Education Endowment Foundation

Thinking Mathematically

Appendices

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Oxford MeasurEd

The Education Endowment Foundation is an independent charity dedicated to breaking the link between family income and education achievement. We support schools, nurseries and colleges to improve teaching and learning for 2 – 19-year-olds through better use of evidence.

We do this by:

- **Summarising evidence.** Reviewing the best available evidence on teaching and learning and presenting in an accessible way.
- **Finding new evidence.** Funding independent evaluations of programmes and approaches that aim to raise the attainment of children and young people from socio-economically disadvantaged backgrounds.
- **Putting evidence to use.** Supporting education practitioners, as well as policymakers and other organisations, to use evidence in ways that improve teaching and learning.

We were set-up in 2011 by the Sutton Trust partnership with Impetus with a founding £125m grant from the Department for Education. In 2022, we were re-endowed with an additional £137m, allowing us to continue our work until at least 2032.

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Appendix 1: Original TiDIER checklist

TIDieR checklist

This section presents a detailed description of the intervention following an adapted Template for Intervention Description and Replication (TiDieR) checklist. The purpose of this detailed and structured description of the intervention is to ensure a shared understanding of what is being evaluated among key stakeholders (e.g., EEF, delivery partner, evaluation team) alongside improving the consistency of intervention descriptions in EEF study plans and reports (Humphrey et al. 2016).

BRIEF NAME

Thinking Mathematically

WHY (Rationale)

While many pupils leave primary school without achieving the expected level in maths, a persistent attainment gap exists between socio-economically disadvantaged pupils and their less disadvantaged peers. For instance, in 2023, 59% of pupils from socio-economically disadvantaged backgrounds reached the expected level at the end of Key Stage 2 compared to 79% of pupils from non-disadvantaged backgrounds (Boylan et al. 2024). In Key Stage 2 and GCSE standardised national assessments, all pupils, but particularly those from socio-economically disadvantaged backgrounds, tend to score less well on problem-solving questions than on fluency questions that assess the ability to perform mathematical calculations using well-rehearsed procedures quickly and accurately (Russell 2000).[1] This may be partly because pupils in UK secondary schools have limited exposure to practice solving problem-solving questions in class (Boylan et al, 2024). Moreover, schools often do not have a pre-existing consistent approach to the teaching of mathematical problem solving (Noyes et al. 2023, Ofsted 2023) and provide limited professional development opportunities focused on metacognition in the context of maths (Boylan et al. 2024). There is some evidence to suggest that disadvantaged pupils are less likely to use metacognitive and self-regulatory strategies without being explicitly taught these strategies (Crenna-Jennings 2018). Providing regular opportunities for pupils to explore various strategies for problem-solving can enhance their confidence, efficiency, and flexibility in choosing appropriate approaches (Woodward et al. 2012).

The Thinking Mathematically programme sets out to address the problems outlined above. For Year 7 pupils, the aims of the programme are to (i) better equip them to tackle unfamiliar mathematical problems (ii) improve maths attainment and (iii) narrow the disadvantage gap between pupils from disadvantaged backgrounds and their peers at Key Stage 3 and GCSE. For participating teachers, the programme aims to equip them with the knowledge and skills to adapt teaching to explicitly address problem-solving challenges.

Thinking Mathematically has several core components backed by evidence, including:

- **Use of a bank of problem-solving tasks** – The programme resources include a bank of problem-solving tasks that pupils do not have a well-rehearsed, ready-made method to solve, as prescribed by the EEF Guidance Report on improving maths (EEF 2022).
- **Think-aloud approach** – Encouraging teachers to 'verbalise their metacognitive thinking as they approach and work through a [mathematical problem]' (EEF 2018) to support the development of pupils' problem-solving skills by modelling how to plan their solution to a problem, monitor their progress towards the solution and evaluate the process of solving a problem while reflecting aloud.

[1] This information is based on data available to schools from national assessment providers.

- **Use of heuristics** – Providing pupils with a list of prompts to help them monitor and reflect during the problem-solving process can enable them to develop a habit of mathematical talk (Woodward et al. 2012).
- **A de-brief** – Facilitating a de-brief in which pupils are asked to explain each step used to solve a problem can enable them to communicate their reasoning and choice of strategy as well as compare and reflect on other strategies used by their peers (Woodward et al. 2012).

The Thinking Mathematically pilot builds on two previous rollouts of the programme. The first rollout took place in Cumbria and North East England and involved 10 secondary schools with approximately 250 Year 7 pupils – one Year 7 class per participating school. The second rollout took place between April and July 2023 in the North, North East and North West of England and involved a further 10 schools.[2] Unlike with the first rollout, all Year 7 pupils in participating school took part (approximately 1800 pupils overall). In the second rollout, schools were required to deliver the programme to Year 7 pupils at least once a week over a 10-week period. Half of all participating schools came from Education Investment Areas (EIA)[3] with weak outcomes data. While free school meal (FSM) eligibility was not a specific focus or requirement for taking part, participating schools from EIAs featured a disproportionate amount of FSM pupils. The evidence from the attendance records and survey responses from the second rollout was presented in a report submitted to the EEF. It showed that the programme was acceptable and feasible in schools. Key findings include:

- Attendance for training was high, with 91% of attendees joining the training day face-to-face and 9% attending remotely. All participants stated that the training was useful and pitched at the correct level.
- 92% of lead teachers reported that it was straightforward to share their learning with the wider team and that it was manageable to conduct the one session per week and deliver it in the way intended. Those who did not find it manageable reported this was due to summer term diary challenges, planned summative assessments, and strike days.
- The problem-solving question bank and initial training were regarded as the most effective strands of support by participating teachers.

Some changes have been made to programme delivery based on key learnings following the second rollout. These include:

- **Intervention duration** – Participants in the most recent development cycle suggested that a 10-week delivery period is too short to embed practice and achieve meaningful outcomes. Therefore, the length of the intervention has been increased to 20 weeks.
- **Mode of ongoing support** – An element of the ongoing support provided to schools in the previous cycle was an in-person visit to each school. This has been replaced by an online meeting for each school in the pilot as it would be logistically challenging for BRS to visit 30 schools in several regions where the programme is being delivered. However, in-person visits will be delivered to schools requiring additional support.
- **Frequency of completing delivery logs** – Lead teachers completed the delivery logs during the development cycle on a weekly basis. During the pilot, the delivery log will be completed on a fortnightly basis instead to minimise the burden on schools.

[2] Different schools were involved in each round of the previous two rollouts. The schools who took part in the previous two rollouts will not be participating in this pilot.
[3] EIAs are the third of local authorities in England where educational outcomes (e.g., reading, writing, maths) were the weakest. This is based on sustained low performance across Key Stage 2 and Key Stage 4 in 2017 to 2019 (DfE 2023).

WHO (Recipients of the intervention)

The programme follows a train-the-trainer (TTT) model. Blackpool Research School (BRS) delivers the training to two lead teachers at each school who cascade the training to all Year 7 maths teachers at their school. The intervention is delivered to all Year 7 pupils by all trained Year 7 maths teachers at participating schools.

WHO PROVIDED

The intervention has been created and is led by Simon Cox, Director of BRS and a secondary maths specialist. David Middleton works alongside Simon and is the Lead Teacher for the Research School. Heather Martin is an experienced maths teacher and Assistant Principal at a Multi Academy Trust in Blackpool. Simon, David and Heather Martin provide the face-to-face training in the two recruitment regions (North West and Yorkshire and the Humber) and offer ongoing remote support to the nominated lead teachers from each school. At present, the core delivery team consists of three members of staff, but they can draw on a wider pool of trainers if needed.

In schools, the intervention is delivered by all Year 7 maths teachers who receive cascading training and support from the lead teachers.

WHAT (Procedures)

Initial training

The programme begins with two attendees (lead teachers) from each school attending a full day face-to-face initial training session delivered by BRS. The training covers the key elements of the intervention. It also equips lead teachers with resources to support implementation and cascading at their school, including sections on the fortnightly delivery log, cascading expectations, and progress monitoring.

Cascading

The two lead teachers at each school are responsible for implementing the TTT model at their school, following guidance set out by BRS. Minimum expectations for successful cascading include:

- Two lead teachers leading a meeting for all Year 7 maths teachers before delivery begins. This meeting should be scheduled for at least one hour and be structured around the videos provided by BRS.
- Teachers having a minimum of one hour set aside before delivery starts to explore the lesson resources.

Alongside these requirements, BRS recommends that schools:

- make time for teachers to rehearse the 'think aloud' approach in pairs or small groups before delivery (this is modelled during the face-to-face training day)
- provide coaching support for teachers from one of the two lead teachers throughout delivery, including lesson drop-ins and follow-on discussions (resources are provided by BRS to support this)
- have ongoing discussions about implementation by ensuring that programme delivery is a standing item on team meeting agendas for the duration of delivery

Implementation

Delivery is overseen by one of the two lead teachers at each school (a ‘delivery lead’, who is usually, but not always, the head of the maths department). In each school, the approach is delivered by all Year 7 maths teachers once per week in their classes over a 20-week period. Delivered as part of usual mathematics, each session takes 20 minutes, with flexibility to allow up to 30 minutes in the initial few weeks of implementation while the teachers get used to the programme.

