pupil experience and outcomes.

Overview of the evaluation design

The trial will evaluate the efficacy of the SKTM programme. It will examine the impact on the mathematics attainment of Y8 pupils, their mathematics self-efficacy and their experience of opportunities to think, reason and discuss within their lessons. It will also assess changes to teachers' identity and practice.

The efficacy trial design addresses important contextual issues about the deployment of NSTs and current patterns of attainment grouping in secondary schools in England. The SKTM programme focuses on non-specialists teaching KS3 (specifically Y7 and Y8 classes), with 90% of classes likely to be grouped by attainment (Taylor et al., 2020). There is a lack of direct evidence about when Y7 classes are put into sets or streams. However, indirect evidence suggests that 50% of schools use sources of information that are generated after pupils start Y7 (Taylor et al., 2019). The timing of attainment grouping could therefore delay SKTM delivery, if Y7 pupils were to be included in the sample, as allocation of teachers to classes is necessary before randomisation. Further, a potential confounding variable is the different quality of transition for Y7 between schools, a factor associated with differences in outcomes (Boylan et al., 2024). To address these contextual issues, the intention to treat pupil sample is one Y8 class per school per teacher participating in the SKTM.

The SKTM is delivered by Maths Hubs in local cohorts by Cohort Leads, and so randomisation will be stratified by cohort (group of teachers taking part in SKTM under a cohort lead in each area), so that each cohort group is similar in size to those in the usual SKTM delivery if the recruitment target is met. This would give 10-12 schools per cohort, with half allocated to the intervention group receiving the SKTM programme in 2025-26, and the other half to the control group (who will be offered the same programme in 2026-27).

The design will support testing a Theory of Change by measuring key primary and secondary outcomes identified in the Theory of Change:

- a primary outcome of pupil mathematics attainment assessed using GL Progress Test in Mathematics 12
- secondary outcomes of pupil mathematics self-efficacy and experience of Teaching for Mastery related practices (cognitive activation); and teacher mathematics identity.

The mixed-methods Implementation and Process Evaluation (IPE) will assess perceptions of other outcomes that are not practical or easily measured in the impact evaluation. Additionally, the IPE will address a comprehensive set of other implementation dimensions.

The evaluation design is informed by:

- consideration of the availability of measures to assess outcomes
- the practicality of measuring outcomes considering issues of participant burden
- a Theory of Change which allows for flexible delivery and adaptation by Cohort Leads, as well as expected variation in the support for non-specialists by their schools

Central to the expected outcomes for NSTs are changes in mathematical knowledge and pedagogical content knowledge. However, measuring mathematics knowledge across the range of mathematical content addressed in the SKTM would require participants to undertake mathematical assessment, ideally before the trial, and necessarily at the end – and would require both SKTM participants and teachers in the control sample to participate in assessment. Such a test would likely affect recruitment to the trial and data collection at the end of the trial.

Approaches to measuring mathematical pedagogical content knowledge of teachers require considerable time commitment from teachers. For example, the COACTIV study of secondary teachers' content and pedagogical content knowledge in Germany, involved an assessment that took 12 hours of teacher time to complete (Krauss et al., 2008). An alternative approach could be to sample a specific area of mathematical knowledge. However, assessments are only available for some mathematics content areas and those that do exist still take more than an hour to administer (see for example, Bradshaw et al., 2014), have not been tested for reliability in England and the programme protocol means that this specific mathematical content may not be a prominent feature of materials used with participants in every cohort. Consequently, potential outcomes on teacher subject and pedagogical content knowledge will be considered through the implementation and process evaluation rather than measured in the impact evaluation

The intervention

The SKTM Secondary Non-specialist Teachers' programme is an established programme for non-specialist teachers in England, developed by the NCETM, and informed by subject knowledge provision for non-specialist teachers and wider programmes of mathematics teacher professional development. The description of the intervention is provided in two parts. First, an overview of the SKTM programme is provided, including the aims and summary of the programme structure and processes. Differences between the usual SKTM delivery and adaptations for trial implementation are included. Second, a detailed description of the SKTM programme to be implemented in the trial is provided.

Overview of the SKTM programme

The SKTM programme is part of a larger body of mathematics teacher professional development delivered by the NCETM and the Maths Hub programme. In the secondary phase of schooling the overarching aims are to:

- establish a culture of high expectations for all pupils (including disadvantaged pupils and pupils with SEND) in which they develop deep knowledge, understanding and confidence in mathematics, succeed in GCSE mathematics, and are ready to continue studying mathematics post-16.
- introduce, embed, and sustain Teaching for Mastery (TfM) pedagogical approaches with fidelity and consistency, making effective use of high-quality resources.
- ensure all teachers of mathematics have the specialist knowledge and skills required to teach mathematics effectively.

The SKTM programme contributes to this by focussing on non-specialist teachers of mathematics, aiming to:

- improve subject and curriculum knowledge of secondary mathematics with a particular emphasis on mathematical structures in key areas.
- increase the use of a range of pedagogic approaches consistent with Teaching for Mastery.
- improve pupils' knowledge and understanding of, and attitudes towards, mathematics.

The NCETM is funded by the DfE to deliver SKTM in England, with delivery targets each year. SKTM is a one-year programme with NSTs participating in cohorts recruited by the 40 Maths Hubs. Maths Hubs identify Cohort Leads to lead the professional development who are experienced mathematics specialists. In the usual implementation, some Cohort Leads lead more than one cohort and/or lead professional development for more than one Maths Hub.

Usual cohorts vary in size from four to 35 teacher participants, with a mean of approximately nine. In the SKTM trial, the mean cohort size will be smaller due to the need to have both a participant and control sample. However, the hubs participating in the trial are ones that have previously had higher levels of recruitment. In usual delivery, the SKTM programme can start either in the autumn or the summer and last for at least two terms. For the SKTM trial, all delivery will start in the autumn term, and the programme will last three school terms as this is the most common form of delivery.

Any teacher who meets the NCETM definition of a non-specialist and teaches in a state-funded secondary school is eligible to participate. There is no requirement to teach any particular year group in the usual SKTM delivery. In the SKTM trial, schools are requested to timetable the participants to teach at least one Y8 class for the purpose of evaluating impact.

The content of the programme is particularly relevant to teaching KS3 mathematics, although some participants may also be teaching KS4 GCSE classes. The content is organised into 18 modules delivered over the equivalent of six days of training. Key professional learning mechanisms are teaching and modelling by Cohort Leads, individual study using workbooks, collaboration between participants, professional experimentation through school-based tasks, and more generally applying learning to teaching mathematics. Schools are encouraged but not required to provide participants with additional formal or informal mentoring in their schools by specialist mathematics teachers. There is no planned variation to the usual materials and processes for the SKTM trial, other than trial data collection activities.

Materials and approaches are aligned with Teaching for Mastery and key outcomes of the programme are that participants understand and apply pedagogic principles aligned with TfM[1]. Figure 1 provides a summary of key aspects of TfM from (NCETM, 2022).

The SKTM programme is designed to support non-specialists to develop an understanding of key principles, lesson design, and practice in the classroom, appropriate to the participants' non-specialist status. This is completed in a single school year, and within the limits of six days equivalent training and associated school-based learning.

Core learning from the programme focuses on the principles of the underlying assumption that everyone can enjoy and learn mathematics, learning behaviours to support making connections, and teachers' professional learning is continual and collaborative. The principle of coherent curriculum design is a feature of departmental practice, rather than individual teacher practice and so, for SKTM secondary teacher participants, is a contextual feature that is dependent on the departments and schools they work in rather than an outcome of participation in the programme.

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[1] Mastery Explained | NCETM

The core aspect of TfM lesson design within the programme is the careful selection of representations and models. Potentially, participants will also improve linking of lesson content and activities to prior learning, to support steps in learning progression.

Whole class interactive teaching is central to classroom practice and the use of precise mathematical language. Dependent on departmental practice, participants may also emphasise teaching number facts and other key mathematical facts to automaticity, with regular practice. Other aspects of TfM principles, lesson design and classroom practice presented in Figure 1, may also be addressed during the programme and are additional participant learning.

Central to TfM are five ‘big ideas’ of mathematical thinking, coherence, variation, fluency, and representation. There are overlaps between TfM pedagogy and cognitive activation in teaching (see, OECD, 2013), providing opportunities for thinking, reasoning, and discussion.

The SKTM programme, in common with all NCETM subject knowledge programmes, is based on a model of knowledge for teaching mathematics that includes both subject matter knowledge and pedagogical content knowledge (Ball et al., 2008).

Figure 1: Aspects of Teaching for Mastery (adapted from NCETM, 2022)

Underpinning principles

Mathematics Teaching for Mastery assumes everyone can learn and enjoy mathematics.

Mathematical learning behaviours are developed such that pupils focus and engage fully as learners who reason and seek to make connections.

Teachers continually develop their specialist knowledge for teaching mathematics, working collaboratively to refine and improve their teaching.

Curriculum design ensures a coherent and detailed sequence of essential content to support sustained progression over time.

Lesson design

Lesson design links to prior learning to ensure all pupils can access the new learning and identifies carefully sequenced steps in progression to build secure understanding.

Examples, representations and models are carefully selected to expose the structure of mathematical concepts and emphasise connections, enabling pupils to develop a deep knowledge of mathematics.

Procedural fluency and conceptual understanding are developed in tandem because each supports the development of the other.

It is recognised that practice is a vital part of learning, but the practice must be designed to both reinforce pupils’ procedural fluency and develop their conceptual understanding.

In the classroom

Pupils are taught through whole-class interactive teaching, enabling all to master the concepts necessary for the next part of the curriculum sequence.

In a typical lesson, the teacher leads back and forth interaction, including questioning, short tasks, explanation, demonstration, and discussion, enabling pupils to think, reason and apply their knowledge to solve problems.

Use of precise mathematical language enables all pupils to communicate their reasoning and thinking effectively.

If a pupil fails to grasp a concept or procedure, this is identified quickly, and gaps in understanding are addressed systematically to prevent them falling behind.

Significant time is spent developing deep understanding of the key ideas that are needed to underpin future learning.

Key number facts are learnt to automaticity, and other key mathematical facts are learned deeply and practised regularly, to avoid cognitive overload in working memory and enable pupils to focus on new learning.

The SKTM programme in the trial: TIDieR description

The structure and processes of the SKTM programme as intended to be implemented in the trial are described using the TIDieR framework[2].

Name

The Specialist Knowledge for Teaching Mathematics (SKTM): Secondary Non-specialist programme

Why

Recruiting and retaining secondary mathematics teachers is challenging so non-specialist teachers (NSTs) of secondary mathematics are an important part of the mathematics teaching workforce. Often, they are deployed to teach pupils with low attainment and therefore teach a disproportionate number of disadvantaged pupils. NSTs as a group need professional development to support mathematics subject and subject teaching knowledge. Effective professional development for NSTs may impact positively on outcomes for pupils and specifically disadvantaged pupils, eventually enabling more of them to achieve higher grades in GCSE maths.

The SKTM programme aims to address these professional development needs of NSTs.

Who (participants)

Teachers: Non-specialist teachers of mathematics who have not undertaken Initial Teacher Training in Mathematics. This includes teachers with Qualified Teacher Status (QTS) but in another subject or specialism and non-qualified teachers. All participants must be teaching in a state-funded school and there is a commitment by the school for the teacher to teach some mathematics in the trial year, including teaching at least one Y8 class for at least 50% of the

[2] TIDieR framework

Y8 class's mathematics lessons. The SKTM trial will recruit 15 cohorts of teachers with an expected mean cohort size of five or six participants in each cohort.

Pupils: The pupils in the Y8 class of the participating teacher[3].

What (materials)

Cohort Leads, described in the section below 'Who (provider)' are provided with the following materials to support delivery of SKTM sessions:

- PowerPoint slides for 18 core sessions, with presentation slides to share with participants, and notes for Cohort Leads
- A SKTM Secondary Handbook that is common to the SKTM for secondary non-specialist teachers and for secondary school teaching assistants; the handbook gives an overview of the content of the 18 sessions[4], the workbooks and school-based tasks, with guidance about how to use the course materials, deliver sessions and support participants.
- A Local Leaders of Mathematics Education handbook. Local leaders of mathematics education (LLME) is a designation for all those who lead Maths Hub professional development activities including SKTM Cohort Leads. The LLME handbook provides an overview of the LLME role and relevant frameworks, such as the relationship between different types of LLME activity and the professional development principles underpinning activities. Additionally, Cohort Leads can draw on a wider range of NCETM secondary professional development materials, including video materials.

Teacher participants are provided with 18 core session workbooks. For in-person training, workbooks are provided in print form. For online training participants use an online version during sessions. Participants can access electronic versions through an online platform. Workbooks include a summary of session mathematics subject content and pedagogical content, session objectives, mathematical tasks for participants to complete, and school tasks focused on developing teaching knowledge and skills. School tasks may be reflective tasks on participant's teaching or material to use with pupils leading to reflection. Workbooks contain links to further material, including NCETM subject audits[5] for teachers. Completion of subject audits is optional. Subject audits focus on mathematical content for KS3 Mathematics. There are 17 audit documents with each linking to NCETM Secondary Mastery Professional Development Materials. Each document contains audit questions for teachers to self-assess their confidence in relation to concepts and contain exemplifications, explanations and links to further support.

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[3] If a nominated teacher has more than one Y8 class, the school will be asked to put forward the class with which the teacher spends most time.

[4] The mathematical content of the 18 sessions is provided in Appendix A.

[5] https://www.ncetm.org.uk/classroom-resources/secondary-subject-knowledge-audit/

What (procedures)

Participants attend training sessions facilitated by Cohort Leads. It is anticipated that in the SKTM trial, training for up to ten cohorts will be delivered as six full days in person, one as four full days and three partial days. The other cohorts may be a mixture of online or blended training. The variation in delivery patterns in the trial reflects usual SKTM delivery. Blended and online training is provided for geographical reasons.

Usually, in each full day training there are three core sessions per day and so three workbooks used, with the amount of time for each session possibly being split unevenly. Cohort Leads might choose for one of the full days to cover only two sessions and workbooks to work on specific content in more depth.