During delivery, teachers use the question bank, handbook and classroom resources provided by BRS to select appropriate problem-solving questions for use in lessons and to support the implementation of the strategy. In the weekly problem-solving sessions, teachers model their own thinking using a ‘think aloud’ method and

appropriate worked examples. Teachers provide pupils with support using heuristic checklists and create 'de-brief' opportunities for pupils to discuss their methods and thought processes when solving mathematical problems. This might take the form of whole-class discussions led by teachers, pupils working out solutions in pairs, or individual reflection.

During implementation, the delivery lead in each school completes a delivery log on a fortnightly basis. The delivery log includes:

- reflections on how the weeks went (what went well/less well)
- whether TM approach implemented and if not, why not
- duration and number of sessions

The delivery logs are shared with BRS and used by BRS to identify schools who may benefit from additional implementation support (see below).

Ongoing support

Ongoing support is provided by BRS to all schools through (i) two regional online check-in meetings and (ii) one one-to-one online meeting. Schools requiring additional support receive (iii) a supportive implementation visit.

Regional online check in meetings – The online regional check-in meetings revisit key aspects of the teaching approaches, facilitate discussion between schools, and invite feedback. Each meeting lasts for 30 minutes and is attended by the same lead teachers who participated in the training sessions. The two check-in meetings are held during weeks 4/5 and weeks 12/13 of the 20-week programme.

Online meeting – A one-to-one online meeting is provided to all schools to allow the lead teachers to give any feedback on programme implementation that has not been captured in the delivery logs. Each meeting lasts for 30 minutes and is attended by the same lead teachers who participated in the initial training. They take place at around Week 10.

Implementation support visit – The delivery team organises specific in-person school visits for schools identified as needing additional implementation support. An additional implementation support visit may be offered if:

- a school fails to complete two delivery logs in a row despite reminders by BRS
- after Week 3 the classroom sessions take longer than stipulated, i.e., longer than 20 minutes

The visits are carried out by a single member from BRS and are aimed at addressing early-stage implementation challenges typically occurring within the initial eight weeks of the 20-week programme. The duration of each visit is tailored to the specific needs of the school, with the expectation that visits are around half a day long. During these visits, BRS observes implementation of the intervention in classrooms and provides tailored and constructive feedback. Lead teachers in each school facilitate the visit; however, the level of participation from other Year 7 maths teachers will vary by school and depend on the nature of the schools' challenges.

WHAT (Resources)

Schools are provided with resources to support cascading and delivery. Resources include:

- video exemplification of expert teachers implementing TM in lessons
- programme handbook
- train-the-trainer (cascading) slides, guidance and videos
- problem bank for teachers to select from

- sample scripts to use with selected problems
- slides for teachers to use in lessons
- problem structure grid for use in lessons
- heuristics for pupils to use in lessons

HOW (Mode of delivery)

The intervention is delivered in-person to all Year 7 pupils during regular math lessons.

The training and ongoing support delivered to lead teachers by BRS includes a mix of in-person and online delivery. The initial one-day training is in-person. Ongoing support is both online (regional check-in-meetings and one-to-one meetings) and in-person (implementation support visits).

Lead teachers implement the TTT model in person at each participating school. They deliver cascading training sessions for all Year 7 math teachers in participating schools. Additionally, all Year 7 math teachers involved in the intervention are advised to meet in person once a fortnight for a minimum of 20 minutes to discuss implementation strategies, although this is optional.

WHERE

TM sessions are held during timetabled Year 7 maths lessons in the classroom.

Delivery takes place in secondary schools across North West England and Yorkshire and the Humber.

The initial full-day, in-person training is conducted in locations within each of the two regions. Additional locations may be added if necessary to accommodate the geographical spread of participating schools.

WHEN and HOW MUCH

TM sessions are delivered once per week over the course of 20 weeks and are expected to last around 20 minutes or less per session.

TAILORING (Adaptation of the intervention)

Delivery is overseen by one of the two lead teachers at each school, one of whom is the 'delivery lead'. There is flexibility around who the delivery lead at each school is, although this is usually the head of the maths department.

BRS have set minimum expectations for the cascading of training by lead teachers to all Year 7 maths teachers, but schools can choose whether to carry out the additional recommended activities, e.g., making time for teachers to rehearse the 'think aloud' approach in pairs or small groups before delivery or having ongoing discussions about implementation during team meetings.

Schools do not have to make substantial changes to schemes of learning or existing classroom pedagogy and can incorporate the sessions into regular math lessons. Teachers have flexibility over how long they want each session to last (up to 20 minutes), what problems to select for their weekly session as well as what format the debrief should take. While the sessions are expected to last up to 20 minutes, there is flexibility to allow up to half an hour in the initial few weeks of implementation while the teachers get used to the programme.

HOW WELL (Strategies to maximise effective implementation)

A range of strategies are being used to ensure effective implementation. A fortnightly delivery log (detailed above) is shared by schools with the delivery team (DT) by lead teachers at participating schools. This delivery log is

used by BRS for monitoring purposes and to identify challenges to effective implementation. Ongoing support has been incorporated into the programme design to address any identified challenges. In school, these include fortnightly meetings for all Year 7 maths teachers participating in the intervention. From BRS, these include the two online, regional check-in meetings, a one-to-one online meeting and an implementation support school visit, if required.

Appendix 2: Memorandum of Understanding (MoU)

Evaluation of the Thinking Mathematically Pilot

Memorandum of Understanding for participating schools

The Education Endowment Foundation (EEF) is funding Blackpool Research School (BRS) to pilot (try out) the Thinking Mathematically (TM) programme with 35 schools between September 2024 and April 2025.

The EEF have asked Oxford MeasurEd to independently evaluate the pilot. The evaluation team at Oxford MeasurEd, led by Dr Lydia Marshall, will carry out research to understand whether TM might equip Year 7 maths teachers with the knowledge and skills to support Year 7 pupils to tackle unfamiliar mathematical problems. The team will also investigate whether TM can be delivered in a way that is feasible and acceptable for schools, staff, and pupils. These findings will inform the EEF's future decisions about whether the programme can be delivered more widely and tested for wider impact.

This Memorandum of Understanding (MOU) sets out the plans for the pilot, and the responsibilities relating to the pilot and the evaluation for:

- **BRS (the delivery team)**
- **Oxford MeasurEd (the evaluators)**
- **participating schools**

Please read this MOU carefully before signing.

If you have any questions about the evaluation, please contact Lydia Marshall and the Oxford MeasurEd evaluation team at TM-evaluation@oxfordmeasured.co.uk.

If you have any questions about the TM programme, please contact Simon Cox from Blackpool Research School at simon.cox.blackpool@researchschool.org.uk.

Aims of the programme

TM is an evidence-informed programme that explicitly teaches Year 7 pupils how to tackle unfamiliar mathematical problems. The programme uses a train the trainer (TTT) approach where two Year 7 maths teachers are trained by the delivery team (DT) in the use of modelling, heuristics, and discussion. The trained teachers then share the learning with all Year 7 maths teachers in the school with the aim of:

- developing a consistent approach to problem-solving
- enhancing pupil enjoyment and success
- improving maths learning outcomes

Aims of the evaluation

The evaluation will investigate whether the TM pilot:

- provides promising indicative evidence that the programme can deliver on its expected outcomes
- demonstrates that the programme can be delivered using an approach that is feasible and acceptable for schools, staff and pupils
- suggests that the programme is ready to be delivered at scale to test for wider impact

Evidence in these three domains will inform the EEF's decisions about whether the potential impact of TM should be evaluated in a large-scale trial. The evaluation will also inform the design of any such trial by providing a deeper understanding of the theory underpinning the programme and potential outcome measures that could be used to evaluate impact.

Programme delivery

TM is a one-year programme. In each school, Year 7 teachers will deliver TM problem-solving sessions weekly within timetabled lessons. The sessions involve teachers using a 'think aloud' to model their own thinking, supporting pupils in solving a problem through the use of heuristic checklists, and a de-brief where pupils discuss solutions in pairs followed by a teacher-led whole-class discussion.

The delivery team from BRS will train two Year 7 maths teachers in each school. The training will involve an initial one-day in-person training, followed by ongoing support for all schools throughout the programme and bespoke support for some schools identified as needing additional implementation support. The ongoing support includes one online meeting per school and two online regional check-in meetings to revisit key aspects of the teaching approaches, facilitate discussion between schools, and invite feedback. The bespoke support includes school visits by the delivery team. The trained teachers will cascade training to all Year 7 maths teachers who will deliver the classroom sessions. During delivery, delivery leads at each school complete a fortnightly delivery log and all Year 7 maths teachers in the school will meet a minimum of once per fortnight for at least 20 minutes to discuss implementation.

Can my school take part?

Your school is eligible to take part as long as you are willing to fulfil the responsibilities set out in this MOU and your school is not taking part in any other EEF-funded projects in Year 7 during the 2024/25 academic year.

What will the programme involve for my school?

Your school will need to:

- nominate two Year 7 maths teachers for training (hereafter called lead teachers)
- provide contact details for the staff taking part in the programme to the evaluation team in June and July 2024
- release the lead teachers to attend the one-day in-person training session in September 2024, one online session in January 2025 and the two online regional check-in meetings in December 2024 and March 2025
- arrange a one-hour long in-school cascade training session for all Year 7 maths teachers in September/October 2024 led by the lead teachers, with an additional one hour of time set aside for all teachers of Year 7 maths to explore the programme materials
- support the use of time in timetabled maths sessions once a week to deliver the problem-solving sessions for 20 weeks from November 2024 to April 2025
- provide time for Year 7 maths teachers to meet once per fortnight for at least 20 minutes to discuss implementation
- ensure shared understanding and support of all school staff for the programme

The participating lead teachers will need to:

- attend a full-day in-person training in September 2024
- cascade the training to all Year 7 maths teachers in September/October 2024

- attend a one-to-one online session in January 2025
- attend two online regional check-in meetings in December 2024 and March 2025
- meet with all Year 7 maths teachers once per fortnight for at least 20 minutes to discuss implementation
- complete the fortnightly delivery log throughout the 20-week delivery period

Some participating lead teachers may need to:

- arrange a school visit for the delivery team if the fortnightly delivery logs show that they would benefit from additional support

The participating teachers will need to:

- attend an in-school cascade training session led by the lead teachers in September/October 2024
- deliver the TM problem-solving sessions once a week within timetabled lessons during the 20-week delivery period
- meet with all Year 7 maths teachers once per fortnight for at least 20 minutes to discuss implementation

What will the evaluation involve for my school?

All schools that take part in the pilot of TM must participate in the evaluation.

Your school will need to:

- provide information about the school to the evaluation team, including the proportion of pupils eligible for free school meals (FSM); their approach to ability grouping; and names and email addresses of all Year 7 maths teachers who agree to have their details shared with the evaluation team
- send out parent/carer information sheets about the **programme** to parents/carers of Year 7 pupils
- encourage all Year 7 maths teachers to take part in a short online survey before and after the programme (see details below)

If your school is selected as a case study school for an in-person visit by the evaluation team, your school will need to:

- allow the nominated lead teachers, Year 7 maths teachers, Year 7 pupils and a member of the Senior Leadership Team (SLT) to take part in evaluation activities (see details below)
- support with logistical arrangements and allow the evaluation team to attend the school for evaluation activities
- send out parent/carer information sheets about the **evaluation** and privacy notices to parents/carers of Year 7 pupils, including opt-out forms
- share pupil information sheets about the **evaluation** with Year 7 pupils, including opt-out forms
- ensure shared understanding and support of all school staff for the evaluation and encourage participation in evaluation activities

All participating Year 7 maths teachers in your school will be invited to complete:

a 10-minute online survey in September 2024
a 15-minute online survey in April – May 2025

The evaluation team at Oxford MeasurEd will also analyse the complete set of delivery logs that the lead teachers complete on a fortnightly basis to better understand how the programme was delivered in practice.

We will carry out in-person visits with a selection of schools (case study schools) in January – March 2025. This involves:

- observation of a classroom delivery session
- a 1-hour focus group discussion with some Year 7 maths teachers
- a 45-minute paired interview with lead teachers (option to be done online)
- a 45-minute interview with a member of SLT (option to be done online)

a 30-minute in-person paired pupil interview

What support will my school receive?

To support your school to deliver the TM programme, the delivery team from BRS will provide:

- the training for school staff described above under the requirements for your school
- bespoke support including one-to-one online meetings and potentially school visits by the delivery team if identified as needing additional implementation support
- access to resources to support implementation and cascading including video exemplification of expert teachers implementing TM in lessons, programme handbook, train-the-trainer (cascading) slides and video, problem bank for teachers to select from, sample scripts to use with selected problems, slides for teachers to use in lessons, problem structure grid and heuristics for pupils to use in lessons

To support your school's participation in the evaluation, the evaluation team at Oxford MeasurEd will:

- inform all participants about plans for the evaluation and how findings will be used
- carry out the evaluation in a way that causes minimum disruption and additional workload for all participants including school staff and pupils
- organise all data collection activities including interviews, focus group discussions, observations and surveys
- provide maths departments at case study schools which complete all evaluation activities a £150 Amazon thank you voucher in recognition of the school's time and commitment to the evaluation.

The evaluation team at Oxford MeasurEd also commit to:

- submit the evaluation design for ethical review and approval from the Oxford MeasurEd ethics board
- ensure that all participation in the evaluation is based on voluntary and informed consent (see below)
- carry out and report on the evaluation in a robust and independent manner
- handle all data relating to the evaluation in accordance with the UK's General Data Protection Regulation (GDPR) and only for research purposes (see information on data protection below)

Participant consent

The two participating lead teachers and an SLT member responsible for managing the maths department should have been given the chance to read the MOU and attached school information sheet and privacy notice,

and to have agreed to participate in the pilot before the MOU is signed and submitted. They should all sign the MOU.

Teachers and SLT members will be provided with more information at the point of being invited to take part in interviews, observations and/or surveys and will have the right to choose not to take part in these activities, though we hope they will. They will also be able to change their mind about taking part in the activities, or to withdraw from their data being used for the evaluation (see attached privacy notice for more information).

Your school will need to provide the parents/carers of Year 7 pupils with a parent/carer information sheet outlining information about the programme before the programme begins. Parents/carers will not be able to withdraw their child from the programme as it takes place during scheduled classroom hours.

If your school is chosen as a case study school for an in-person visit, Year 7 pupils will need to be given a pupil information sheet about the evaluation, including an opt-out form. Parents/carers of Year 7 pupils in case study schools will also need to be sent an additional information sheet about the evaluation, including an opt-out form and the privacy notice. Case study schools should not select any pupils for the paired interviews if they or their parent/carer object to their child's data being used for the evaluation. The Oxford MeasurEd evaluation team understands schools to be in *loco parentis* and able to consent to classroom observations.

Data Protection

BRS and **Oxford MeasurEd** will collect personal data to meet the objectives of the programme and the evaluation.

All personal data will be collected, processed, and stored in line with the UK's General Data Protection Regulation (GDPR). Full details of how data will be collected, processed, and stored, data processing roles and the legal bases for processing personal data can be found in the attached privacy notices, which can also be found online:

- BRS privacy notice can be found **here**.
- Oxford MeasurEd privacy notice for the evaluation can be found **here**.

For this evaluation, Oxford MeasurEd is a data controller who also processes data. Our legal basis for processing data for the evaluation is "legitimate interest". For special categories of personal data, we are using the research exception.

All data will be treated with strictest confidence and no participant will be identified in any report arising from the research. All personal data will be stored securely and will be securely deleted once the evaluation is complete by June 2026.

In line with UK GDPR and data protection regulations, all school staff have a duty to keep all personal information secure and confidential and notify their school of any breaches as soon as possible.

If you have any concerns about data protection and the TM programme, please contact the Data Protection Team at BRS via the BEBCMAT Data Protection Officer at smo@bebcmat.org.uk. If you have any concerns about data protection and the evaluation, please contact Oxford MeasurEd's Data Protection Officer at michael.annoh@oxfordmeasured.co.uk.

Key dates

Dates	Programme activities	Evaluation activities
April – June 2024	• BRS delivery team recruit schools and collect MOUs	
June – July 2024		• Oxford MeasurEd collect background information about participating teachers
September 2024	• Lead teachers attend full-day in-person TTT training on delivering the TM programme with BRS delivery team • Schools distribute parent/carer information sheets about the programme to parents/carers	• Oxford MeasurEd researcher observes TTT training sessions • All Year 7 maths teachers complete online survey
September – October 2024	• Lead teachers cascade training to all Year 7 maths teachers in their school	
November 2024 – April 2025	• Year 7 maths teachers deliver TM sessions weekly for 20 weeks • Year 7 maths teachers and lead teachers meet once per fortnight for 20 minutes to discuss implementation • Lead teachers complete fortnightly delivery logs • Lead teachers attend a one-to-one online session with BRS delivery team • Lead teachers attend two online regional check-in sessions with BRS delivery team	• Oxford MeasurEd researcher observes classroom delivery sessions in case study schools • Oxford MeasurEd researcher interviews SLT member in case study schools • Oxford MeasurEd researcher carries out focus group discussions with some Year 7 maths teachers in case study schools • Oxford MeasurEd researcher carries out paired interviews with lead teachers in case study schools • Oxford MeasurEd researcher carries out paired pupil interviews with Year 7 pupils in case study schools
April – May 2025		• All Year 7 maths teachers complete online survey

Signature page

By signing below, you are indicating that you commit to the responsibilities outlined in this MOU on behalf of your school.

Please make sure the two lead teachers and an SLT member who manages the maths department sign this MOU and **return it to the TM delivery team at** simon.cox.blackpool@researchschool.org.uk **by 28 June 2024** at the latest.

If you have any questions about the TM programme or the evaluation, please contact the following people:

Questions about the **Thinking Mathematically programme**?	Questions about the **evaluation?**
Please contact the delivery team at BRS: Simon Cox simon.cox.blackpool@researchschool.org.uk David Middleton d.middleton.blackpool@researchschool.org.uk	Please contact the evaluation team at Oxford MeasurEd: TM-evaluation@oxfordmeasured.co.uk

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We commit to the TM pilot and evaluation as detailed above.

School details:		
School name:	Postcode:	
Phone no.:		
Participating lead teacher (Delivery Lead):		
Signed:	Print name:	Date:
Phone no.:	Email:	
Participating lead teacher:		
Signed:	Print name:	Date:
Phone no.:	Email:	
SLT member managing maths department:		

Signed:	Print name:	Date:
Phone no.:	Email:	

This information will be shared with Oxford MeasurEd and used to organise TM and evaluation activities.