In the SKTM trial, it is planned that each cohort will have a distinct Cohort Lead, or Leads if two Cohort Leads share leadership of a cohort. This difference is necessary to uphold the clustering assumptions in the impact design. Usually, Cohort Leads each year will include a mixture of those with previous experience of leading the secondary SKTM programme and those who are new to it. It is expected that the cohorts in the trial will all have a Cohort Lead who has led at least one cohort previously. This modification is in keeping with conducting an efficacy trial that aims for implementation conditions that can test the core principles of the Theory of Change.

Cohort Leads who are delivering the programme for the first time receive an additional one day's worth of training from the central NCETM team. Additionally, during the trial Cohort Leads will take part in two half day online workshops with the NCETM SKTM programme team and will have one day face to face network meeting with others delivering the SKTM programme. Furthermore, with other Local Leaders of Mathematics Education, Cohort Leads will participate in 3 days of local hub organised and led sessions that are not specific to the SKTM programme.

The Cohort Lead uses the training materials to introduce subject and subject teaching content, model teaching techniques and support participants to collaborate. In sessions participants practise and rehearse new methods. Participants collaborate on maths tasks to explore subject knowledge, pedagogy, and pupil misconceptions. Each session uses a workbook with tasks for use in during sessions, mostly mathematics tasks, and school-based tasks. School-based tasks may be:

- maths tasks like those used during training events
- reflective tasks related to mathematics tasks or mathematics content
- engaging with additional professional development resources or materials
- pedagogical activities such as reflecting on the potential use of, or planning to use, curriculum materials and resources
- reflective tasks related to teaching and learning mathematics

The Cohort Leads select the materials for the specific participants by selecting which materials and which tasks to include or encourage participants to complete. Selection is based on knowledge of their participants' strengths and weaknesses, how they respond in sessions and participant feedback on activities in school.

Cohort Leads as Local Leaders of Mathematics Education feedback to the NCETM programme team on delivery and report any areas of ongoing challenge and to inform future developments. Teachers set personal development goals and based on the training, including the school-based tasks, apply new techniques in their classrooms throughout their teaching, promoting practice tailored to their context. Additional to school tasks in the workbooks recommended by the Cohort Lead, the participant may complete other school-based tasks included in the workbooks.

Core training focuses on effective teaching strategies such as whole-class interactive teaching, and back and forth interaction such as questioning, short tasks, explanation, demonstration, careful selection of representations, and discussion. These strategies closely align with the TfM approach's recommendations for classroom practice, which are designed around the core ideas of building reasoning through mathematical thinking, developing factual and procedural fluency, and building conceptual knowledge in pupils.

The NCETM provides a certificate for Maths Hubs to give to those participants that have successfully engaged with the programme, with a recommendation that this should include at least 80% attendance or five or more out of six days equivalent. Participants can partially meet the attendance criteria by undertaking alternative activities for one or more sessions if they cannot attend in person. Successful engagement also requires participants to engage with tasks during sessions and with school-based activities agreed with the Cohort Lead. Further details are provided in Appendix E.

Who (provider)

National delivery of the SKTM programme is managed by the NCETM who support Cohort Leads, providing specific networking and training as needed, and provide programme materials. The NCETM is funded by the Department for Education (DfE) to lead professional development in mathematics education in England.

Local delivery is led by 15 Maths Hubs with previous relatively high levels of participant recruitment. Each Maths Hub has a lead organisation contracted by the DfE to lead mathematics teacher professional development in their local area. The Maths Hub network is led by the NCETM.

Maths Hubs identify and support Local Leaders of Mathematics Education (LLMEs) to develop and embed expertise in designing and leading mathematics professional development. LLMEs are experienced mathematics teachers and subject leaders who have undertaken the NCETM's Professional Development Lead Programme.

How

Maths Hubs will lead local recruitment of cohorts by advertising through their local networks with national support from the NCETM and EEF.

Training is based on 18 sessions linked to workbooks. Sessions take place face to face or online. For face-to-face sessions, the Maths Hub organises the venue. Sessions are usually grouped into whole day training events. However, sessions may be delivered for some cohorts in shorter training events or in a mix of full days or shorter events.

Cohort Leads select materials and tasks from the session PowerPoints and the workbooks with participants adapting tasks for their local context.

Teacher participants apply their learning in their maths teaching, and specifically in the trial with Y8 classes.

Where

The hubs in the trial are in the following regions East Midlands, East of England, London, Northwest, Southeast, Southwest, West Midlands, Yorkshire and the Humber, and serve areas with diverse geographies. Face to face training events typically take place in a school, but other venues may be used.

When and how much

The SKTM trial will take place between September 2025 and July 2026. Participants experience six days equivalent of training. Participants have access to 18 session workbooks with multiple tasks that can be completed during sessions and in school. The number of activities used in a workbook varies between sessions, and Cohort Leads are likely to select between a half and two thirds the material.

Tailoring (adaptation)

By design, the programme materials are intended to be used flexibly and so with variation by Cohort Leads selecting materials dependent on participant needs and responses, and participant teachers adapting tasks to their school contexts. Significant adaptations beyond this are that:

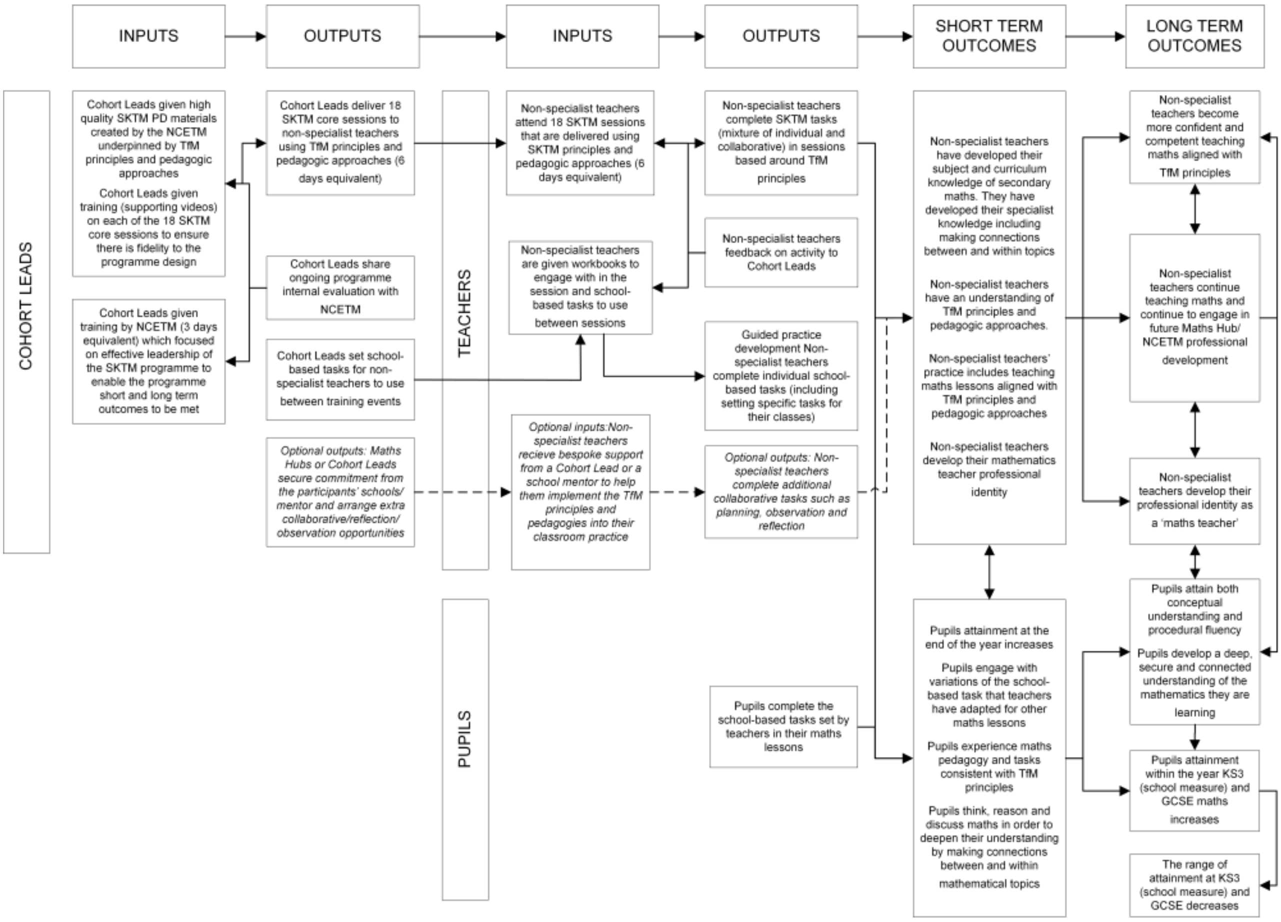
- the hub may choose to deliver the programme online or in person or in a hybrid form, often depending on geographical considerations.
- Cohort Leads have three days (additional to the six days equivalent training) that they can use to tailor the programme for participants. Examples of use of this time are providing additional training on KS4 mathematics content or individual one to one support through extra collaborative planning, observation/ or reflection opportunities.
- schools are encouraged but not required to allocate participants a school-based subject mentor to support participants' professional learning. They are particularly encouraged to do so if this is the first year a participant is teaching mathematics. School-based mentoring would typically be 'light touch' compared to the amount of mentoring experienced by early career qualified mathematics teachers.

Theory of Change

The programme logic model

The programme logic model is presented in Figure 2.

Figure 2: The programme logic model



Programme outcomes

The logic model identifies a set of teacher and pupil outcomes. It is likely that each set of outcomes for teachers and pupils considered as a single set will be interconnected, and there will also be connections between them. For example, the development of non-specialist teachers' pedagogical content knowledge (mathematics specialist knowledge in the logic model) is likely to support the development of mathematics teacher professional identity. One aspect of mathematics teacher identity is an experience of belonging to a community. If there is more engagement by the non-specialist in the SKTM cohort community, their departmental community or other mathematics teacher communities, this may in turn help to support the development of specialist knowledge.

Considering the relationship between pupil and teacher outcomes, these can be expected to be interconnected with changes in outcomes for pupils positively feeding back into teacher change and learning (Boylan et al., 2018).

Mediators and moderators

Given the centrality of Teaching for Mastery (TfM), an important contextual issue, and one for assessing ‘business as usual’, will be the extent to which participating schools have previously engaged with TfM professional development, and the extent to which schools’ existing practices are aligned with TfM principles. Other potential moderators and mediators of the programme are:

- variability in delivery and experience across cohorts and maths hubs
- characteristics of the non-specialists (e.g., QTS/non-QTS, maths related qualifications)
- previous experience teaching mathematics
- the deployment of non-specialists that may influence outcomes, including the proportion of maths teaching versus own specialism, shared classes with a specialist teacher, year groups taught
- other classes (numbers, and attainment range) and year groups taught by the participants during the trial as these will provide additional learning opportunities for practice
- departmental support for and experience and acceptance of TfM practices or related practices and principles, and the maths and other teaching policies of the department, school and trust
- the previous prevalence of non-specialists in the department and staff experience of supporting non-specialists
- the culture of the maths department as a mathematics teacher community, for example the extent to which collaboration and joint planning are embedded in the departmental practice
- previous engagement with NCETM and Maths Hubs, and other engagement during the trial.

Impact evaluation design

Research questions

Primary research questions

1. What impact does the intervention have on mathematics attainment for Y8 pupils as measured by the primary outcome *GL Assessment Progress Test in Mathematics 12* (PTM12)?

Secondary research questions

2. What impact does the intervention have on mathematics attainment for Y8 disadvantaged pupils as measured by the primary outcome (PTM12)? (Using FSM eligibility from the National Pupil Database (NPD) as a proxy for disadvantage).
3. What impact does the intervention have on mathematics attainment for high attaining Y8 disadvantaged pupils, as measured by the primary outcome (PTM12)? *
4. What impact does the intervention have on teacher identity, as measured by The Teacher of Mathematics Identity Scale (ToMI) (Willis et al., 2023)?
5. What impact does the intervention have on pupils' experience of opportunities to think, reason and discuss mathematics, as measured by the Cognitive Activation Scale (CAS) (Zhang, Wang and Yang, 2021)?
6. What impact does the intervention have on pupil self-efficacy, as measured by mathematics self-efficacy (Toland and Usher, 2016)?

*Please note that for research question 3, "high attaining Y8 disadvantaged pupils" are defined as either:

- ***Primary Definition:*** *Pupils eligible for FSM with a scaled score of 110 or more (classified as achieving the higher standard) in KS2 maths.*
- ***Secondary Definition:*** *Disadvantaged pupils in the top 15% of the class based on maths performance at KS2.*

We may expect that the numbers for the primary definition to be very small, given that most pupils with a scaled score of 110 or more will most likely be in the higher sets. Should numbers suffice for the primary definition, this will be included as a subgroup for the impact analysis. If numbers are not sufficient for the primary definition, we will move to the secondary definition.

Design

Table 1: Trial design

Trial design, including number of arms		Three-level multisite Cluster Randomised Trial design with school level randomisation (within each of the cohorts) (two-arm)
Unit of randomisation		School
Stratification variables (if applicable)		Cohort area*
Primary outcome	**Variable**	Pupil mathematics attainment
	Measure (instrument, scale, source)	Progress Test in Mathematics 12 (GL Assessment) Scale: 0 – 50
Secondary outcome(s)	**Variable(s)**	1. Identity as a Teacher of Mathematics (ToMI) (teacher level) 2. Pupils' experience of opportunities to think, reason and discuss mathematics (pupil level) 3. Mathematics self-efficacy (pupil level)
	Measure(s) (instrument, scale, source)	1. The Teacher of Mathematics Identity Scale (ToMI) (Willis et al., 2023) Scale: 15 – 105 2. Cognitive Activation Scale (CAS) (Zhang, et al., 2021) Scale: 9 – 36 3. Mathematics self-efficacy Scale (Toland and Usher, 2016) Scale: 24 – 144
Baseline for primary outcome	**Variable**	KS2 Mathematics attainment
	Measure (instrument, scale, source)	KS2 Mathematics attainment obtained from the NPD Scale: 0- 110
Baseline for secondary outcome	**Variable**	1. Identity as a Teacher of Mathematics (ToMI) (teacher level) 2. Pupil level CAS - no baseline measure. 3. Pupil mathematics self-efficacy - KS2 Mathematics attainment.
	Measure (instrument, scale, source)	1. The Teacher of Mathematics Identity Scale (ToMI) (Willis et al., 2023) Scale: 15-105 2. Pupil level CAS - no baseline measure. 3. KS2 Mathematics attainment from NPD. Scale: 0- 110

* Please see glossary for definition of cohort

The proposed design for the impact evaluation is a two-arm, three-level multisite cluster-randomised trial design (MSCRT) with school level randomisation (within each of the cohorts). This is an efficacy trial, and so the design is not powered to detect heterogeneity of effect size across cohorts. The 3-level MSCRT design acknowledges the clustering of pupils into schools and that the schools will be clustered into cohorts. The design has one class per school; thus, school and classroom levels are identical.