Appendix 3: Privacy notice

Evaluation of the Thinking Mathematically Pilot

Privacy notice

In line with the UK General Data Protection Regulation (GDPR), there are certain things that we need to let you, as a research participant, know about how your information will be processed. In this privacy notice, we explain what personal data is being collected for the evaluation of the Thinking Mathematically pilot, who will have access to your personal data, how your data will be used, stored, processed and deleted, the legal basis for data processing, and who you can contact in case of a query or a complaint.

Background

Thinking Mathematically (TM) is a maths programme that explicitly teaches Year 7 pupils how to tackle unfamiliar mathematical problems by developing a consistent approach to problem-solving to increase their enjoyment of maths and improve maths learning.

The Education Endowment Foundation (EEF) is funding Blackpool Research School (BRS), to pilot (try out) TM with 35 schools between September 2024 and April 2025. In each school, two Year 7 maths teachers will be trained to deliver TM. The lead teachers will cascade training to all Year 7 maths teachers in the school who will deliver TM to all Year 7 pupils.

The EEF has asked Oxford MeasurEd to evaluate the pilot. The evaluation will investigate:

- whether there is evidence that TM can achieve what it aims to achieve
- whether TM can be delivered as intended in schools.

Results of the evaluation will inform a decision about whether TM could be used to support pupils in more schools.

Detailed plans for the pilot and evaluation – including the activities that participants will be asked to take part in – are set out in the Memorandum of Understanding (MOU) for schools and the parent/carer and school information sheets.

Participants' personal data will be collected as part of BRS's delivery of TM and for Oxford MeasurEd's evaluation. **This privacy notice covers data that will be collected for the evaluation.** You can find BRS's privacy notice about data collected during delivery of TM **here**.

What personal data is being collected for this evaluation?

The evaluation will involve collecting personal data from or about school staff (participating teachers and senior leadership team members), delivery team staff (people employed by BRS involved in delivering TM) and participating pupils.

Table 1 and Table 2 below set out the personal data that will be collected from or about school and delivery team staff and participating pupils. If your child's school is chosen as a case study school for data collection activities, you will receive more information about this in December 2024 or January 2025.

Table 1 Personal data collected about school and delivery team staff

	Data collected
Contact details	• First name • Last name • Email address • Phone number (only for lead teachers and SLT members)

	• School name
Demographic and background information	• Job title (only school staff) • Qualifications (only school staff) • Years of experience (only school staff) • Age (only school staff)
Research data	• Interview recordings and transcripts • Survey responses • Notes from training observations • Focus group discussion recordings

Table 2 Personal data collected about participating pupils

	Data collected
Name	• First and last name (only those pupils participating in paired interviews)
Demographic and background information	• Gender (only those pupils participating in paired interviews)
Research data	• Interview recordings

Who will have access to my personal data?

During the evaluation, only the evaluation team at Oxford MeasurEd and the delivery team at BRS will have access to personal data.

Table 3 and Table 4 set out how personal data will be collected. No data will be transferred outside of the evaluation team by Oxford MeasurEd during the evaluation.

Table 3 How personal data about staff will be collected and transferred during the evaluation

	How data will be collected
Contact details	• BRS will share MOUs which include contact details for lead teachers and a member of SLT from participating schools with Oxford MeasurEd through a secure cloud server that can only be accessed by the Oxford MeasurEd team. • Participating schools will provide contact details of participating staff to Oxford MeasurEd via a password-protected spreadsheet • BRS will share contact details for members of the delivery team through a secure cloud sever that can only be accessed by the Oxford MeasurEd team.
Demographic and background information	• School staff will enter these as part of survey responses into a secure online survey platform using personalised pseudo-anonymous ID.

Research data	• Researchers will record individual and paired interviews and focus group discussions using video conferencing software or encrypted digital recorders. Online interviews will be transcribed automatically using Microsoft Teams or TL;DV software. The researchers will save the recordings and transcripts in secure cloud storage that can only be accessed by the Oxford MeasurEd team. • School staff will enter survey responses into a secure online survey platform using personalised pseudo-anonymous ID. • Researchers will record notes from training observations digitally in secure cloud storage that can only be accessed by the Oxford MeasurEd team.

Table 4 How personal data about pupils will be collected and transferred

	How data will be collected
Name	• Pupils participating in paired interviews will be asked to enter their first name and surname on an age-appropriate consent form which will be provided on the day of the paired interview. Providing their name and surname will be optional. The form will be photographed after the interview, and images saved in secure cloud storage that can only be accessed by members of the evaluation team.
Demographic and background information	• Pupils participating in paired interviews will be asked to enter their gender on an age-appropriate consent form which will be provided on the day of the paired interview. Providing information about their gender will be optional. The form will be photographed after the interview, and images saved in secure cloud storage that can only be accessed by members of the evaluation team.
Research data	• Researchers will record paired interviews using encrypted digital recorders. The researchers will save the recordings in secure cloud storage that can only be accessed by the Oxford MeasurEd team.

How will the data be used?

Data use

The evaluation team at Oxford MeasurEd will only use the data collected for research purposes. The team will:

- use **staff names and contact details** to organise observations, interviews, focus group discussions and surveys for the evaluation
- **only** use pupil names in the case of safeguarding concerns – to refer concerns to relevant authorities if appropriate
- use **demographic and background information about staff and pupils** to describe who took part in the research and explore whether experiences of TM are different for different groups of people
- analyse **research data** from observations, focus groups, interviews and surveys to answer the evaluation questions

All data will be treated with the strictest confidence – the Oxford MeasurEd team will remove names and contact details from this research data before analysing it and will not identify any individuals in evaluation reports or presentations.

No personal information will be transferred outside of the European Economic Area (EEA).

Participants can withdraw their data from being used for research purposes until July 2025 (when data analysis begins) by contacting the Oxford MeasurEd evaluation team at TM-evaluation@oxfordmeasured.co.uk.

Data storage

Oxford MeasurEd will securely store personal information about participants until the end of the evaluation. All data will be stored electronically in a folder in Oxford MeasurEd's secure cloud system that can only be accessed by the Oxford MeasurEd team.

Oxford MeasurEd will minimise use of non-electronic (i.e., paper) documents containing personal data. Where these are needed – for example, paper copies of the school staff contact details or pupil consent forms – documents will be kept on the individual's person and securely destroyed (shredded) the same day.

Oxford MeasurEd will securely delete all personal information about participants no more than six months after the submission of the final report of the pilot (by June 2026 at the latest).

What is the legal basis for processing my data?

For this evaluation, Oxford MeasurEd is a data controller who also processes data. This means that we are responsible for deciding the purpose and legal basis for processing data.

Our legal basis for processing data for the evaluation is "legitimate interest". This means that we believe that there is a genuine reason for us to process this data (to evaluate the pilot), that this data is needed to fulfil this purpose (we couldn't evaluate the pilot without this information), and that using this data won't interfere with individuals' interests, rights, or freedoms.

What should I do if I don't want my/my child's personal data to be used for the evaluation?

You can withdraw from your/your child's data being processed for the evaluation at any time, by emailing TM-evaluation@oxfordmeasured.co.uk or filling out the parent/carer opt-out form. These will be shared in December 2024 or January 2025 only in schools where evaluation activities will take place, i.e., case study schools selected for in-person visits. We will not use any identifying information about you/your child from the moment you withdraw. We will not use research data (survey, interview, or discussion responses) that we have collected from you/your child up until that point unless it has already been anonymised for analysis.

We will also handle your or your child/children's personal data in accordance with the other rights given to individuals under UK GDPR. In certain circumstances, data subjects have the right to restrict processing, to rectification or erasure and to make a subject access request to see all the information held about them. To enquire about exercising any of your rights as a data subject, please contact Oxford MeasurEd's Data Protection Officer at michael.annoh@oxfordmeasured.co.uk.

Who can I contact with a query or a complaint?

If you have any questions about how this information will be processed, or about the evaluation, please contact us (the Oxford MeasurEd evaluation team) at TM-evaluation@oxfordmeasured.co.uk.

To enquire about exercising any of your rights as a data subject, please contact Oxford MeasurEd's Data Protection Officer at michael.annoh@oxfordmeasured.co.uk.

Under UK GDPR, you have the right to raise any concerns with the Information Commissioner's Office (ICO) via their website at www.ico.org.uk/concerns.

Appendix 4: School information sheet

Evaluation of the Thinking Mathematically Pilot

School Information Sheet

Blackpool Research School is delighted to invite applications from schools who teach pupils in Year 7 in North West and Yorkshire and the Humber to take part in a pilot study (funded by the Education Endowment Foundation) to evaluate the Thinking Mathematically programme. The programme has been designed by and will be delivered by Blackpool Research School.

What is Thinking Mathematically?

Thinking Mathematically is a 20-week programme for children in Year 7 which is delivered as part of the timetabled maths lessons. The programme draws upon evidence from the EEF's Improving Mathematics in Key Stages 2 and 3 guidance report and aims to increase teachers' use of modelling and classroom discussion to improve pupils' metacognitive skills and resilience when answering problem-solving questions.

The Thinking Mathematically programme provides training for Year 7 maths teachers in engaging pupils in solving unfamiliar problems and promoting discussion about the methods chosen and decisions made when solving problems.

Teachers deliver sessions based around a mathematical problem once a week for 20 weeks. Each session lasts approximately 20 minutes with the aim of:

- developing pupils' resilience when solving problems
- encouraging pupils to discuss and reason about mathematical problems, and recognise that there are often multiple different ways of tackling a problem

The programme will run from September 2024 – April 2025. Participants will have access to extensive online resources and receive support from the Thinking Mathematically team.