The design is based on one Y8 maths teacher per school participating in the evaluation, with the Intention to Treat (ITT) sample being pupils in the Y8 maths class taught by the nominated teacher for at least 50% of their mathematics lessons. Recruited schools will be asked to put forward a single Y8 class and a single SKTM teacher to participate in the trial.

The evaluation employs a wait-list design, so that all schools allocated to the control group will receive the SKTM intervention during the 2026/27 academic year, subject to DfE funding. To minimise attrition, intervention schools will receive an incentive payment of £500, and control schools will receive an incentive payment of £1,000 upon completion of evaluation activities. The control group will continue with business as usual during 2025/26. Control schools will be monitored through the IPE.

The primary outcome for the trial is mathematics attainment as measured by the Progress Test in Mathematics designed by GL assessment (PTM12). This will be administered to all pupils in the ITT Y8 class at each school. There are two pupil level secondary outcomes; pupil experience of opportunities to think, reason and discuss mathematics as measured by the *Cognitive Activation Scale (CAS)* (Zhang et al., 2021), and pupil self-efficacy as measured by *mathematics self-efficacy* (Toland and Usher, 2016). An additional secondary outcome is at the teacher level, looking at impact on teacher identity as measured by *The Teacher of Mathematics Identity Scale* (*ToMI)* (Willis et al., 2023).

Participant selection

To participate, schools must be a state-funded secondary school in England, must have a non-specialist teacher who has not undertaken Initial Teacher Training in mathematics and is teaching a Y8 class (if the class is shared, the non-specialist teacher needs to teach at least 50% of the lessons). If schools have more than one non-specialist teacher, only one will be eligible for the trial.

Schools will then nominate a single Y8 class to participate in the trial. SHU will provide guidance to schools as to which class should be nominated, i.e. the Y8 class that will be taught by the teacher receiving the SKTM programme in 25/26 for at least 50% of their mathematics lessons. We anticipate that in most cases this will be relevant to a single Y8 class, however in the instance where the teacher receiving the SKTM programme is allocated to more than one Y8 class, it should be the class where the teacher spends more of their time than the other class. Should their time be equal, SHU will randomly select one of these classes to participate in the trial (using class name rather than requesting lists of pupils for all classes). Once the participating class has been established, SHU will then request the pupil details for that class. All pupils in this class are eligible for the trial. Parents/carers will have the option to opt their child out of the evaluation activities at least two weeks prior to schools sending class lists. It is anticipated that the ITT sample will be around 4,500 pupils (estimating around 25 pupils per class across a maximum of 180 schools).

NCETM will work with a sample of 15 cohorts to recruit between 150-180 schools to the trial. Upon recruitment to the trial, schools will be asked to sign a Memorandum of Understanding (MoU) provided by NCETM. Schools will then be responsible for distributing the SHU information sheet and opt-out consent form to all parents/carers of potential pupil participants. SHU will then request class lists from schools for the Y8 class starting in 2025/26 proposed to be taught by the teacher receiving SKTM for at least 50% of their mathematics lessons.

Outcome measures

Baseline measures

For the primary outcome (PTM12), the baseline measure will be KS2 mathematics attainment raw score obtained from the NPD. Pupil details obtained from schools (UPN, pupil name and pupil DOB) will be provided to the DfE with a meaningless identifier generated by the evaluation team. DfE will then provide the NPD variables to SHU along with the meaningless identifier in the secure research service, where SHU will link the trial data with the NPD data.[6] For the pupil level secondary outcomes, it will not be possible to collect data on the pupil secondary outcome measures at pre-intervention, given that the ITT class will not be established well enough prior to randomisation, to administer these to the relevant pupils. However, KS2 mathematics attainment will be used as the baseline measure in analyses of the pupil self-efficacy in mathematics secondary outcome. Analysis of the pupil cognitive activation secondary outcome will not include a baseline covariate in the model.

The teacher level secondary outcome will have a baseline measure identical to the outcome measure, i.e. *The Teacher of Mathematics Identity Scale (ToMI)* (Willis et al., 2023). Please see section below (secondary measure data collection) for details of how this measure will be administered.

Primary outcome

As noted above, mathematics attainment as measured by the *GL Assessment Progress Test in Mathematics 12* (PTM12)[7] (not included in the appendix due to copyright) will be the primary outcome for this trial. The test is designed to reflect the curriculum content that pupils who are 12 years old would typically learn and therefore is a suitable test of likely school GCSE attainment as specified in the pupil outcomes in the programme logic model. The test has been standardised with a sample of pupils from UK schools. The total raw score will be used with a scale ranging from 0–50.

Although the recommended GL assessment paper for the age group in this trial is PTM13, after careful consideration this was not deemed suitable for pupils participating in this trial as it is likely that they will have lower levels of prior attainment (previous deployment of the SKTM programme indicates that schools signing up to receive SKTM generally have lower overall attainment levels) and potentially will not have covered all the topics on the PTM13 assessment paper. It has thus been agreed that PTM12 will be used, and that the raw scores only will be used in analysis rather than the age adjusted scores. At the point of requesting class lists from schools (post recruitment to the trial), SHU will ask for setting information for the participating classes. Once SHU has collated the setting information across schools in the trial this will confirm if it is the case that participating classes are made up of lower sets. Should this not be the case, SHU will then revisit the decision of whether to use PTM12 or PTM13.

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[6] Secure Research Service - Office for National Statistics

[7] https://www.gl-assessment.co.uk/assessments/products/progress-test-in-maths-for-secondary/ and a technical report on the test properties is here ptm-technical-information.pdf

In terms of outcome data, the primary outcome PTM12 papers will be distributed to schools directly, and schools will be responsible for administration. Along with the PTM12 test papers, GL testing guidance will also be sent to schools, along with clear guidance from SHU to ensure that all papers are completed under exam conditions. Once papers are complete, they will be returned to GL Assessment who will mark the papers and then provide the scores to SHU.

Secondary outcomes

(i) Teacher secondary outcomes

The logic model posits that changes in professional identity will result from participation in the SKTM. This will be measured using the Teacher of Mathematics Identity scale (Willis et al., 2023) with the following measure:

(a) Teacher of Mathematics Identity (ToMI) score

ToMI will be administered to all teachers nominated by schools to participate in SKTM (one teacher per school), at baseline (June 2025[8]) and endline (June 2026). Teacher of Mathematics Identity (ToMI) was previously measured via a scale developed using exploratory and confirmatory factor analysis by Willis et al. (2021). This study used the 15-item single-factor solution, which revealed good internal reliability ($\alpha = 0.86$). This score reflects teacher perceptions of their belonging to a mathematics community, their self-efficacy as a teacher of mathematics and their enthusiasm to be a teacher of mathematics. Responses are made on a 7-point Likert scale ranging from strongly disagree (1) to strongly agree (7). The instrument can be found in Appendix B. In the Impact Evaluation the ToMI scale total score will be used as a secondary outcome measure, rather than the sub-scales of belonging to a mathematics community, their self-efficacy as a teacher of mathematics and their enthusiasm to be a teacher of mathematics. The sub-scales are not being used as secondary measures because the SKTM trial will be the first use of the TOMI scale with non-specialist teachers in England. Data on the sub-scales will be used in the IPE. Scores on the TOMI measure overall range from 15 to 105.

(ii) Pupil secondary outcomes

Two pupil secondary outcomes will be measured: experience of cognitive activation practice and pupil mathematics self-efficacy. Both measures are designed to be non-intrusive for pupils and straightforward to administer.

a) Experience of cognitive activation practices

A programme outcome in the Theory of Change is for pupils to experience opportunities to: ‘think, reason and discuss their mathematics in order to deepen (by making connections within and between topics) their understanding’. This summarises some aspects of the expected outcomes for pupils if TfM practices are adopted.

[8] We envisage that most schools will be able to provide details of the SKTM teacher prior to the summer holiday 2025, however if some schools are unable to provide this detail until early September, we will administer the baseline survey as soon as we have teacher contact details in September and prior to randomisation.

This programme outcome will be measured by using the Cognitive Activation Scale (CAS) (Zhang, Wang & Yang, 2021). The CAS items map onto aspects of the TfM pedagogy and principles and so will measure the extent to which the experience of mathematics teaching of the pupils is impacted by teacher participation in the programme. The CAS will be administered to all participating pupils in the ITT sample (one Y8 class per school) at endline only (June 2026). The CAS cannot be used as a baseline before the trial starts as it would not be practical to do before randomisation without reducing the length of the intervention below the minimum two term requirement. This is because pupils would need to have experienced mathematics teaching by the non-specialist teachers for at least some weeks to meaningfully complete the CAS. Cognitive activation is assessed by asking pupils to evaluate features of their lessons. The 9-item cognitive activation scale is adopted from the PISA 2012 Student Questionnaire. Cronbach's alpha was 0.86 for this scale. In this scale, the pupils are surveyed about their exposure to some certain activities in the mathematics lessons: how often the mathematics teacher asks them to reflect on problems, solve complex problems, and apply knowledge to new contexts (please see Appendix C for full questionnaires). The pupils are asked to rate on a Likert-type scale from 1 (never) to 4 (always) for each item. Scores range from 9-36. The pupil ratings can be analysed at both the pupil level and the teacher level (Leudtke, Keoller, Marsh, & Trautwein, 2006). At the pupil level, the score represents the individual pupil's perception of cognitive activation strategies in mathematics lessons. Thus, it is suitable as an impact evaluation measure in this trial as a secondary outcome.

At the teacher level, individual pupil scores can be aggregated by calculating the average ratings of all the pupils taught by the same teacher to represent the overall level of a teacher's use of cognitive activation strategies in the class, corrected for individual idiosyncrasies. Because of the likelihood of variation in completion rates from class to class, the aggregated CAS at teacher level will not be used as a secondary teacher outcome but will be considered in the IPE.

b) Pupil mathematics self-efficacy

Additionally, the logic model identifies an intended pupil outcome of pupils' attitude to mathematics improving, including self-efficacy. To measure this pupil secondary outcome, the mathematics self-efficacy scale (Toland & Usher, 2016) will be used. This scale is designed for and has been used with similar aged samples of pupils. Mathematics self-efficacy is measured using a 24-item scale. Responses are made on a 6-point Likert scale ranging from not at all confident (1) to completely confident (6). Scores range from 24-144.

The mathematics self-efficacy scale was originally part of a larger survey on mathematics motivation. Items were crafted to reflect the middle school mathematics learning standards (e.g., use of ratios and proportions) of the National Council of Teachers of Mathematics (NCTM; 2000) and in accordance with guidelines for constructing self-efficacy items (Bandura, 2006; Bong, 2006). Pupils are asked to rate how confident they are at successfully completing exercises related to 24 mathematics topics without using a calculator, on either a scale with descriptive anchors at 1 (not at all confident) and 6 (completely confident) or a 0-100 confidence scale with descriptive anchors at 0 (not at all confident), 50 (somewhat confident), and 100 (completely confident). Items on both surveys are placed on one page with one sentence as the stem (i.e., "How confident are you that you can successfully solve mathematics exercises involving ...") and 24 statements completing the stem (e.g., order of operations; copies of the instruments along with each item are provided in Appendices A and B). We have opted to use general mathematics topics rather than providing specific mathematics problems as this corresponds to the outcome of interest in the study (i.e., course grade in mathematics). The instrument can be found in Appendix D.

The mathematics self-efficacy scale will be administered to all participating pupils in the ITT sample (one Y8 class per school) at endline only (summer 2026).

Secondary outcome measure data collection

The teacher level secondary outcome (ToMI) will be administered online via the survey tool Qualtrics, with the link sent to all participating teachers directly via email. SHU will then be responsible for scoring this data.

The pupil level secondary outcomes (CAS and mathematics self-efficacy) will be administered online via Qualtrics to all participating pupils via schools. Schools will be asked to administer these measures in class and given clear guidance to support pupils with any understanding of the language, but not to influence their answers in any way. These measures will be scored by SHU. Any language translations or different formats required will be available on request.

All secondary measures are available publicly and are included in the appendices to the protocol.

Sample size

Table 2: Sample size calculations

		Overall	FSM
Minimum Detectable Effect Size (MDES)		0.12-0.13 sds	0.17-0.18 sds
Pre-test/ post-test correlations	level 1 (pupil)	0.67	0.57
	level 2 (school)	0.71	0.61
Intracluster correlations (ICCs)	level 2 (school)	0.10	0.06
Alpha		0.05	0.05
Power		0.80	0.80
One-sided or two-sided?		Two-sided	Two-sided
Average cluster size (schools per cohort)		10-12	10-12
Total number of cohorts		15	15
Number of schools within each cohort	Intervention	10-12	10-12
	Control	10-12	10-12
	Total	150-180	150-180
Number of pupils per school (total)*	Intervention	18 (2700-3240)	5 (750-900)
	Control	18 (2700-3240)	5 (750-900)
	Total	18 (5400-6480)	5 (1500-1800)

*Please note that whilst we have assumed a maximum of 25 pupils per class in the evaluation summary, for the power calculations we have assumed a more conservative estimate of 18 pupils per class to account for potentially smaller class sizes and attrition.

Schools will be recruited within each “cohort” (please see glossary for definition). We will aim to recruit between 10 and 12 schools within each cohort with a total of approximately 15 cohorts. A minimum of 10 schools per cohort allows at least five teacher participants in the intervention group which reflects the size of participant groups under normal delivery conditions. To aid recruitment, a degree of flexibility is given to allow cohorts to recruit up to 12 schools, this range is presented in Table 2 above. Thus, the total number of schools recruited will be between 150 and 180. It may be that one of the Cohort Leads work across two cohorts (it was confirmed with the delivery partner that this may be the case for only one of the Cohort Leads), in which case these two cohorts may be combined into one cohort for the purposes of trial design to give a total of 14 cohorts. A small reduction in the number of cohorts has minimal effect on the MDES, providing the target number of schools is recruited.

The primary outcome will be GL PTM12, taken at the end of Y8, with KS2 Maths attainment as the baseline. An Intention to Treat (ITT) approach (Moher et al., 2010[9]) will be adopted.

[9] See https://www.bmj.com/content/bmj/340/bmj.c869.full.pdf

This means that pupils in the Y8 maths class taught by the nominated teacher at the point of randomisation will be in the analysis sample regardless of their teachers' engagement with the SKTM programme or whether the pupil or teacher does not remain in the class through the 2025/26 academic year.

Considering the EEF funded meta-analysis of professional development (Sims et al., 2021), PD programmes with all fourteen mechanisms would have a predicted MDES of 0.17[10]. An initial review of the SKTM approach suggests that if participants experience effective school support, twelve or more mechanisms may occur and nine or ten where there is less support in school (these numbers are tentative). Also given effect sizes for other recent EEF efficacy trials, we aim to keep the MDES lower than 0.17.

The statistical sensitivity of multisite CRT design can be estimated using the Minimum Detectable Effect Size (MDES); the smallest effect size that could be detected as statistically significant is set as p<0.05 with a statistical power of 80% or higher. The multisite design is essentially a 2-level CRT with school level randomisation in each of the 15 cohorts. This is an efficacy trial and so is not powered to detect variation in impact across cohort areas. The MDES estimates were undertaken using the following formula taken from the powerup! software (Dong et al., 2013).

$$MDES_{3LMSCRT} \sim M_{L(J-2)-G} \sqrt{\frac{1}{P(1-P)}} \sqrt{\frac{ICC_2(1-R_2^2)}{LJ} + \frac{(1-ICC_2)(1-R_1^2)}{LJn}}$$

- n=number of pupils per school. J=mean number of schools per cohort/hub. L=number of cohorts/hubs. G=number of level 2 (school) covariates used.
- P = the proportion of level 2 clusters randomised to the intervention - 0.50 with a balanced design.
- $M_{L(J-2)-G}$ is the group effect multiplier value of t-distribution for 2-tailed test with alpha=0.05, two-tailed & beta = 0.80 with L(J-2)-G degrees of freedom.
- ICC_2 is the school level ICC (proportion of variance between-schools).
- R_2^2 = proportion of between-school variance that is accounted for by covariate(s); between-school explanatory power.
- R_1^2 = proportion of within-school, between-pupil variance that is accounted for by covariate(s); residual or within-school, between-pupil explanatory power.

Sample size assumptions:

- Total number of cohorts = 15
- Mean number of schools per cohort allowed to vary between 10 and 12 (resulting in a total sample of between 150 and 180 schools across the 15 cohorts)

[10] Note this is based on correlation so the value given is only indicative and SKTM may have other mechanisms (such as SK focus) not included in the EEF model. The EEF mechanisms are: A. Build knowledge (managing cognitive load, revisiting prior learning B. Motivate staff (setting and agreeing on goals, presenting information from a credible source, providing affirmation and reinforcement after progress) C. Develop teaching techniques (instruction, social support, modelling, monitoring and feedback, rehearsal) D. Embed practice (providing prompts and cues, prompting action planning, encouraging monitoring, prompting context specific repetition).

- Number of pupils per school/classroom, a minimum of 18 (five of whom classed as FSM)
- School level ICC = 0.10 for whole sample and 0.06 for the FSM subsample (Singh et al., 2023)
- Explanatory power:
    - Whole Sample: Between-School R^2=0.50 (R=0.71); Within-School, Between-Pupil R^2=0.45 (R=0.67) (Singh et al., 2023).
    - FSM Subsample: Between-School R^2=0.32 (R=0.57); Within-School, Between-Pupil R^2=0.37 (R=0.61) (Singh et al., 2023).
- Up to 15 school level covariates (14 cohort dummies and school level KS2 attainment).
- In each of the 15 cohorts, half of the schools with be randomised to the SKTM programme and the other half to the control group (P=0.50).

With 180 schools (a mean of 12 per cohort), the MDES is 0.12 sds whilst 150 schools (10 per cohort) results in an MDES of 0.13 sds. Whilst the trial will be powered to detect an impact for the complete ITT sample (18 pupils per school), indicative MDES estimates for the FSM subsample are also provided. With 180 schools, the indicative MDES for the FSM subsample is 0.17 sds whilst a sample of 150 schools results in an indicative MDES of 0.18 sds.

To consider the potential impact of attrition on statistical sensitivity, illustrative MDES estimates are provided for 10% and 20% attrition at the pupil level. Please note that these are illustrative MDES estimates because they assume that attrition will be random. The illustrative MDES estimates indicate that the design appears to be robust to the impact of attrition up to 20%.

- For the ITT sample,
    - 10% attrition results in illustrative MDES estimates between 0.12 (with 180 recruited schools) and 0.14 sds (150 recruited schools).
    - 20% attrition results in illustrative MDES estimates between 0.13 (with 180 recruited schools) and 0.15 sds (150 schools).
- For the FSM subsample,
    - 10% attrition results in illustrative MDES estimates between 0.18 and 0.19 sds.
    - 20% attrition results in illustrative MDES estimates between 0.18 and 0.21 sds.

Randomisation

Randomisation will take place at school level. It will be stratified by cohort so that each area has a balance of intervention and control schools. This will prevent a situation where all schools in each cohort are in the intervention or control group, which will assist delivery of the programme. No other stratifiers will be used. It is assumed that the random allocation will produce a good balance between key school characteristics such as %FSM and KS4 mathematics attainment. This will be checked once all schools are recruited, with figures presented in the Statistical Analysis plan. Randomisation will be conducted as soon as recruitment is closed (planned for early October 2025). Schools must fulfil all trial requirements including submission of pupil data and teacher completion of the TOMI survey to be entered into the randomisation. Randomisation will be conducted by a member of the evaluation team using Stata (‘stratarand’ command), with another member of the evaluation team present.

Statistical analysis

Impact evaluation methods and analysis

Primary analysis

As noted above, being an efficacy trial, the design is not powered to detect heterogeneity of effect size across cohorts. The analysis will not attempt to generalise beyond the sample of schools within the trial. To answer RQ1, multi-level linear regression models will be constructed acknowledging that pupils are clustered in schools, and that schools are clustered into cohorts. The endpoint pupil level PTM12 will be the outcome variable with the (school level) trial arm (1=Intervention or 0=Control) as the independent variable and baseline KS2 score as a covariate (at both pupil and school levels) and 14 school-level dummy variables for the 15 cohorts[11]. Adding the cohort dummy variables follows the fixed effects approach recommended in the EEF analysis guidance for efficacy trials with multi-site designs. An intention to treat (ITT) approach will be taken that includes all pupils within schools randomly allocated to the intervention or control group regardless of whether the SKTM programme was implemented. The ITT approach best preserves randomisation (and therefore the strength of internal validity) and will provide the most robust estimate of the causal impact of the SKTM programme.

Sub-group analyses of primary outcome

Exploratory analyses of sub-groups will examine evidence of differential impact relating to pupil eligibility for FSM (using EVERFSM_6_P obtained from the NPD) (RQ2), and “higher attaining disadvantaged pupils” (RQ3). Both groups will be analysed using two approaches. The first is a subgroup analysis including only the relevant cases. The second will include all cases and enter two additional variables to the model (using the approach outlined for the primary analysis); a main effect term for FSM eligibility and an interaction between this and treatment group membership. These analyses will directly examine evidence of differential impact for SKTM.

In terms of disadvantaged higher attainers, we anticipate that the numbers may be very small for the first definition given the likelihood that those with a scaled score at KS2 of 110 and above are likely to be in higher sets. If numbers are very small for this subgroup, we will move to the secondary definition.

Secondary outcome analyses

To answer RQ4 (teacher level), a linear regression model will be employed, using the ToMI total score as the outcome. The explanatory variables will comprise the treatment allocation (1=Intervention or 0=Control), baseline ToMI score and cohort dummy variables as covariates.

The secondary analysis to answer RQ5 and RQ6 (pupil level measures) will each employ a multi-level linear regression model with pupils clustered into schools. For each model, the

[11] In the power analyses, up to 15 school level variables have been assumed; the school-level (mean) KS2 mathematics attainment plus 14 cohort dummy variables.

relevant secondary outcome measure (as listed above) will be the outcome/dependent variable, and the explanatory variables will comprise the trial arm (1= Intervention or 0=Control), KS2 baseline measure at school and pupil level (pupil maths self-efficacy only), and cohort dummy variables.

Estimation of effect sizes

The impact of SKTM will be estimated by converting the model coefficient for the trial arm variable into Hedges' g effect sizes. For the primary outcome analysis and follow-on exploratory analyses, statistical uncertainty will be expressed as standard errors of multilevel model coefficients and use of 95% confidence intervals.

Analysis in the presence of non-compliance

The ITT analysis provides the most robust estimate of the causal impact of the SKTM programme on the primary outcome. It focuses on preserving randomisation, best ensuring that the only difference between the intervention and control groups is group membership (all other differences are random). However, the ITT analysis does not take compliance with the SKTM programme into account. In other words, the ITT analysis captures the causal impact of SKTM for pupils who are randomised to the SKTM programme. To estimate the impact of SKTM for pupils within schools randomised to the intervention group who received the programme as intended, a compliance analysis will be undertaken. A combination of fidelity and dosage of SKTM will be drawn on to construct a binary compliance variable at the school (i.e. class) level. A school will be deemed compliant if both of the following criteria are met:

1) the teacher from the school participates sufficiently to receive a certificate from the Maths Hub leading their cohort (see the intervention description for details of end of programme certificates and Appendix E). Certification is awarded according to three criteria: teacher attendance at core sessions (80% or more), completion of intersessional tasks (50% or more), and engagement with tasks during sessions (compliance presumed, with Cohort Leads identifying any cases of non-engagement). The Maths Hub will only provide certificates to participants if the participants' Cohort Lead implemented the programme using the materials provided by the NCETM. Data on certification will be collected by NCETM.

2) the teacher from the school self-reports that they have used SKTM teaching approaches in at least some Y8 lessons in a mid-year monitoring survey (see IPE research methods) to be completed by the participants after the fourth day or equivalent of training. Data on the use of SKTM teaching approaches will be collected by SHU.

The binary compliance variable will be used to estimate the Compliers Average Causal Effect (CACE) using an instrumental variable and two stage least squares (2SLS) approach. The CACE analyses will provide the best estimate for the impact of SKTM for pupils who have received the programme as intended in terms of fidelity and dosage. However, because CACE does not preserve randomisation, causal conclusions cannot be drawn from these analyses. The ITT and CACE analyses together provide two perspectives; an estimate of the causal impact of being allocated to receive SKTM (ITT) and an estimate of the impact of receiving reach as intended and specified (CACE).

Missing data analysis

The baseline and ITT analysis samples will be compared to help illustrate the impact of missing data for the primary outcome variable. Reasons for any missingness will be summarised and a multi-level logistic regression model (1=in ITT model; 0=not in ITT model) will examine whether missingness is associated with any relevant school or pupil-level covariates.

If one or more explanatory variables are found to account for a statistically significant amount of variation in the missing data outcome, we will undertake a sensitivity analysis to repeat the ITT analysis with these variables included. The potential bias introduced by missing outcome data on the ITT estimate will be illustrated by comparing the estimated ITT effect size with the effect size estimated from the ITT model including the additional variables.

Further detail on missing data analysis will be provided in the Statistical Analysis Plan (SAP).

Additional analysis and robustness checks

Exploratory analysis will be conducted to investigate effect of the highest mathematics qualification of the non-specialist teacher. It is expected that non-specialist teachers do not have a mathematics degree but do have a mathematics GCSE, so this is likely to focus on comparing teachers with and without A-level or equivalent in mathematics. This information will be obtained from the baseline teacher survey collected by SHU. However, there is uncertainty around the number of participating teachers with different mathematics qualifications, and the potential complications of individuals educated outside of England. If a viable subgroup can be identified from the data collected, then the effect of highest mathematics qualification will be examined in a sensitivity analysis where the headline ITT model is repeated for classes with teachers in both the higher and lower qualification groups.

Implementation and process evaluation (IPE) design

Overview

The IPE design explores implementation as described in the logic model, contextual influences, evidence on the intervention and business as usual group, and the cost of the SKTM programme. The IPE complements the impact evaluation by investigating potential causal relationships between activities and outcomes that may be identified in the impact evaluation. Quantitative measures of mathematics teacher identity, pupil experience of cognitive activation and mathematics self-efficacy in the impact evaluation are further investigated through mixed-method evaluation that will collect quantitative and qualitative attitudinal data, teacher participation, and contextual data from school subject leaders. Intention to continue to teach mathematics and deployment to teach mathematics the following year will be collected as perception of impact. The rationale for including this outcome in the IPE rather than in the impact design is because of the possibility for control schools' teachers joining the SKTM programme the following year. This may influence whether those teachers are timetabled to teach mathematics the following year. Participation in the trial as part of the control group may influence this outcome. So, attempting to make causal claims in relation to the impact of the trial on future teaching would be inappropriate.

Cost-effective instrument design will draw on items developed for previous similar evaluations. For example, we previously developed a matrix model for assessing adherence to TfM (Boylan et al., 2018a) and items to assess use of models and representations (Demack et al., 2022). Instruments will be designed in consultation with the NCETM and EEF, with items linked to IPE dimensions and indicators, and research questions, this will support quality assurance. Instruments will be designed to complement and extend scales used as secondary impact measures.

Sampling protocols and approaches will be undertaken with review by NCETM and EEF to support quality assurance and minimise bias. Analysis will be undertaken using common protocols, coding frameworks and templates to ensure consistency by researchers. Analysis meetings will further support quality assurance.

IPE research questions

The IPE research questions are numbered to follow on from the impact research questions.

9. What is the evidence that the SKTM programme achieves its aims[12]and outcomes for non-specialist teachers and pupils as detailed in the programme logic model, including perceptions of impact?

10. To what extent is the SKTM implemented as intended, and specifically what is the fidelity and adherence to the programme by Cohort Leads and non-specialist teachers?