Training includes a blend of face-to-face initial training, cascaded training to deliver back in school, online support sessions, and school visits to equip teachers with:

improved knowledge and understanding of the research evidence around mathematical problem solving
knowledge and strategies to model mathematical problem solving in lessons, use question prompts to support pupils in their problem solving, and to lead a class 'de-brief' discussion of strategies and approaches used in solving problem

We are looking for 35 schools in the North West and Yorkshire and the Humber who will be able to:

- commit to releasing two teachers of Year 7 maths (referred to as 'lead teachers') to attend a face-to-face day of training, one one-to-one online support session and two regional online support sessions during the 20-week programme period
- commit to providing one hour of time for lead teachers to cascade the training to other teachers of Year 7 maths in your school, with an additional one hour of time for all teachers of Year 7 maths to explore the programme materials
- commit to delivering the programme materials in Year 7 maths lessons for 20 minutes, once a week for 20 weeks alongside your existing scheme of learning
- commit to providing time for Year 7 maths teachers to meet once per fortnight for at least 20 minutes to discuss implementation
- support the pilot evaluation by taking part in the research activities summarised below and detailed in the evaluation's Memorandum of Understanding (MOU)

Your school is eligible to take part in the Thinking Mathematically Pilot as long as your school is not participating in any other EEF-funded projects in Year 7 during the 2024/25 academic year.

What are the benefits for my setting?

- Your setting will receive access to a promising approach that aims to improve pupils' mathematical development.
- You will receive the Thinking Mathematically training and resources FREE of charge.
- By taking part in the pilot study, your setting is adding to the evidence base and knowledge on what works in maths education in England.

How will the Thinking Mathematically programme be evaluated?

The EEF have asked Oxford MeasurEd to evaluate Thinking Mathematically. Oxford MeasurEd will carry out research to understand how well the programme works. All schools that take part in the pilot of Thinking Mathematically will deliver the programme and **must** participate in the evaluation.

The evaluation will investigate whether the pilot of Thinking Mathematically:

provides promising indicative evidence that the programme can deliver on its expected outcomes
demonstrates that the programme can be delivered using an approach that is feasible and acceptable for schools, staff and children
suggests that the programme is ready to be delivered at scale to test for wider impact

Your school is expected to take part in evaluation activities, including online surveys with staff. You might also be asked to take part in additional activities if selected for an in-person visit by the evaluator. This will include a paired interview with lead teachers, a focus groups with Year 7 maths teachers, an interview with a member of SLT, an observation of a classroom delivery session, and a paired pupil interview. The full requirements of the evaluation are set out in the MOU, and you will need to agree to take part in the evaluation if you want your school to take part in the Thinking Mathematically programme.

What do I need to do now?

If you are interested in taking part in the pilot evaluation of Thinking Mathematically, please complete the MOU and **return it to the TM delivery team at** simon.cox.blackpool@researchschool.org.uk **by 28 June 2024** at the latest. Please note that schools will be selected **on a first come, first served basis.**

Where can I find out the results of this pilot evaluation?

At the end of the programme, a final report will be written by the evaluation team. This report will be published on the EEF's website (educationendowmentfoundation.org.uk) in Spring 2026.

Who do I contact if I have further questions?

Questions about the **Thinking Mathematically programme**?	Questions about the **evaluation?**
Please contact the delivery team at Blackpool Research School. Simon Cox (Director) simon.cox.blackpool@researchschool.org.uk Blackpool Research School	Please contact the evaluation team at Oxford MeasurEd: TM-evaluation@oxfordmeasured.co.uk

BEBCMAT 14 - 17 Metro House Metropolitan Drive Blackpool FY3 9LT	

Appendix 5: Pupil information sheet

Thinking Mathematically Study

Pupil Information Sheet

Hi,

We are writing to you because your school is taking part in a maths programme with Year 7 pupils like yourself called Thinking Mathematically, which we want to learn more about.

What is Thinking Mathematically?

Thinking Mathematically is a maths programme for Year 7 pupils at your school. It is meant to help you get better at solving tricky mathematical problems.

You may know that you have been using Thinking Mathematically methods during your regular maths lessons since the beginning of the school year.

Who are we?

We are a team of researchers from a small organisation called Oxford MeasurEd.

We are trying to find out how good the Thinking Mathematically programme is so that it can help more Year 7 pupils learn how to solve mathematical problems.

What are we doing?

We want to do a few activities with Year 7 pupils to learn more about the programme. Here is a short overview of what we want to do:

- **We want to observe a session** 👀 – Someone from our team will come to your school to watch how the Thinking Mathematically programme looks like. They might sit in on one of your maths lessons.

- **We want to interview two pupils** 💬 – Your teacher might ask you if you want to take part in a short interview with one of our researchers. During the interview, we will ask you and another pupil:
  - about a math problem you solved and explain how you did it. We promise that this is not a test ☺
  - what you like or don't like about the Thinking Mathematically methods, and if there's anything that's easy or hard for you.

  We will speak to you for about 30-45 minutes at the end of the school day. A member of staff from your school will be nearby.

What will we do with what we see or hear from you?

- Everything that we see during the maths lesson or hear from you during the interview will be kept safe and secure with us.
- We will not tell anyone what we saw or how you answered our questions.
- The only time we would tell someone about it is if we were worried about your safety.

Do I have to take part?

It is up to you to take part in the interview. You can also ask us if you have any questions by emailing us at TM-evaluation@oxfordmeasured.co.uk.

What next?

If you decide that you do not want to take part, let us know by filling out the form below or tell your teacher. Remember that if you decide to take part, you can still stop at any time.

Yours sincerely,

Lydia Marshall
Evaluation Director
Oxford MeasurEd

☐ Tick this box if you **DO NOT** want to be asked by your teacher to take part in an interview about the Thinking Mathematically programme.

🖍️ My Name: _____ 📚 My Class: _____

🏫 School's Name: _____

☑ Signature: _____

🗓️ Date: _____

Thanks a bunch!

Appendix 6: Exemplar teacher notes

Thinking mathematically: an evidence-informed approach to problem solving

Week 10: teacher notes

This week's problem:

1132 is a four-digit number.
All of the digits are either 1, 2 or 3.

How many different four-digit numbers can be made with the digits 1, 2 and 3?

How many of those numbers are even?

Introduction

The main aim of this problem is to present pupils with an unfamiliar task which requires some thinking to access. This week the focus is on listing combinations, but in a different way to those problems in previous weeks.

Mathematics needed

- Listing combinations

Key vocabulary

- Different
- Systematic
- Digit
- Even numbers

Resources needed

- Google Sheets presentation to project
- Prompt questions for pupils (one each)
- Printed problem for pupils (one each)

Teacher notes

Plan-Monitor-Evaluate

The purpose of this task is for pupils to recap the 'Plan' aspect of the 'Plan-Monitor-Evaluate' process, to introduce the 'Monitor' aspect, and to give pupils the opportunity to evaluate their work through the 'de-brief' process.

Strategies used in this task

Strategy	Status	Notes
Think aloud	Used	
Worked examples	Used	A video example from last week of a different but mathematically similar question has been provided to support thinking
Heuristics	Used	The 'Plan', 'Monitor', and 'Evaluate' resources are all to be shared.
De-brief	Used	

Solution

This is different to last week's sandwich problem in that order does matter - a ham and cheese sandwich is the same as a cheese and ham sandwich but 23 is not the same as 32!

There are 27 different 4-digit numbers that use the digits 1, 2, and 3, and that begin with a 1. Nine of these are even. The full list of numbers is:

1111	1112	1113	1121	1122	1123	1131	

1132	1133	1211	1212	1213	1221	1222	1223
1231	1232	1233	1311	1312	1313	1321	1322
1323	1331	1332	1333				

Similarly, there will be 27 that start with a 2, 9 of which will be even.

And 27 that start with a 3, 9 of which will be even.

Total number = 27 x 3 = **81**

Number that are even = 9 x 3 = **27**

Sample script

OK, so last week's question was about sandwiches and this week's looks completely different - it's about numbers. I can ask myself the same questions I was asking before about what maths is involved and how I might get started on the problem.

Let's read through the question first. I'm going to read it twice to make sure I get all of the information that I need. *[read the question and highlight key information as before].*

Here is my working out so far. What do you think of my attempt?

[Next, show the video of last week's solution. This hopefully will support pupils in recognising the underlying structural similarities between the two problems]

[These are the types of questions that should be used by the teacher (although not all will be relevant to all problems)]:

Planning my approach

- What is the problem asking me to do?
- Have I seen problems before that look like this one?
- What mathematics might help me to solve this problem?
- What information in the problem is important?
- What information is less important?
- What might I need to work out?
- Would drawing a diagram help?

[Give pupils a chance to make a start on the problem]

OK, I'm now going to stop you. I want us to think about whether what we are doing is working and how we know. Has anyone noticed anything interesting? What strategy are you using? Is this easier or harder than you expected it to be?

[take feedback from the class, and use the Monitor prompt questions]

Monitoring my progress

- Is my chosen strategy working?
- Are there different ways to solve this problem?
- Should I think about solving this problem in a different way, or should I stick with my plan?
- Has my teacher shown me anything which might help me here?
- Would it help if I asked another pupil to check my work so far?
- Look back: have I made any obvious mistakes?