11. What are important moderators and mediators for SKTM implementation and outcomes, and what are their influences on implementation and outcomes?

12. What indications are there about the relationships between different programme outputs and outcomes for Cohort Leads, non-specialist teachers and pupils, including perceived outcomes identified through the IPE and any outcomes measured through the impact evaluation?

13. What differences are there in implementation and perception of outcomes for disadvantaged pupils and for disadvantaged high attaining pupils as defined in the impact evaluation?

14. What resources are required to implement SKTM and what are the programme costs?

15. How far is SKTM different from usual practice in terms of the support for and practices of non-specialist teachers?

16. What formative learning does the SKTM trial offer for future implementation of the SKTM, including its Theory of Change, and for other programmes for non-specialists, similar PD approaches, and programmes supporting TfM in secondary schools?

IPE dimensions

Fidelity is a key implementation dimension. There are components of the SKTM that vary in their degree of prescription. For example, Cohort Leads are expected to deliver content from all 18 sessions, but the specific content delivered is not prescribed in advance. Therefore, both fidelity to implementation design and fidelity to intervention theory will be considered (Boylan, 2025, in press). Fidelity to implementation design considers adherence to the programme protocols, and implementation of the programme as planned. Fidelity to intervention theory considers whether adaptations or choices made in the implementation of the less prescribed components are in keeping with the Theory of Change.

For the SKTM programme this distinction will be applied as follows.

[12] The aims of the programme are stated on page 11 of the protocol.

Fidelity to implementation design components:

- Cohort Leads use materials from all 18 sessions
- teacher attendance at training sessions,
- teachers use some workbook materials from each session,
- teachers undertake a school-based task identified in each training event (events comprising one or more sessions)
- teachers apply learning in Y8 teaching

Fidelity to implementation theory components:

- Cohort Leads selection of materials from training materials
- teacher engagement with workbook and session materials as a whole
- teachers adapting school-based tasks and other tasks to their setting in keeping with TfM and SKTM principles
- teaching becomes more aligned with TfM

Research questions will address a wider range of IPE dimensions beyond fidelity as summarised.in Table 3. These are informed by the EEF's framework of implementation dimensions[13].

Table 3: IPE dimensions, factors and indicators

Dimensions	Factors and indicators
Fidelity, adherence, variance and adaptation	• Cohort Lead delivery fidelity in the use of programme materials and tasks; variance in the use of flexible time for additional support • Cohort variance: cohort size, delivery mode and timing of training events over the year • Teachers: fidelity of attendance, use of workbooks, and use of school-based tasks, use of TfM principles and that adaptation of tasks keeps fidelity to TfM • Variance of additional support and mentoring e.g., school-based support e.g., mentors
Dosage and quality	• The frequency of TfM teaching pupils experience in lessons • Shared classes (between non-specialist and specialist teacher) • Pupil movement during the year • Teacher turnover • Quality of PD, including materials and in-school support for teachers

[13] IPE_Handbook.pdf

Dimensions	Factors and indicators
Reach and responsiveness	• Recruitment, profile of schools and teachers, profile of pupils benefiting, and specifically reach to disadvantaged and high attaining pupils • Teacher response to programme materials and TfM including use of principles beyond Y8 classes • Pupil response to mathematics teaching including response of disadvantaged and high attaining pupils
Perceived impact	• Teacher, subject leader and Cohort Lead views on teacher change including on teacher subject matter knowledge and pedagogical content knowledge, motivation of participants to teach mathematics, self-efficacy, belonging to the mathematics teacher community and other identity changes such as beliefs about mathematics, mathematics teaching and pupil learning • Teacher views on pupil affect, particularly additional to pupil self-efficacy (enjoyment, motivation, aspiration) • Teacher pedagogical practices additional to CAS that are important in the programme - mathematical structure and representation, the linking of lesson content and activities to prior learning, and the use of precise mathematical language • Aggregation of pupil experience of practice (cognitive activation) at teacher level and pupil experience of TfM pedagogy additional to CAS • Teacher allocation to teach mathematics in the following year and intention to teach mathematics in the future
Programme assumptions and mediators	• Indicators of the causal relationships between programme inputs, outputs and outcomes • Perceived factors that have influenced outcomes
Programme differentiation and business as usual	• Existing practice in the ITT sample schools and specifically the use of mastery curriculum schemes (Maths Mastery, Power Maths etc.) • Other relevant PD engaged in by control teachers/schools during the trial • Engagement with TfM and TfM related practices in control schools (e.g., engagement with maths hubs during the trial) • Comparison of IPE teacher pedagogy survey items (SKTM and control), comparison of CAS data (SKTM and control)
Costs	• Financial costs of the programme for delivery and additional costs for schools, calculated both for the trial version of the programme and for the usual implementation, if different. • Perceptions of cost/benefits balance

Dimensions	Factors and indicators
Context and moderators	• Variability across cohorts and Maths Hubs • Characteristics of non-specialists (e.g., Qualified Teacher Status/ non-Qualified Teacher Status, highest mathematics qualification, mathematics related qualifications), the amount of time teaching mathematics • Deployment of non-specialists (proportion of maths teaching versus own specialism, shared classes with a specialist teacher, year groups taught, the reasons for deployment) • Classes (numbers, and attainment range) and year groups taught by non-specialist teachers • Departmental support for and experience/acceptance of TfM practices (via NCETM or otherwise) and department/trust maths policies • Prevalence/frequency of non-specialist in the department and so experience of supporting non-specialists • Department as a maths teacher community • Previous/other engagement with NCETM by the Department
Programme improvement, replication and development	• Formative learning to improve the programme • Identification of determinants and core components • Potential for replication • Lessons from adaptation to context • Indications of changes or resources needed to programme development

Research methods

Overview of data collection

The IPE will use documentary analysis, observations, surveys, interviews, and data collected through impact evaluation instruments but analysed independently. The surveys will be hosted on the Qualtrics website with links sent by email to teachers and subject leaders using contact information provided on recruitment. Most interviews will be conducted online except for interviews undertaken during case study visits.

The description of methods and data collection is organised into six categories of the main sources providing data in each case. These are:

- The NCETM and whole programme data collection
- Cohort Leads and SKTM training implementation
- Teachers
- Subject leaders

- Pupils
- School case studies

Across these categories detail is provided of differences in data collection between intervention and control samples is also included.

NCETM and whole programme data collection

1. Review of NCETM evaluation and monitoring data from previous cohorts

The NCETM have supplied aggregated and anonymised data on previous cohorts, including participant numbers by cohort, cohorts, maths teaching as percentage of the participants' timetable, and year groups taught by the participant. This provides comparative data between the trial implementation of the SKTM programme and previous implementation.

2. Monitoring information for the trial cohort

The NCETM will collect and provide data on participants' attendance at SKTM events collated as days equivalent. For any teachers or schools that stop participating, the NCETM through Cohort Leads will attempt to collect data on the reasons for stopping participation.

3. Review of course materials

Course materials will be reviewed to understand the programme and the Cohort Lead training and support nationally, and to support instrument design and analysis. The focus for review will be the 18 session workbooks. For the corpus of workbooks, tasks will be classified in relation to categories informed by the programme's conceptual framework of types of knowledge (Ball et al., 2008). For school-based tasks, the type of learning stimuli will also be analysed. The way other course materials support use of the session workbooks will also be analysed.

4. Meetings and written communication with NCETM leads

Three meetings will take place to collect data on programme implementation, the programme Theory of Change and issues relevant to implementation dimensions. Meetings will take place in summer 2025, spring 2026, and summer 2026, and there is likely to be additional communication before and afterward to discuss the issues raised in the meeting. These interviews will be additional to other project meetings focused on evaluation administration.

Cohort Leads and SKTM training events

1. Observation of network meetings with Cohort Leads

NCETM provide a variety of opportunities for Cohort Leads to network with other SKTM Cohort Leads, as well as other Maths Hub professional development leaders, and for support and professional development in programme delivery. Meetings and events take place face to face and online. Up to two days equivalent of meetings and events will be observed, with the sample of events informed by the composition of the Cohort Leads undertaking trial implementation. Observations will take place during the trial implementation period (September 2025 to July 2026).

2. Cohort lead profiles

NCETM will collect from Maths Hubs a profile of Cohort Leads' prior experience of leading professional development and specifically leading SKTM and share this with SHU. This will inform sampling for teacher and subject leader interviews, and case studies.

3. Cohort Lead survey

The initial Cohort Lead profile will be supplemented and triangulated with data collected through a survey of Cohort Leads. Likely content areas are maths teaching experience, subject leadership experience, TfM experience, PD leadership experience, and SKTM PD leadership experience. The survey will take place in summer 2025, to inform case study sampling.

4. Cohort Lead interviews

A sample of 10 Cohort Leads will be interviewed in February 2026 to collect data on their characteristics and experience, implementation of the programme, including adaptations and tailoring, the Cohort Leads' views of key moderators and mediators on participation and outcomes, and perceptions of impact. Interviews will be 30–45 minutes long.

The sample will consist of the four Cohort Leads from which case study schools will be sampled. As these will be experienced Cohort Leads (see case study sampling below), the other six Cohort Leads will be sampled to ensure variation in Cohort Leads' experience, cohort size and delivery modes are represented in the sample.

5. Observation of SKTM training days and events

SKTM training events will be observed to collect data on implementation fidelity, adaptation and variation. As SKTM training can consist of full days as well as shorter events, the exact number of observations will be decided to ensure all types of delivery modes are observed. The timing of observations will reflect the implementation delivery patterns. A total of four days equivalent of SKTM training will be observed, or the equivalent of days 2 to 5 of the training. Day 1 will not be observed due to avoiding disrupting the introduction to the programme. It is anticipated that some training for each of the cohorts that the four case study teachers are part of will be observed.

6. Cohort Lead workshop input to case study design and conduct

Prior to the first and third visits of the four case studies (see below), Cohort Leads for the four case study teacher participants will contribute to the design of the case study visits. The Cohort Leads will participate in design to support sampling of case studies, and the design of case study instruments including observation tools. This will be done through a workshop for the four Cohort Leads for the cohorts that the case study teachers participate in. The workshop would last 45-60 minutes.

Teachers

1. Pre-randomisation survey

All non-specialist teachers nominated by schools on recruitment to the trial will be surveyed prior to randomisation to collect baseline IPE data. Data collection will include the following areas, if not collected during recruitment: teaching qualifications and 'home' subject teaching experience, mathematics teaching experience, attitudes to teaching mathematics, and to teaching their home subject, and future intentions to teach mathematics. The ToMI scale in the impact evaluation that has a sub-scale of self-efficacy to teach mathematics will be used to collect additional data in this area. A small number of items will be included focused on self-efficacy to teach specific mathematical content or to use mathematical pedagogical practices or both. The content of these items will be informed by analysis of course materials and input from the NCETM.

The TOMI scale from the impact evaluation will be administered at the same time.

The intended sample is all recruited teachers (target of 180 teachers).

2. Monitoring survey

All SKTM participant teachers (target of 90) will be asked to complete a short monitoring mid-year survey to collect interim data on adherence and fidelity in the use of SKTM programme materials, school-based tasks and use of TfM principles when teaching Y8 classes. This survey would be timed so that participants will have completed four days equivalent of training – subject to the specific cohort timetables. In addition, mid-year monitoring will assess mid-year teacher attrition for the SKTM participant teachers by triangulating NCETM provided attendance data. Non-respondents will be contacted initially by Cohort Leads to ask if they have stopped attending. The SHU team will then contact confirmed non-attendees to ascertain if the school has withdrawn from the trial. Monitoring survey links will be provided via Cohort Leads with follow up emails directly to teachers.

3. SKTM participant teacher end of trial survey

All SKTM participant teachers (target of 90) will be asked to complete an end of trial survey. The end of trial survey will have some duplication from the pre-randomisation survey, for example, attitudes to teaching mathematics. Additional items will be included on the use of Teaching for Mastery and cognitive acceleration related practices, and pedagogical content knowledge. Data on response to the SKTM programme will also be collected.

If possible, the end of trial survey will take place after the last training experiences, and near to the time of the Progress in Mathematics Test testing. Potentially, this survey will be administered with the ToMI scale. A decision will be made considering whether administering the ToMI survey separately would reduce non-responses to ToMI

4. Control teacher end of trial survey

All teachers in the control sample (target of 90) will be asked to complete an end of trial survey. The end of trial survey will have the same duplicated items as the pre-randomisation trial and questions to assess the business-as-usual condition.

Potentially, this survey will be administered with the ToMI scale. A decision will be made considering whether administering the ToMI survey separately would reduce non-responses to ToMI.

5. SKTM Teacher interviews

A sample of 10 teachers participating in the SKTM programme will be interviewed in Summer 2026, with one teacher sampled from 10 cohorts. The interviews will triangulate and add depth to data collected from the teacher surveys. The interviews will be 30-45 minutes long.

The sample will be stratified by teacher prior maths teaching and department moderators (e.g., prior TfM engagement, school mentoring/support), and variation in delivery mode (e.g., face to face or online). Four of these will be teachers participating in case studies.

6. Class aggregation of the Cognitive Activation Scale

The Cognitive Activation Scale is a secondary instrument in the impact evaluation. Individual pupil data will be aggregated to produce statistics on the mean and standard deviation of each item for each class. These statistics will be analysed in relation to relevant implementation dimensions, principally teacher reported fidelity and teacher and school moderators. Class aggregation of CAS will be undertaken independently of impact evaluation analysis

7. Teacher of Mathematics Identity (ToMI) subscales

As noted above, the ToMI secondary measure has sub-scales of belonging to a mathematics community, their self-efficacy as a teacher of mathematics and their enthusiasm to be a teacher of mathematics. Sub-scale data collected in the impact evaluation will be analysed in relation to relevant implementation dimensions, principally teacher reported fidelity, and teacher and school moderators.

Subject leaders

Subject leaders will also be nominated during the recruitment process. The subject leader might be:

- the head of department
- the maths KS3 lead
- another maths teacher nominated to mentor the non-specialist.

1. Subject leader pre-randomisation survey

All subject leaders (target 180) will be surveyed before randomisation. This survey will collect data on potential moderators, such as: departmental relationship to TfM (current practices and previous PD), Y8 curriculum and setting, the level of prescription of curriculum and pedagogy, departmental culture, the usual deployment of non-specialist teachers, and reasons for the participant NST being allocated to teach maths.