So, think now about your work so far. If you've already got an answer, I want you to be thinking about whether there are any more shapes that might work.

Leading the de-brief

As you circulate the room, look out for pupils who are using different strategies - for example, keeping a digit the same then altering others.

It is useful to choose a couple of pupils who are willing to explain what they did to the rest of the class during the de-brief section.

Some questions to consider might include:

- Can you convince me that your answer is correct?
- What strategy did you use to solve the problem?
- Would you approach the problem in a different way if you tried it again?

- Could you explain your strategy to someone else?

Evaluating my success

- Does my answer make sense? How do I know?
- Is there any way that I can check my answer?
- Am I sure I have answered the question? *Re-read the problem and your solution to make sure!*
- Does my answer need units?
- Would another pupil understand my working out? *You could ask a friend to check.*

- Can I explain to someone else what I did and why I did it?
- Would a different way of solving this problem been quicker?
- Would I solve the problem in a different way if I tried it again?
- Could I share and discuss these different approaches with another pupil?

Appendix 7: Exemplar topic guide

THINKING MATHEMATICALLY PILOT EVALUATION

Topic Guide – Paired Pupil Interviews

Thinking Mathematically is a 20-week programme for children in Year 7. The programme aims to increase teachers' use of modelling and classroom discussion to improve pupils' metacognitive skills and resilience when answering problem-solving questions. It provides training for Year 7 maths teachers in engaging pupils in solving unfamiliar problems and promoting discussion about the methods chosen and decisions made when solving problems.

Blackpool Research School (BRS) is implementing a pilot of Thinking Mathematically funded by Education Endowment Foundation (EEF). EEF have asked Oxford MeasurEd to carry out a formative evaluation of the pilot.

Oxford MeasurEd will investigate the programme's **promise, feasibility, and readiness for trial (scalability).** Findings in these three domains will inform EEF's decisions about whether Thinking Mathematically should be scaled up further and evaluated in a larger trial.

The purpose of the paired pupil interviews is to gather information and reflections from their perspective on:

- their experience of the programme
- the outcomes and mechanisms for change
- the quality and acceptability of the programme components

The interview will be conducted with a pair of Year 7 pupils in-person by a member of the Oxford MeasurEd evaluation team. They will last approximately **30-45 minutes**.

The following guide does not contain pre-set questions but rather lists the key themes and sub-themes to be explored with participants. It does not include follow-up questions like `why', `when', `how', etc. as it is assumed that participants' contributions will be fully explored throughout in order to understand the how-s and why-s.

LIST OF RESOURCES

Please bring the following resources with you to the paired pupil interview:

- 2x pupil information sheets
- 2x pupil demographic monitoring form (Appendix A)
- Selection of 3x Thinking Mathematically problems and prompt questions, including one from most recent week
- 2x sheets to record benefits (Appendix B)

1. INTRODUCTION (approx. 5 min)

Aim: to explain the aims of the research, how the interview will be conducted and how the data will be used.

- Explanation of the interview:
  - *The purpose of today's discussion is to understand your experiences of the Thinking Mathematically programme – this is the programme you have been using at the beginning of one of your maths lessons each week where you work through a maths problem with the help of prompts.*
  - *Your teacher might have handed out an information sheet about this. Did you receive this?* [Hand out the pupil information sheet and check they have received it. If haven't

received it, give them a minute to read the sheet]. *Are you aware of what part of your maths lessons I am referring to?* [confirm understanding]
    - *The interview should last around 45 minutes.*
    - *There are no right or wrong answers – we are only interested in your views, both good and less good. You also do not have to agree with one another.*
- Explanation of how the data will be used:
    - *What you share with me/us will be used by my/our team to write a report on how well the programme works and what impact it has on your learning.*
    - *We will not use your names in the report, but because we are speaking to a small number of pupils, people who know you might recognise your opinions. If there is anything you say that you would prefer us not to include in our report, just let us know at the end of our chat, and we will not use it.*
    - *Since this is a group discussion, please respect each other's privacy by keeping what's said here between us. Of course, you are welcome to share your own thoughts outside this discussion if you would like.*
    - *Participation is voluntary. This means you don't have to take part, and you can skip questions or end the discussion at any time.*
    - [Hand out pupil demographic monitoring form provided in Appendix A] *This is a form where we would like you to write down your name, gender, and ethnicity. This just helps us keep a record of who we have spoken to and lets us describe the group in our report – but remember, we won't use your name in the report. We want to make sure everyone is comfortable, so please take a look and let us know if you have any questions before we begin.* [allow time for pupils to complete the monitoring form]
    - *We would like to record our discussion, so we don't forget anything important. Only my team will have access to the recordings, which we will delete six months after the report is written.*
- Explanation of disclosure:
    - *Before we begin, I also need to let you know that if you were to tell me anything that was a cause of concern that you or someone else was at risk of harm, I would need to report this to my manager who would decide how we act on the information shared. I will let you know if this is the case.*
- *Any questions?*
- Recording consent:
    - Ask for permission to start recording. [start recording on the recording device]
- Obtain verbal consent to participate.

2. BACKGROUND (approx. 2 min)

Aim: to 'warm up' the participants and understand their experiences of learning maths

- Introductions
    - Check if the pupils know each other
    - One good thing that happened to them at school in the last week

3. PUPILS' METACOGNITIVE ABILITY (approx. 15 min.)

Aim: to explore pupils' ability to talk through a mathematical problem they recently addressed in a classroom session using a visualiser

[provide pupils a few Thinking Mathematically problems they recently used in class – including one from the week before the visit, along with the prompt questions]

- *We are interested in understanding how pupils like you think about and solve problems like the ones you have been working on in class during Thinking Mathematically sessions. This isn't a test, and we are not here to check how much you know or how well you solve the problem. We only want to learn about the different ways pupils approach problems and what helps them think through the problems. We will look at a problem you have worked on recently and we would love for you to show us how you approached it step by step. If you are unsure about something, you can use the prompt questions to guide you – they are there to help you. Feel free to share your thoughts out loud. Remember, there are no right or wrong answers. We are just curious to hear about your experiences and how you tackle things like this in class. Also feel free to share if you are finding the problem or steps challenging or easy while you are working through the problem. Is that clear? Are you ready?* [wait for pupils to indicate they are ready]
- *Here is a problem you recently worked on in class. [give pupils a few minutes to solve the problem and remind them that they can use prompt questions if unsure and that we are not testing their skills and ability]*
    - *Can you walk us through how you approached this problem?*
        - What helped in tackling the problem
        - *Did the prompt questions help you solve the problem?*
            - *Why/why not?*

4. VIEWS OF THE PROGRAMME (approx. 7 min.)

Aim: to understand pupils' views on the quality and acceptability of the intervention and how it can be improved

- Quality and acceptability
    - *You just talked me through one of the mathematical problems you worked on during the Thinking Mathematically sessions. You used the prompt questions to work through the problem. When working on these problems in your class, your teacher might think out loud how they would deal with the problem themselves and ask you to share how you solved the problem in pairs or with the whole class. Is that right?*
    - Parts of the session they enjoy/most useful parts
    - Parts of the programme they do not enjoy/find hard to understand
    - Feelings about each of the programme components, if not already mentioned
        - Prompt if necessary:
            - Weekly problems
            - Prompt questions
            - Think-aloud by teacher
            - Debrief
    - Views on whether everyone feels included/gets a chance to share their thinking
    - Suitability of amount of time dedicated to each TM session within a lesson
        - Whether long enough for it to be useful
        - Whether it feels rushed/too slow
    - Any feedback from other pupils
- Barriers and facilitators
    - Anything that makes it easier/more difficult to tackle the weekly problems, if not already mentioned
- Key recommendations
    - Anything they would want to happen differently

- Length/frequency of sessions
- Types of questions
- Activities

5. PERCEIVED BENEFITS (approx. 5 min.)

Aim: to understand pupils' views on perceived benefits and unintended consequences and identify the most effective programme components

- Benefits for pupils
  - Any benefits/changes as a result of tackling problem-solving questions each week
    - Prompt if necessary:
      - knowledge of how to solve problems
      - confidence in approaching maths problems
      - enjoyment of maths problem-solving
    - Views on whether all pupils would have benefitted in these ways
  - [Record any benefits listed by the pupils in the template provided in Appendix B]
  - Ask each pupil to rank them in order from most important change to least important and explain their ranking.
- Unintended consequences
  - Any other consequences of programme participation
    - Positive
    - Negative

6. FINAL REFLECTIONS (approx. 3 minutes)

Aim: to obtain overall thoughts and differences to business as usual

- Compare to other things they do in maths class
  - Differences
  - Similarities
  - What would they prefer to spend time on
- Final closing comments – anything else that has not been covered [turn off audio recording]

Close

- Any questions?
- Thank participant for taking part
- Reiterate confidentiality and limits to anonymity
- Check whether there is anything which they would not like to be included in the write up of the findings

Appendices

Appendix A

Thinking Mathematically Study

Pupil Demographic Monitoring Form

🖍️ My Name: _____

👦🏻👧🏾 Gender (select one):

- ☐ Male
- ☐ Female
- ☐ Non-binary
- ☐ Prefer Not to Say
- ☐ Prefer to Self-describe: _____

🏫 School's Name: _____

☑ Signature: _____

🗓️ Date: _____

Bottom of Form

Appendix B

RANKING BENEFITS/CHANGES

Benefit/change	Pupil 1	Pupil 2
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Appendix 8: Pre-delivery survey

THINKING MATHEMATICALLY

Pre-delivery survey

Welcome to our pre-delivery survey of the Thinking Mathematically programme. We are inviting all teachers who teach **Year 7 maths** in participating schools to complete this survey. The survey should take around **10-15 minutes** to complete.

This is the first of two surveys that will help us understand how well the Thinking Mathematically programme has worked in participating schools. We will invite you to complete the second survey in April 2025. You do not need to know anything about the Thinking Mathematically programme to complete this survey.

There are no right or wrong answers – we are just interested in your experiences and approaches to teaching Year 7 maths. Please answer as honestly as you can. Your responses will only be visible to the evaluation team at Oxford MeasurEd.

You can find out more about our evaluation and the surveys in the email we sent you inviting you to take part in this survey. You can find out more about how we will use your data in the **privacy notice**.

If you have any questions or concerns about the evaluation, please contact the Project Director, Lydia Marshall, at **TM-evaluation@oxfordmeasured.co.uk**.

Q1. Are you happy to continue?

- Yes >> Q2
- No

Thank you – opt out

Thank you for your interest in the evaluation. If you change your mind about taking part in the survey, you can come back using the same link to complete the survey.

ABILITY TO TEACH PROBLEM-SOLVING

First, we would like to understand how you feel about teaching mathematical problem-solving.

Q2. How much would you say you understand about how teachers can explicitly teach problem-solving skills?

- I don't understand this at all
- I only understand this a little bit
- I mostly understand this
- I fully understand this

Q3. How confident would you say you feel, overall, about teaching mathematical problem-solving?

- Not at all confident
- Only slightly confident
- Confident
- Very confident

The next questions are about how confident you feel about particular aspects of teaching mathematical problem-solving to Year 7 pupils.

Q4. First, how confident would you feel if asked to identify appropriate mathematical problems that challenge your Year 7 pupils to think critically and apply problem-solving skills?

- Not at all confident
- Only slightly confident
- Confident
- Very confident

Q5. How confident would you feel if asked to model your thinking while solving a maths problem for Year 7 pupils?

- Not at all confident
- Only slightly confident
- Confident
- Very confident

Q6. How confident would you feel if asked to facilitate discussions where Year 7 pupils discuss and compare their problem-solving strategies?

- Not at all confident
- Only slightly confident
- Confident
- Very confident

YEAR 7S' UNDERSTANDING OF PROBLEM-SOLVING

The next questions are about your Year 7 maths pupils' ability to tackle mathematical problems.

Q7. Thinking about the average Year 7 pupil that you teach, how confident do you think they are to tackle unfamiliar maths problems?

- Not at all confident
- Only slightly confident
- Confident
- Very confident

Q8. Again, thinking about the average Year 7 pupil that you teach, how <u>able</u> do you think they are to tackle unfamiliar maths problems?

- Not at all confident
- Only slightly confident
- Confident
- Very confident

Q9. Again, thinking about the average Year 7 pupil that you teach, how much would you say they <u>enjoy</u> solving mathematical problems?

- Not at all
- Somewhat
- Quite a bit
- A lot

Q10. Thinking about the average Year 7 pupil that you teach, to what extent do they <u>reflect on how they approached a problem</u> once they have come up with a solution?

- Not at all
- Somewhat
- Quite a bit
- A lot

Q11. And once again, thinking about the average Year 7 pupil that you teach, how <u>confident</u> do you think they are to discuss mathematical problem-solving with their peers?

- Not at all
- Somewhat
- Quite a bit
- A lot

Q12. Finally, what proportion of your current Year 7 pupils would you say understand that there can be <u>more than one way</u> to solve a mathematical problem?

- None of my pupils understand this
- Only a few of my pupils understand this
- Most of my pupils understand this
- All of my pupils understand this

RESOURCES TO SUPPORT TEACHING MATHEMATICAL PROBLEM-SOLVING

Now, we would like to ask about the resources available in your school to help you teach mathematical problem-solving. When answering these questions, please do not include any resources that have been provided as part of the Thinking Mathematically programme.

Q13. Are there any resources available to you in your school to help you teach mathematical problem-solving? (For example, this might include textbooks, workbooks, lesson plans, teaching materials or templates).

- Yes
- No >> go to Q16
- I don't know >> go to Q16

Q14. What types of resources are available to you to help you teach mathematical problem-solving? Please select all that apply.

- Textbooks
- Workbooks
- Digital resources
- Problem banks
- Lesson plans
- Lesson slides
- Video exemplifications
- Other, please specify

Q15. How useful are these resources that are available to help you teach mathematical problem-solving?

- Not useful
- Only slightly useful
- Useful
- Very useful

SCHOOL'S APPROACH TO TEACHING PROBLEM-SOLVING

We would like to understand how your school has approached teaching mathematical problem-solving to date, i.e. before your school started taking part in the Thinking Mathematically programme.

Q16. Are there standardised/department-wide guidelines, frameworks or strategies that teachers in your school are expected to use to teach mathematical problem-solving?

- Yes
- No
- I don't know

Q17. How consistent would you say the approach to teaching mathematical problem-solving is across different classes and teachers in your school?

- Not at all consistent
- Only slightly consistent
- Consistent
- Very consistent
- I don't know

Q18. Do maths teachers in your school work together in any of the following ways to discuss and collaboratively plan approaches to teaching mathematical problem-solving?

- Joint lesson planning
- Joint resource preparation
- Resource sharing
- Co-teaching
- Peer observations
- Joint reflections
- Other way of collaborating, please specify
- None of these
- I don't know

ABOUT YOU

Lastly, we would like to ask you some questions about you. We are asking these questions so that we can understand how your experiences may differ according to your personal characteristics and your levels of experience. You can choose to skip any questions if you do not want to provide this information.

Q19. Would you describe yourself as a specialist maths teacher?

- Yes
- No, I qualified as a teacher of a different subject
- No, I mainly teach in another subject area
- No, I qualified as a teacher of a different subject and teach in another subject area

Q20. How long have you been a maths teacher for?

- Less than 1 year
- 1 – 2 years
- 3 – 4 years
- 5 – 10 years
- More than 10 years

Q21. What is the highest level of qualification that you have in any subject?

- Bachelor's degree
- Master's degree
- Doctoral degree
- Other, please specify

Q22. How old are you?

- 20 - 30
- 31 - 40
- 41 – 50
- 51 – 60
- Over 60

YOUR DETAILS

Q23. Please enter your name and email address so that we know who you are*

**We will only use your details to match your answers from this survey to your answers from the post-delivery survey that we will carry out in April/May 2025. Any reports we publish will not identify individuals who completed this survey by name. We will never give away your email to anyone else or use it for commercial purposes and we won't be asking you to complete any more surveys for the evaluation.*

- First name _____
- Last name _____
- Email address _____

Thank you

Thank you for completing this survey. Your answers will be really valuable to the evaluation and we appreciate your time.

If you have any questions, please contact the project director, Lydia Marshall, at **TM-evaluation@oxfordmeasured.co.uk**.

Appendix 9: Post-delivery survey lead teachers

THINKING MATHEMATICALLY

Post-delivery survey – Lead teachers

Welcome to our post-delivery survey of the Thinking Mathematically programme. We are inviting all **lead teachers** in participating schools to complete this survey. The survey should take around **15-20 minutes** to complete.

There are no right or wrong answers – we are interested in how useful the programme has been for you and how well the programme has worked in your school. Please answer as honestly as you can. Your responses will only be visible to the evaluation team at Oxford MeasurEd.

You can find out more about our evaluation and the surveys in the email we sent you inviting you to take part in this survey. You can find out more about how we will use your data in the privacy notice.

If you have any questions or concerns about the evaluation, please contact the Project Director, Lydia Marshall, at TM-evaluation@oxfordmeasured.co.uk.

Q1. Are you happy to continue?

- Yes >> Q2
- No >> Thank you – opt out

Thank you – opt out

Thank you for your interest in the evaluation. If you change your mind about taking part in the survey, you can come back using the same link to complete the survey.

TRAINING AND ON-GOING SUPPORT

In this section, we want to know about how you found the training and support you received to deliver the Thinking Mathematically programme.

Q2. What training/ongoing support did you access from the team at Blackpool Research School (Simon Cox and David Middleton) Select all that apply.

- Face-to-face training day in September 2024 >> Go to Q6, skip Q3-Q5 if NOT selected
- Online check-in 1 on 4th December 2024
- Online one-to-one meeting in January 2025 (an online meeting with your school only)
- Online check-in 2 on 5th March 2025

- None of these

Q3. How confident would you say you felt about cascading the training to Year 7 maths teachers in your school after the initial training you received from the team at Blackpool Research School?

- Not at all confident
- Only slightly confident
- Confident
- Very confident

Q4. How much would you say you understood about how the Thinking Mathematically programme should be delivered in the classroom after the initial training from the team at Blackpool Research School?

- Not at all
- Somewhat
- Quite a bit
- A lot

Q5. How confident would you say you felt about delivering the Thinking Mathematically programme in the classroom after the initial training from the team at Blackpool Research School?

- Not at all confident
- Only slightly confident
- Confident
- Very confident

Q6. Did a member of the Thinking Mathematically team at Blackpool Research School visit your school to support delivery of the programme?