2. SKTM subject leader end of trial survey

Subject leaders of schools with teachers participating in the SKTM programme will be surveyed at the end of the trial (target 90). A selection of questions will be repeated from the pre-randomisation survey, with additional items (e.g., whether the NST will be teaching maths the following year, the subject leader views and response to the SKTM programme, and additional costs incurred by the school for teacher participation).

3. Control subject leader end of trial survey

Subject leaders in schools in the control condition will be surveyed at the end of the trial (target 90). Some questions will be the same as questions in the SKTM subject leader end of trial survey to support comparison. Additionally, data will be collected on the business-as-usual condition (e.g., whether alternative PD has been accessed).

4. SKTM subject leader interviews

To triangulate and add depth to the survey data, a sample of 10 subject leaders will be interviewed in summer 2026. Four of the subject leaders sampled will be in schools of teachers participating in the case studies. The other six will be sampled so that different school contexts are represented in the sample. The interviews will be 30-45 minutes long

5. Control subject leader interviews

To triangulate and add depth to survey data, a sample of six control school subject leaders will be interviewed in summer 2026 with a focus on the business-as-usual condition. The interviews will be 15-25 minutes long.

Pupils

1. Pupil survey

As part of the impact evaluation, pupils will take the Progress Test in Mathematics 12 test and will complete the CAS pupil experience and mathematics self-efficacy scale. Additionally, as part of the IPE, data will be collected directly from the pupils to explore other affect towards maths, motivation, and experiences of maths teaching other than those experiences observed through the CAS scale. Items will include use of representations in maths teaching and potentially other classroom practices dependent on formative IPE findings. In total five to eight Likert items will be used in addition to the impact measures.

School case studies

The purpose of the case studies is to examine in detail the relationship between outputs and outcomes under favourable conditions and so understand better the moderators and mediators of the programme. The case studies will support testing the programme theory. Therefore, the case studies will be purposefully samples to examine cases where notable change is most likely to be observed due to anticipated high fidelity to the Theory of Change.

Informed by Theory of Change assumptions, sampling will consider the following issues:

- experienced SKTM Cohort Leads may be more likely to implement the professional development as intended.

- teachers who have not taught maths before or only minimally before will have more potential for greater SKTM professional development than others and may have more motivation to engage more fully with the SKTM programme leading to higher fidelity.
- teachers who are teaching mathematics with greater willingness or through choice will engage more fully with the SKTM programme, leading to relatively higher fidelity.
- teachers teaching more mathematics as a percentage of their timetable are likely to be more motivated to engage and have more opportunities for professional experimentation and practice which may lead to more professional learning.
- departments will provide a more conducive context for professional learning if they 1) provide additional support to participants (e.g., have identified a subject mentor) 2) have previously engaged with TfM (e.g., support the use of the SKTM school-based tasks 3) allow flexibility about teaching materials and approaches
- departments are likely to provide more support if they have identified a school mentor and have supported non-specialist teachers previously.

Using these criteria, following recruitment and review of Cohort Lead profile, we will sample four cohorts. Following a review of the teacher and Cohort Leads pre-randomisation survey sample one teacher, and so one school, from each cohort will be sampled, with alternates identified in case the first participant sampled or their school declines to take part in the case studies. The sample will be confirmed following the first training event.

Schools participating in the case studies will be each paid £100 per visit to compensate schools for supply or teacher cover costs that may be needed for teacher and subject leader participation.

The following methods will be used in the case studies with schools visited three times in the autumn, spring and summer terms:

- documentary review: school schemes of work and samples of resources for Y8 maths teaching will be collected and reviewed in relation to alignment with the SKTM programme.
- teacher and subject leader interviews.
- observation of a Y8 lesson taught by the participating SKTM teacher.
- a post lesson de-brief will take place. The post-lesson debrief may happen at the same time or separately than the teacher interview. In the summer term the non-specialist will be invited to include some aspect of their learning from the SKTM programme in the lesson.

Lessons will be audio recorded. This will be for the purposes of reliably recording the amount of teacher exposition, modelling, questioning/interaction, and pupil practice during the lesson. This will support combining participant observation during the lessons leading to a lesson narrative, with analysis of selected lesson features across the four cases over time.

Additionally, during the second or third visit a focus group of pupils in the Y8 class would potentially be conducted to triangulate pupil survey data. Conducting the focus group would be conditional on teacher, school, pupil and parental consent. Focus groups will be conducted with a member of school staff present.

Analysis

Survey data will be analysed descriptively via Excel, SPSS and Stata with data from different instruments matched. Interview data will be analysed through a mixture of deductive codes based on IPE dimensions and indicators, and inductively through identification of themes. The latter will be important to identify emergent outcomes. The interview data will support interpretation of survey data and extend findings for dimensions and issues that the surveys do not address.

Interview data from case studies will be analysed as part of the larger interview data corpus and as part of a case study analysis that will have a longitudinal aspect. A cross-case analysis will be undertaken across the four cases.

IPE analysis will happen separately from impact analysis with the subsequent integration of the IPE and analysis and impact data supporting triangulation and explanation of evidence of impact, and to test and refine the Theory of Change.

IPE methods overview

The IPE methods are summarised in Table 4.

Table 4: IPE methods overview

IPE dimension	RQ addressed	Research methods	Data collection methods	Sample size and sampling criteria	Data analysis methods
Fidelity, adherence, variance and adaptation	RQ9, RQ8	Documentary review Monitoring information Surveys Interviews Case studies	NCETM and whole programme data collection	N/A	Documentary analysis Monitoring information – descriptive statistics
			Observations of Cohort Leads and SKTM training events	All CLA surveyed. 10 CLs interviewed sampled by CL and cohort variables 4 days equivalent of SKTM events sampled by CL and cohort variables	Observations and interviews – thematic analysis informed by the implementation dimensions
			SKTM participant end of trial survey	All SKTM participants	Descriptive statistics
			SKTM teacher interviews	10 teachers sampled by cohort and teacher variables	Thematic analysis
			SKTM subject leaders end of trial survey	All SKTM Cohort Leads	Descriptive statistics
			SKTM subject leader interviews	10 subject leaders sampled by cohort and school characteristics	Thematic analysis
			School case studies observations and interviews	4 case studies purposeful sampling for likely high fidelity and enabling moderators	Case study analysis and cross case analysis

IPE dimension	RQ addressed	Research methods	Data collection methods	Sample size and sampling criteria	Data analysis methods
Dosage and quality	RQ9, RQ8	Documentary review Monitoring information Surveys Interviews Case studies	Observations of Cohort Leads and SKTM training events	All CLA surveyed. 10 CLs interviewed sampled by CL and cohort variables 4 days equivalent of SKTM events sampled by CL and cohort variables	Observations and interviews – thematic analysis informed by the implementation dimensions
			SKTM participant end of trial survey	All SKTM participants	Descriptive statistics
			SKTM teacher interviews	10 teachers sampled by cohort and teacher variables	Thematic analysis
			SKTM subject leaders end of trial survey	All SKTM Cohort Leads	Descriptive statistics
			SKTM subject leader interviews	10 subject leaders sampled by cohort and school characteristics	Thematic analysis
			School case studies observation and interviews	4 case studies purposeful sampling for likely high fidelity and enabling moderators	Case study analysis and cross case analysis
Reach and responsiveness	RQ9, RQ8	Monitoring information Surveys Interviews Case studies	NCETM and whole programme data collection	N/A	Documentary analysis Monitoring information – descriptive statistics
			SKTM participant end of trial survey	All SKTM participants	Descriptive statistics
			SKTM teacher interviews	10 teachers sampled by cohort and teacher variables	Thematic analysis
			SKTM subject leaders end of trial survey	All SKTM Cohort Leads	Descriptive statistics

IPE dimension	RQ addressed	Research methods	Data collection methods	Sample size and sampling criteria	Data analysis methods
			SKTM subject leader interviews	10 subject leaders sampled by cohort and school characteristics	Thematic analysis
			School case studies interviews	4 case studies purposeful sampling for likely high fidelity and enabling moderators	Case study analysis and cross case analysis
Perceived impact	RQ8, RQ11	Cohort Leads and SKTM training events Teacher pre-randomisation survey SKTM participant end of trial survey Control teacher end of trial survey SKTM teacher interviews Subject leader pre-randomisation survey SKTM subject leaders end of trial survey Pupil survey Case studies	Observations of Cohort Leads and SKTM training events	All CLA surveyed. 10 CLs interviewed sampled by CL and cohort variables 4 days equivalent of SKTM events sampled by CL and cohort variables	Observations and interviews – thematic analysis informed by the implementation dimensions
			SKTM participant end of trial survey	All SKTM participants	Descriptive statistics
			Teacher interviews	10 teachers sampled by cohort and teacher variables	Thematic analysis
			SKTM subject leaders end of trial survey	All SKTM Cohort Leads	Descriptive statistics
			SKTM subject leader interviews	10 subject leaders sampled by cohort and school characteristics	Thematic analysis
			Pupil survey	All pupils	Descriptive statistics

IPE dimension	RQ addressed	Research methods	Data collection methods	Sample size and sampling criteria	Data analysis methods
			School case studies, observation and interviews	4 case studies purposeful sampling for likely high fidelity and enabling moderators	Case study analysis and cross case analysis
Programme assumptions and mediators	RQ8.RQ10, RQ11	NCETM and whole programme data collection Cohort Leads and SKTM training events SKTM participant end of trial survey SKTM teacher interviews Subject leader pre-randomisation survey SKTM subject leaders end of trial survey SKTM subject leader interviews School case studies ToMI sub-scale data Pupil experience of CAS aggregated for each Y8 class	Observations of Cohort Leads and SKTM training events	All CLA surveyed. 10 CLs interviewed sampled by CL and cohort variables 4 days equivalent of SKTM events sampled by CL and cohort variables	Observations and interviews – thematic analysis informed by the implementation dimensions
			SKTM participant end of trial survey	All SKTM participants	Descriptive statistics
			SKTM teacher interviews	10 teachers sampled by cohort and teacher variables	Thematic analysis
			SKTM subject leaders end of trial survey	All SKTM Cohort Leads	Descriptive statistics
			SKTM subject leader interviews	10 subject leaders sampled by cohort and school characteristics	Thematic analysis

IPE dimension	RQ addressed	Research methods	Data collection methods	Sample size and sampling criteria	Data analysis methods
			School case studies, observation and interviews	4 case studies purposeful sampling for likely high fidelity and enabling moderators	Case study analysis and cross case analysis
			ToMI -sub-scale data collected in the IE	SKTM and control teachers	Descriptive statistics including association with fidelity and moderator data
			Pupil CAS data aggregated for each Y8 class	All pupils	Descriptive statistics including association with fidelity and moderator data
Programme differentiation and business as usual	RQ13	Control teacher end of trial survey Control subject leaders end of trial survey	Control teacher end of trial survey	All control teachers	Descriptive statistics
			Control subject leaders end of trial survey	All subject leaders	Descriptive statistics
			Control subject leader interviews	Four control subject leaders sampled by school characteristics	Thematic analysis

IPE dimension	RQ addressed	Research methods	Data collection methods	Sample size and sampling criteria	Data analysis methods
Costs	RQ12	SKTM and control subject leaders end of trial surveys	SKTM and control subject leaders end of trial surveys	All subject leaders	Descriptive statistics
		SKTM and control subject leader interviews	SKTM and control subject leader interviews	Ten SKTM subject leaders sampled by school characteristics Four control subject leaders sampled by school characteristics	Thematic analysis
Context and moderators	RQ10. RQ11	Cohort Leads and SKTM training events Teacher pre-randomisation survey SKTM participant end of trial survey Control teacher end of trial survey SKTM teacher interviews Subject leader pre-randomisation survey SKTM subject leaders end of trial survey SKTM subject leader interviews School case studies	Cohort Leads (CLs) and SKTM training events	All CLA surveyed. 10 CLs interviewed sampled by CL and cohort variables 4 days equivalent of SKTM events sampled by CL and cohort variables	Observations and interviews – thematic analysis informed by the implementation dimensions
			Teacher pre-randomisation survey	All teachers	Descriptive statistics
			SKTM participant end of trial survey	All SKTM participants	Descriptive statistics
			Teacher interviews	10 teachers sampled by cohort and teacher variables	Thematic analysis

IPE dimension	RQ addressed	Research methods	Data collection methods	Sample size and sampling criteria	Data analysis methods
			SKTM subject leaders end of trial survey	All SKTM Cohort Leads	Descriptive statistics
			SKTM subject leader interviews	10 subject leaders sampled by cohort and school characteristics	Thematic analysis
			School case studies observations and interviews	4 case studies purposeful sampling for likely high fidelity and enabling moderators	Case study analysis and cross case analysis
Programme improvement, replication and development	RQ14	All methods	All methods	N/A	Data synthesis

Cost evaluation design

The cost evaluation will follow the latest EEF guidance including the EEF's key principles[14]. Costs will be:

1. estimated from the perspective of the school as the crucial decision-maker
2. estimated for the programme as it was implemented in the study
3. based on the resources needed to implement a programme in comparison to the counterfactual
4. estimated based on the full additional obligations incurred
5. estimated using market practices, whenever possible
6. measured in common units adjusted by the year when they are incurred
7. divided into pre-requisites, start-up costs and recurring costs
8. estimated per pupil, for a programme as if implemented over three years.
9. Lastly, variability of costs estimates will be explored through sensitivity analyses if appropriate.

Teacher time devoted to training, preparation, delivery of the intervention and teaching cover will be presented in units of time. Additional resources above those necessary in the counterfactual case will be presented in monetary units.

Cost evaluation will draw on data provided by the developer on the market price of the intervention. Expectations on the time needed for staff cover during training events and the cost of the required materials can be supplied by the developer and confirmed in the post-intervention subject leader survey and triangulated through interviews.

The SKTM programme identifies potential optional additional support for participants, and if such activities occur, any additional costs will be identified. The occurrence of the SKTM in the trial will differ from the usual practice, for example, due to randomisation in hubs, the SKTM work groups may be smaller than usual. Therefore, it will be appropriate to also calculate costs for usual implementation.

All calculations will clearly distinguish between prerequisites, startup costs and recurring costs, and present costs per pupil per year over a three-year period.

Ethics and registration

Ethical approval has been granted by SHU for the SKTM evaluation with registration number ER75429905. SHU has established research ethics procedures in place to ensure research

[14] https://d2tic4wvo1iusb.cloudfront.net/production/documents/evaluation/evaluation-design/Cost-Evaluation-Guidance-Feb_2023.pdf?v=1742154142

is undertaken in accordance with commonly agreed standards of good practice and academic integrity. It aims to promote good practice throughout the assessment of ethical issues and compliance with legal requirements. This can be found at: https://www.shu.ac.uk/research/quality/ethics-and-integrity.

These processes align with BERA and BSA guidelines and operate through the University Research Ethics Committee and Faculty Research Ethics Committees. The project team will always follow these procedures, including operating to standardised protocols concerning anonymity, confidentiality, informed consent, rights to withdraw, and secure (electronic and physical) data storage. The research team is experienced and committed to working in an ethically appropriate and sensitive way and are familiar with the ethical issues arising when working with diverse groups of participants.

Copies of our ethics policy, principles and procedures are available http://www.shu.ac.uk/research/ethics-integrity-and-practice. SHU ensures that professional standards and the well-being of research participants are protected and always maintained.

Agreement to participate in the trial will be sought from schools who will receive a detailed MoU along with a privacy notice to outline how data will be used and stored. Once a school has signed the MoU, an opt-out letter of consent along with information sheet and privacy notice will be sent to the parents/carers of all potential pupil participants. Parents/carers will be given a two-week window to opt their child out of the evaluation.

For qualitative work, all participants will be given information sheets, consent forms and privacy notices prior to participation fieldwork.

The trial will be registered with the ISRCTN (International Standard Randomised Controlled Trial Number) Registry and the trial number will be reported in this document when it is updated.

Data protection

As part of the ethical review, SHU has undertaken a full data protection impact assessment (DPIA) for the evaluation. This includes details of how data will be collected, where and how long it will be stored, and a full risk assessment. A project specific privacy notice has been put together for the evaluation and can be found here: SHU privacy notice.

The processing of personal data through the SKTM evaluation is defined under GDPR as a specific task in the public interest. As data is being processed for the purpose of academic research by SHU, the main aim of which is to improve pupil mathematics attainment, the SHU's legal basis for processing personal data is as a 'Public Task' (Article 6 (1) (e)). https://ico.org.uk/for-organisations/guide-to-the-general-data-protection-regulation-gdpr/lawful-basis-for-processing/public-task/

Free School Meals (FSM) status and KS2 attainment data will be accessed from the NPD by SHU and processed for the purpose of scientific research. Unique Pupil Numbers (UPN) provided by the school to SHU will be used to access this data, which is not classified as Special Category Data under GDPR article 9 but will be treated as such as per DfE guidance:

(https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/747620/Data_Protection_Toolkit_for_Schools_OpenBeta.pdf :p22)

Specifically, we are processing this data to determine if the SKTM programme has different effects on different subgroups of pupils. EEF was established with a remit to break the link between family background and educational attainment, and all EEF projects conduct subgroup analysis on FSM pupils.

The parents/carers of the data subjects involved (young people aged 12-13) will receive full information sheets along with a privacy notice specifying how their data is being used and explaining their right to withdraw at the start of the study. Parents/carers will be sent opt-out consent forms prior to the evaluation as described above.

Participating schools will be sent a MoU upon recruitment to evaluation, along with a privacy notice detailing how data will be used.

In the production of professional or academic publications or presentations, all data will be fully anonymised, and no individual or school will be identified or identifiable. Should we wish to present or publish any information where a school may be identifiable, for example an exemplar case study of how a school has improved because of participation in the SKTM evaluation, we will seek the school's consent for this, through the headteacher. Schools will be entirely free to refuse this, and we will therefore ensure the school remained anonymous in this event.

SHU and NCETM will be joint controllers since both parties will be handling participant's personal data. A data sharing agreement between these two parties will be set up which specifies all fields to be shared, how they will be shared and how long they will be retained .

PTM12 test papers are marked by GL assessment and an electronic file of results is shared with SHU via a secure transfer system managed by GL assessment. Data is pseudonymised so that test scores are attached to a unique identifier only known by SHU and GL assessment.

After the evaluation with EEF is complete, SHU will retain participants' data for research and knowledge-exchange purposes, including presentations at professional or academic conferences, or publications in professional or academic journals, for five years after the publication of the final project report. This will not include any personal identifiers.

At the end of the project, data will be submitted to the EEF Data Archive. At this point, EEF will be data controllers and contractors appointed to manage the Data Archive will be data processors. The evaluation data will also be linked with information about the pupils from the NPD, Department for Education, the EEF's archive manager and, in an anonymised form, with the Office for National Statistics, the UK Data Archive, and potentially other approved researchers. Data collected as part of EEF-funded evaluations is archived to estimate the long-term impact of the interventions, to better understand variation in children's outcomes across evaluations, and to improve the methodological approaches we use to evaluate this impact. Please see here for more information on this: https://educationendowmentfoundation.org.uk/privacy-notices/privacy-notice-for-the-eef-data-archive

Personnel

The Sheffield Hallam University evaluation team members' details are found in Table 5

Table 5: Sheffield Hallam University evaluation team

Name	Post/Job title	Role/Responsibilities
Anna Stevens	Senior Research Fellow	Co-Principal Investigator & Impact Evaluation Lead. EEF Co-liaison Impact design, data analysis and reporting, oversight of trial management (until April 2025)
Martin Culliney	Senior Research Fellow	Co-Principal Investigator & Impact Evaluation Lead. EEF liaison Impact design, data analysis and reporting, oversight of trial management (from April 2025)
Mark Boylan	Professor of Education	Co-Principal Investigator, IPE Lead. Qualitative instrument design, IPE analysis and reporting
Panagiota Blouchou	Research Fellow	Trial management & quantitative researcher. Quantitative data collection and analysis for impact and IPE
Amy Birkhead	Senior Lecturer	IPE qualitative researcher. Qualitative data collection and analysis
Gill Adams	Reader in Education	IPE qualitative researcher. Case study lead and other qualitative data collection and analysis
Hongjuan Zhu	Research Fellow	Mixed methods researcher. Support for survey data collection, trial management and qualitative data collection
Claire Wolstenholme	Research Fellow	Trial management, qualitative researcher
Sean Demack	Principal Research Fellow	Statistical advisor. Provides statistical expertise and quality assurance for impact evaluation

Table 6: NCETM delivery team

Name	Representing	Role/Responsibilities
Paul Rowlandson	NCETM	Assistant Director for School and Professional Development Project lead for SKTM Non-specialist Teachers Programme
Nicola Trubridge	NCETM	Director for School and Professional Development Project Coordination Team for SKTM Non-specialist Teachers Programme
Vivien Townsend	NCETM	Assistant Director for Evaluation and Impact Project Coordination Team for SKTM Non-specialist Teachers Programme
Nicola Fareham	Maths Hubs	Maths Lead linked to this programme Planning and Coordination Team for SKTM Non-specialist Teachers Programme
Jen Shearman	NCETM	Director for Evaluation and Impact
Victoria Povey	NCETM	Project Manager Operations Team

Risks

Table 7: Risks

Potential Risk	Initial risk status			Preventative measures	Reducing the impact	Revised risk status
	Likelihood	Impact	Risk			Risk
Project specific						
Difficulties in baseline/outcome test administration	medium	high	**high**	Baseline measure from NPD administrative data. Previous trials have low attrition for pupil assessments.	SHU has wide experience of relationship building with schools and has a dedicated project manager and administrative assistant resulting in high follow up response rates.	**medium**
Low recruitment of schools	medium	high	**high**	Intervention schools and control schools offered incentive payment. NCETM and SHU can build positive relationships with schools to encourage participation, SHU very experienced in relationship building with schools, and having a single point of contact and dedicated project manager.	Power calculations have been performed for a range of 150 – 180 schools. The maximum will be aimed for, however the MDES is only marginally reduced should we recruit 150 schools. Please see power calculations section for table on attrition rates.	**medium**
Low response rate to IPE surveys/teacher outcome for IE	low	medium	**medium**	SHU will have direct email address for participating teachers, for subject leads and for Cohort Leads. The ToMI survey will be upfront for the teacher survey so that SHU can ensure as high response as possible for this measure. The school incentive is conditional upon key evaluation activities including teacher response to TOMI.	Building a relationship with schools and teachers involved. Targeted reminders to non-respondents. Administrative resource built into costings to conduct follow up telephone calls if needed. Missing data analysis will be conducted for the impact evaluation.	**low**
Low response to pupil secondary outcome measures	medium	medium	**medium**	Teachers will be asked to distribute online surveys to pupils in class. Option of pupils completing online at home via a link sent to parents/carers. Schools offered breakdown of results as further incentive.	SHU to work with schools to understand any issues and support completion, drawing on wide experience of successfully administering pupil surveys of this age group through previous EEF and YEF funded trials	**low**
Low recruitment for case studies	medium	high	**medium**	A financial incentive will be offered to case study schools.	SHU have wide experience of building relationships with schools and a long track record of meeting case study requirements for evaluations.	**Low**
Intervention only partially delivered	Low	high	**medium**	NCETM highly experienced in delivery of training of this nature. SKTM is a pre-established programme.	Delivery is monitored through compliance data. Any impacts on fidelity and dosage of intervention will be reported.	**medium**

Potential Risk	Initial risk status			Preventative measures	Reducing the impact	Revised risk status
	Likelihood	**Impact**	**Risk**			**Risk**
Pupil attrition	medium	low	**low**	One year programme, ITT pupil sample identified in September 2025 at the start of the school year	Whole classes/cohorts take part, therefore statistical sensitivity more affected by schools than individuals.	**low**
Control schools try to join NCETM/SKTM offer	low	high	**medium**	Higher financial incentive to continue as control school and waitlist design.	Control schools monitored and issues reported immediately to SHU/EEF.	**low**
Uncertainty in impact evaluation findings due to small effect sizes for PD programmes of this nature/variations in compliance	low	high	**medium**	School sample size designed to sufficiently power the trial. Compliance data being collected and carefully monitored by SHU.	Power analysis completed, trial powered with MDES 0.12 to 0.13, lower than MDES of 0.17 which may be expected for a trial of this type (please see impact evaluation section). CACE analysis to inform whether compliance with the intervention impacts on findings.	**low**
Inappropriate case study schools' selection	low	medium	**medium**	Survey will inform case study sampling and Cohort Leads will input into sampling.	If school appears inappropriate, rapid resampling and recruiting can take place.	**low**
Generic						
Evaluator staff absence	low	high	**medium**	Very low staff turnover. Project teams routinely see projects through to completion.	internal project team members will provide short-term cover, other experienced researchers will be available within SHU to be brought on to team if necessary.	**low**
School closures/lockdowns	low	high	**medium**	Not expected and in previous lockdowns schools have stayed open wherever possible/moved online.	If external visitors are restricted, fieldwork can be conducted remotely.	**low**
Slippage and deadlines not met	medium	medium	**medium**	Regular project monitoring means potential problems are quickly identified.	Regular contact to be maintained between SHU and EEF project managers to quickly report and address emerging problems. Where a deadline is viewed as problematic this would be discussed at the first instance with EEF.	**low**

Timeline

Table 8: Timeline

Dates	Activity	Team responsible/ leading
January-February 25	Ethics application submitted, DPIA and due diligence form finalised, Design MoU.	SHU
January 25	Develop recruitment strategy	NCETM
February 25	Monitoring data collection tool developed, receive ethical approval and finalise data sharing agreement.	SHU
February - September 25	Recruitment: NCETM to approach around 20 hubs to gauge interest in trial, with a view to recruiting around 15 cohorts to commit to the trial. Share MoUs with recruited schools. Schools to sign and return MoUs once recruited.	NCETM
February - May 25	Further review of course documentation, meetings with NCETM programme team.	SHU
May -25	NCETM share brief profiles of likely Cohort Leads.	NCETM
June - Sept 25	Schools to share details of nominated SKTM teacher with NCETM/SHU once available (one teacher per school).	SHU
June-July 25	Protocol published. Design of teacher survey 1 and subject leader survey 1	SHU
September 25	Sampling of 4 Cohort Leads for case studies.	SHU
September 25	Administer teacher survey (including ToMI from impact evaluation), subject leader survey and Cohort Lead survey (pre-randomisation). Collect pupil lists of the nominated Y8 class for 25/26. Opt-out consent form sent to schools to send to parents/carers. Design instruments for observation of CL training events.	SHU
October 25	Randomisation and inform schools of their allocation in early October. SKTM PD to commence towards end of October. Case study lead sampling	SHU / NCETM

Dates	Activity	Team responsible/ leading
October 25	Hubs to deliver SKTM to intervention schools and collect monitoring data (ongoing)	NCETM
October 25	Cohort Lead workshop for case study design Design case study visit (one) instruments.	SHU
October 25	Sample and recruit SKTM participant interview and case study schools.	SHU
October 25	Receipt and review of updates MI data on previous cohorts including 2024/2025	SHU
November – December 25	Case study visits 1	SHU
September - December 25	Observe Cohort Lead training/event 1 29 Sep 2025 post observation meeting/interview with NCETM including review of what is happening. Observe SKTM teacher training events	SHU
January 26	Cohort Lead interviews	SHU
January - April 26	Observe Cohort Lead training/event 2 (15 Jan 2026)	SHU
January - April 26	Observe SKTM training events (3)	SHU
February 26	Draft SAP, NPD application	SHU
February - March 26	Case study visits 2	SHU
April 26	Publish SAP	SHU
May - July 26	Observe CL training/event 3 25 June 2026	SHU
May - June 26	Cohort Lead workshop to support case study 3rd visit design, and STKM teacher and SKTM subject leader interviews	SHU

Dates	Activity	Team responsible/ leading
May 26	Sample and recruit the control subject leader interviewees. Design SKTM surveys (new intervention sample items); control surveys (new control items; case study data collection; pupil survey items additional to the impact secondary measures)	SHU
May - July 26	Observe SKTM training events (3)	SHU
June 26	SKTM teacher and SKTM subject leader interviews 2	SHU
June - July 26	SHU to administer PTM12, CAS and mathematics self-efficacy (including IPE pupil measures) to classes nominated to be originally in the trial. SHU will request an updated class list for the SKTM class prior to administering PTM12 to track pupil movement.	SHU
June - July 26	Control subject leader interviews	SHU
June - July 26	SKTM teacher and control teacher survey (and administration of ToMI in impact evaluation); SKTM subject leader and control subject leader surveys	SHU
July 26	Cohort Lead survey 2	SHU
July 26	SKTM delivery complete	NCETM
July - September 26	Receipt of MI data from NCETM – attendance, engagement, use of tasks	SHU
Sept 26 – July 27	NCETM to deliver SKTM to control schools	NCETM
Sept - December 26	Impact evaluation data analysis, IPE analysis, Report writing	SHU
December 26	First draft of final report submitted to EEF draft (16th December 2026)	SHU
August 27	Final report published	SHU

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Appendix A: SKTM Session Materials

SKTM Session	**Session Title** (the core concept)	**Knowledge, skills and understanding' statements** (these are the statements that the session design was based on - not all covered and not in the same depth)
Session 1	Introduction	
Session 2	1.1 Place value, estimation and rounding	Understand the value of digits in decimals, measure and integers
Session 3	1.2 Properties of number	Understand multiples
Session 4	1.3 Ordering and comparing	Work interchangeably with terminating decimals and their corresponding fractions
Session 5	1.4 Simplifying and manipulating expressions, equations and formulae	Understand and use the conventions and vocabulary of algebra including forming and interpreting algebraic expressions and equations
Session 6	2.1 Arithmetic procedures	Understand and use the structures that underpin addition and subtraction strategies
Session 7	2.2 Solving linear equations	Understand what is meant by finding a solution to a linear equation with one unknown
Session 8	3.1 Understanding multiplicative relationships	Understand the concept of multiplicative relationships
Session 9	3.2 Trigonometry	Understand the trigonometric functions
Session 10	4.1 Sequences	Understand the features of a sequence
Session 11	4.2 Graphical representations	Connect coordinates, equations and graphs
Session 12	5.1 Statistical representations and measures	Understand and calculate accurately measures of central tendency and spread Construct accurately statistical representations
Session 13	5.2 Statistical analysis	Interpret reasonably statistical measures and representations Choose appropriately statistical measures and representations
Session 14	5.3 Probability	Explore, describe and analyse the frequency of outcomes in a range of situations Systematically record outcomes to find theoretical probabilities Calculate and use probabilities of single and combined events

Session 15	6.1 Geometrical properties	Understand and use angle properties Understand and use similarity and congruence Understand and use Pythagoras' theorem
Session 16	6.2 Perimeter, area and volume	Understand the concept of perimeter and use it in a range of problem-solving situations Understand the concept of area and use it in a range of problem-solving situations Understand the concept of volume and use it in a range of problem-solving situations
Session 17	6.3 Transforming shapes	Understand and use translations Understand and use rotations Understand and use reflections Understand and use enlargements
Session 18	6.4 Constructions	Use the properties of a circle in constructions Use the properties of a rhombus in constructions

Appendix B: ToMI Belonging to a Mathematics Community

	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
	1	2	3	4	5	6	7
I feel that I belong to a broader Mathematics community							
I feel like I am part of a broader mathematics community							
I feel valued withing a broader mathematics community							
I feel an outsider to a broader mathematics community							
I feel neglected within a broader mathematics community							
I have the ability to provide alternative explanations or examples when students are confused about mathematics problems							
I know how to link my teaching of mathematics to my students' everyday interests							
I am a highly capable mathematics teacher							
My mathematics teaching produces a positive change in my students' lives							
My students willingly engage with my requests and instructions in the classroom when I teach mathematics							
I dislike being a teacher of mathematics							
I am enthusiastic about being a teacher of mathematics							
I regret having become a teacher of mathematics							
I am proud to be a teacher of mathematics							
I do not identify as a teacher of mathematics							

Appendix C: Cognitive Activation Scale

Cognitive Activation Scale

Pupils report whether the teacher used these strategies: ‘never or rarely’, ‘sometimes’, ‘often’, always or almost always’.

The teacher…	Never/ rarely	Sometimes	Often	Always/ almost always
1.The teacher… ***encourages us to reflect on problems***				
2.The teacher gives problems that require us to think for an extended time				
3.The teacher asks us to use our own procedures for solving complex problems				
4.The teacher presents problems with no immediately obvious method of solution				
5.The teacher presents problems in different contexts				
6.***The teacher helps us to learn from mistakes we have made***				
7.The teacher asks us to explain how we have solved a problem				
8.The teacher asks us to apply what we have learned to new contexts				
9.The teacher gives problems with multiple solutions				

Appendix D: Mathematics Self-Efficacy Scale

Directions: Using the same scale, please rate how much **confidence you have that you can succeed at exercises related to the following maths topics** without using a calculator. Remember that you can circle any number from 1 (*not confident at all*) to 6 (*completely* confident).

How confident are you that you can successfully solve maths exercises involving . . .		Not at all confident			Completely confident		
1	Multiplication and division	1	2	3	4	5	6
2	Decimals	1	2	3	4	5	6
3	Fractions	1	2	3	4	5	6
4	Ratios and proportions	1	2	3	4	5	6
5	Percentages	1	2	3	4	5	6
6	Powers and exponents	1	2	3	4	5	6
7	Factors and multiples	1	2	3	4	5	6
8	Inequalities (>, <, ≤, ≥, ≠)	1	2	3	4	5	6
9	Order of operations	1	2	3	4	5	6
10	Rounding and estimating	1	2	3	4	5	6
11	Word problems	1	2	3	4	5	6
12	Equations with one variable	1	2	3	4	5	6
13	Equations with two or more variables	1	2	3	4	5	6
14	Graphing	1	2	3	4	5	6
15	Tables, charts, diagrams, and coordinate grids	1	2	3	4	5	6
16	Angles, perimeter, area, and volume	1	2	3	4	5	6
17	Multi-step problems	1	2	3	4	5	6
18	Measurement	1	2	3	4	5	6
19	Mean, median, range, and mode	1	2	3	4	5	6
20	Chance and probability	1	2	3	4	5	6
21	Negative numbers	1	2	3	4	5	6
22	Explaining in words how you solved a maths problem	1	2	3	4	5	6
23	Using maths in other subjects	1	2	3	4	5	6
24	Doing quick calculations in your head	1	2	3	4	5	6

Appendix E: NCETM guidance for Maths Hubs and Cohort Leads on certification of participation

SKTM Secondary Non-specialist Teachers Programme (NCP25-30e)

Reporting of Compliance (EEF Trial)

Why do we need to report compliance?

The evaluation of the SKTM Secondary Non-specialist Teachers Programme will take the form of a randomised controlled trial (RCT). This research design involves splitting a sample of participants (in this case schools) into two groups: one that receives an intervention and one that does not. Once the intervention is complete, the two groups are compared according to an outcome measure, to evaluate the impact of the intervention.

However, in practice, interventions during research do not always go entirely to plan. There might be a subset of participants who do not fully comply with the intervention, or an intervention might not be fully implemented as it was intended. In the case of the SKTM Programme, issues of non-compliance can affect the impact that the intervention has on teachers and students, thus affecting the difference between outcome measures in the evaluation. Therefore, the evaluators request that cases of non-compliance are identified so that they can be accounted for within their analyses.

What types of compliance do we have to report?

To enable the evaluation team to carry out their analysis we will report on the compliance of the delivery of the hub activity; the fidelity of programme delivery by Cohort Leads; and engagement of participants, at various points in the year. We will report the data shared with the NCETM within the Reporting and Data Submission (RDS) processes. In summary:

- **Hub Activity:** A hub activity will be reported as compliant if it is marked as planned/green/completed at appropriate points within the RDS process.
- **Cohort Lead:** A Cohort Lead will be reported as compliant if their MHLM Link has approved their HAPPI form at both the planning stage (11/12/2025) and at the evaluation stage (16/07/2026). Please see guidance below regarding criteria for approving HAPPI forms, which is to be shared with MHLM teams.
- **Participant:** A participant will be reported as compliant if they are issued with an SKTM participation certificate at the end of the programme and have been marked as 'completed' on MHPod. Please see guidance below regarding criteria for issuing certificates, which is to be shared with hub operation teams/Cohort Leads.

Reporting of Hub Activity Compliance

A hub activity will be reported as compliant if it is marked as planned/green/completed at appropriate points within the RDS process.

Hub Activity RAG status

RAG status guidance for all Hub Activity at RDS4 (RDS6) and RDS7

- **Planned:** This is the default status. This should be changed as soon as delivery has begun. If delivery has not begun, a Comment (not DfE Commentary) should be added, giving the start date.
- **Green:** All elements of this hub activity are working well, and it is on track for completion.
- **Amber:** There are some issues with part of this hub activity delivery. This may include leadership or participant attendance issues. Actions should be taken and outlined in the DfE Commentary section of MHPod to show how the risk of non-completion has been mitigated.
- **Red:** There are significant threats to this hub activity completing successfully. This could include a previous Amber where actions have been ineffective, or where participant attendance is poor for over 50% of the group. The DfE Commentary should be added to here to show what new action will be taken to mitigate this risk.
- **Completed:** The delivery of this hub activity has concluded. This should be changed as soon as the hub activity is completed.
- **Cancelled:** This hub activity is no longer able to be delivered. A detailed explanation should be added to the DfE Commentary tab, to explain why this is the case and what mitigation the hub took to minimise the risk of this outcome. There are financial implications for marking a hub activity as Cancelled.

Reporting of Cohort Lead Compliance

The impact of the SKTM Programme is likely to be moderated by the degree to which Cohort Leads adapt the materials. Cohort Leads have agency to tailor the programme to meet the needs of their participants. However, care should be given to ensure that adaptations do not cause the programme to deviate from its core aims and principles of teaching for mastery. This document is to support Maths Hub operational teams with processes regarding approving and monitoring HAPPI forms.

Hub Activity Plan Progress and Impact (HAPPI) form

Cohort Leads should complete the planning stage of the HAPPI form. Following this, MHLM Links will approve HAPPI forms, providing the plans show fidelity to the programme aims and design. The plans should indicate use of the NCETM-provided core session materials, show evidence of the Cohort Lead planning intersessional school-based tasks for participants. The deadline for this approval process is 11/12/25.

Similarly at the evaluation stage, the Cohort Lead will complete the HAPPI form evaluating the impact of their delivered programme. As with planning, the MHLM Links will review and approve the evaluation stage by 16/07/26.

MHLM Link guidance

As a MHLM Link, when HAPPI forms have been approved, it signals that a Cohort Lead has been compliant with the programme design and delivery. Please consider the design of the programme alongside the following points:

1. There are 18 Core Sessions that are designed by the NCETM to be delivered over the equivalent of six days, either face-to-face or online (there is a complete suite of Desmos materials for online delivery).
2. Cohort Leads develop a 'schedule' for all of the 18 core sessions - this can be done collaboratively with other Cohort Leads during NCETM-led national workshops and further guidance can be provided to Cohort Leads from the PCT.
3. Cohort Leads are not necessarily required to use all the core material session slides, but would be expected to use at least 50% of them. They may adapt the design and delivery of their programme based on their participants to ensure the key learning happens within the session.
4. Cohort Leads are asked to design and set intersessional school-based tasks for their participants following each of their events, to encourage them to apply aspects of what they have learned during the session in their schools. The programme should include at least five intersessional tasks.

5. In addition to the six days of delivery, Cohort Leads have an additional three days of time to design bespoke support for the Non-specialists. This might involve: one-to-one meetings with participants, collaborative planning, an extra session on KS4 material, arranging to observe a specialist, etc.

Reporting of Participant Compliance

The impact of the SKTM Programme is likely to be moderated by the degree to which individuals engage with the programme. Participation encompasses attendance at core sessions, engagement with tasks during the sessions, and the completion of school-based tasks in between sessions. This document is to support Maths Hub operational teams with ongoing RAG rating and issuing of certificates at the end of the year for participants on SKTM Programmes.

Participant RAG Rating – guidance

Levels of participation are indicated by hubs through the RAG rating at appropriate points (detailed in the RDS briefing) during the academic year. Hub operations teams in conjunction with Cohort Leads are advised to consider the following guidance when doing this:

- **Green:** This is the default status. The participant is participating as well as can be expected: they are participating during sessions, engaging with at least 50% of the intersessional tasks and are on track for at least 80% attendance (equivalent to at least 15 Core Sessions) by the end of the programme.
- **Amber:** The participant has had reduced participation, with drops in attendance or engagement with intersessional tasks and is currently finding it hard to make up for missed activity but remains committed to the programme. A drop in attendance could be considered as below 80%, but there is enough time remaining in the year for their overall attendance to be at least 80% by the end of the programme.
- **Red:** The participant has not been participating, with attendance poor and there is no communication regarding commitment. A reason should be added to Comments. Please ensure new comments are dated and have details of the participant that has a Red status.
- **Withdrawn:** This is the status to use if the participant has withdrawn from the particular 2025/26 programme. A reason should be added to Comments. Please ensure new comments are dated and have details of the participant that has a Withdrawn status.
- **Completed:** Participated during the year and was still committed at the end of the year.

Attendance registers should be retained as they may be requested to check participant compliance with the programme.

SKTM Participation Certificate – guidance

This certificate (link to Knowledge Base) is for hubs to issue to participants who successfully complete an SKTM Programme. The certificate of SKTM participation is only to be given to those individuals who have attended and actively participated in all components of the SKTM Programme. It is not to be used by those currently participating in a programme or intending to participate at some point in the future. The certificate is awarded to an individual rather than a school.

Adapting the certificate:

In order to award the certificate to an individual who has successfully participated in an SKTM for the duration of the programme, first please:

- Replace the 'xxx' with the name of the SKTM Programme
- Insert the full name of the individual
- Insert the name of your Maths Hub
- Insert the full title of the programme, written using title case
- Insert the correct academic year in the format 2025/26

- Save the certificate as a PDF file so it cannot be further amended by the recipient.

If the certificate is to be printed or shared electronically, please use the PDF version to avoid further amendments.

Awarding the certificate:

A certificate of SKTM participation is only to be given to those individuals who have participated sufficiently in the SKTM Programme. Sufficient participation is indicated by a RAG rating of Completed at the end of the year.