- Yes >> Go to Q7
- No >> Go to Q9, Go to Q12 if 'none of these' selected to Q2

Q7. How long did that visit last?

- Less than 2 hours
- 2 – 4 hours
- More than 4 hours

Q8. Which of the following activities took place during the visit?

- A member of the Blackpool Research School team observed a classroom session
- A member of the Blackpool Research School team provided tailored and constructive feedback
- Other, please specify
- Don't know/can't remember

Q9. Thinking about all of the training and support you have received, how useful would you say the training or support from the Thinking Mathematically team at Blackpool Research School has been?

- Not useful

- Only slightly useful
- Useful
- Very useful

Q10. Did anything make it hard for you to access the training or support from the team at Blackpool Research School? Select all that apply.

- Lack of support from the team at Blackpool Research School
- Lack of support from your Senior Leadership Team (SLT)
- Quality of resources
- Lack of time
- Other commitments/priorities
- Other, please specify
- Nothing made it hard

Q11. Did anything make it easy for you to access the training or support from the Thinking Mathematically team at Blackpool Research School? Select all that apply.

- Support from the Thinking Mathematically team at Blackpool Research School
- Support from your Senior Leadership Team (SLT)
- Resources (e.g., programme handbook, handouts, website etc.)
- Other, please specify
- Nothing made it easy

CASCADING

Q12. Did a cascading meeting take place for Year 7 maths teachers at your school?

- Yes >> Go to Q14
- No >> Go to Q13, skip Q14, Q15 and Q17

Q13. If not, please specify how cascading took place at your school. Please state if cascading did not take place at your school. >> Go to Q18.

Q14. How long was the cascading meeting for Year 7 maths teachers at your school?

- Less than 15 minutes
- 15 – 30 minutes
- 31 minutes – 1 hour
- More than 1 hour
- Don't know/can't remember

Q15. What activities took place during the cascading meeting? Select all that apply.

- Watching the cascading video
- Presentation by lead teacher/(s) using Power Point slides
- Teachers receiving the programme handbook at the start of the session
- Other, please specify
- Don't know/can't remember

Q16. Did anything make it hard for you to deliver the cascading meeting? Select all that apply.

- Lack of support from your Senior Leadership Team (SLT)
- Lack of resources
- Lack of time
- Other commitments/priorities
- There was no cascading meeting at my school
- Other, please specify
- Nothing made it hard

Q17. Did anything make it easy for you to deliver the cascading meeting? Select all that apply.

- Initial training from the team at Blackpool Research School
- Support from your Senior Leadership Team (SLT)
- The time the session was held (e.g. during regular departmental meeting)
- Programme handbook
- Training video
- Other, please specify
- Nothing made it easy

Q18. Did Year 7 maths teachers in your school have a one hour or more set aside before delivery started to explore the resources?

- Yes
- No
- Don't know/can't remember

DELIVERY

Now, we would like to learn about what the classroom delivery of Thinking Mathematically looked like in the Year 7 maths classes you teach. We want to know what worked in practice – so please answer honestly.

Q19. How often did Thinking Mathematically classroom sessions take place throughout the 20-week period of the pilot? Please think about the average number of times each of your Year 7 maths classes had a session.

- More than once every week
- Every week
- At least every second week
- Fewer than every second week but at least once a month
- Less than once every month
- Never >> Skip Q20-Q24, Go to Q25, Skip Q26, Go to Q27, Skip Q28-Q31 and Q50

Q20. What proportion of the Thinking Mathematically sessions that you delivered took 20 minutes each?

- None of the sessions
- Less than half of the sessions
- Half of the sessions
- More than half of the sessions
- All of the sessions >> Go to Q22

Q21. Of those Thinking Mathematically classroom sessions that you delivered that did not take 20 minutes, how long were the sessions?

- They were always less than 20 minutes long
- They were always more than 20 minutes long
- They varied (sometimes less than and sometimes more than 20 minutes long)

Q22. Did you use the problems in the order given by the delivery team in your Year 7 maths classes?

- No
- Yes, sometimes
- Yes, always
- Don't know

Q23. During the Thinking Mathematically classroom sessions you delivered, which of the following activities took place every time?

- Modelling your own thinking using a 'think aloud'
- Pupils working through the problems independently
- Pupils using prompts to guide their thinking
- Pupils discussing and comparing solutions and approaches
- Other, please specify

Q24. Place these activities in the sequence in which they typically took place during the Thinking Mathematically classroom sessions. Note: If some activities happened at the same time, please give them the same rank.

- <Display options selected in response to previous question>

Q25. Do you think anything made it hard for you to deliver the Thinking Mathematically classroom sessions? Select all that apply.

- Lack of support from Senior Leadership Team (SLT)
- Lack of resources
- Lack of time
- Timing of session, i.e., when the session was held
- Mixed ability classrooms
- Other commitments/priorities

- Other, please specify
- Nothing made it hard

Q26. Do you think anything made it easy for you to deliver the Thinking Mathematically classroom sessions? Select all that apply.

- Support from your Senior Leadership Team (SLT)
- Opportunities to rehearse
- Ongoing discussions about implementation
- Resources (e.g., worked examples, sample scripts etc.)
- Other, please specify
- Nothing made it easy

Q27. Did any of the following activities take place at your school?

- Teachers rehearsing 'think aloud' approach in pairs or small groups before delivery
- Lead teachers providing coaching support to teachers
- Lead teachers observing lessons and having follow-on discussions with teachers
- Staff having ongoing discussions about implementation during team/department meetings
- Other, please specify
- None of these

The next questions are about how you and your pupils felt about the programme.

Q28. How enthusiastic did you feel about delivering the Thinking Mathematically programme at the beginning of the programme?

- Not at all enthusiastic
- Only slightly enthusiastic
- Enthusiastic
- Very enthusiastic

Q29. How enthusiastic did you feel about delivering the Thinking Mathematically programme by the end of the programme?

- Not at all enthusiastic
- Only slightly enthusiastic
- Enthusiastic
- Very enthusiastic

Q30. How engaged would you say your Year 7 pupils were in the Thinking Mathematically sessions at the beginning of the programme?

- Not at all engaged
- Only slightly engaged
- Engaged
- Very engaged

Q31. How engaged would you say your Year 7 pupils were in the Thinking Mathematically sessions by the end of the programme?

- Not at all engaged
- Only slightly engaged
- Engaged
- Very engaged

ABILITY TO TEACH PROBLEM-SOLVING

Now, we would like to understand how you feel about teaching mathematical problem-solving.

Q32. How much would you say you understand about how teachers can explicitly teach problem-solving skills?

- I don't understand this at all
- I only understand this a little bit
- I mostly understand this
- I fully understand this

Q33. How confident would you say you feel, overall, about teaching mathematical problem-solving?

- Not at all confident
- Only slightly confident
- Confident
- Very confident

The next questions are about how confident you feel about particular aspects of teaching mathematical problem-solving to Year 7 pupils.

Q34. First, how confident would you feel if asked to identify appropriate mathematical problems that challenge your Year 7 pupils to think critically and apply problem-solving skills?

- Not at all confident
- Only slightly confident
- Confident
- Very confident

Q35. How confident would you feel if asked to model your thinking while solving a maths problem for Year 7 pupils?

- Not at all confident
- Only slightly confident
- Confident
- Very confident

Q36. How confident would you feel if asked to facilitate discussions where Year 7 pupils discuss and compare their problem-solving strategies?

- Not at all confident
- Only slightly confident
- Confident
- Very confident

YEAR 7S' UNDERSTANDING OF PROBLEM-SOLVING

The next questions are about your Year 7 maths pupils' ability to tackle mathematical problems.

Q37. Thinking about the average Year 7 pupil that you teach, how confident do you think they are to tackle unfamiliar maths problems?

- Not at all confident
- Only slightly confident
- Confident
- Very confident

Q38. Again, thinking about the average Year 7 pupil that you teach, how able do you think they are to tackle unfamiliar maths problems?

- Not at all able
- Only slightly able
- Able
- Very able

Q39. Again, thinking about the average Year 7 pupil that you teach, how much would you say they enjoy solving mathematical problems?

- Not at all
- Somewhat
- Quite a bit
- A lot

Q40. Thinking about the average Year 7 pupil that you teach, to what extent do they reflect on how they approached a problem once they have come up with a solution?

- Not at all
- Somewhat
- Quite a bit
- A lot

Q41. And once again, thinking about the average Year 7 pupil that you teach, how confident do you think they are to discuss mathematical problem-solving with their peers?

- Not at all confident

- Somewhat confident
- Quite a bit confident
- Very confident

Q42. Finally, what proportion of your current Year 7 pupils would you say understand that there can be more than one way to solve a mathematical problem?

- None of my pupils understand this
- Only a few of my pupils understand this
- Most of my pupils understand this
- All of my pupils understand this

Q42a. Which of the following best describes the type of Year 7 maths classes you currently teach?

- Classes with high ability learners
- Classes with low ability learners
- Mixed ability classes

OUTCOMES

Next, we want to ask you about the potential benefits and consequences for you, your Year 7 pupils and the school/department as a whole as a result of taking part in the Thinking Mathematically programme.

Q43. Were there any positive consequences for you as a result of taking part in the Thinking Mathematically programme? Select all that apply.

- Increased understanding of how to explicitly teach problem-solving skills
- Increased confidence about teaching mathematical problem solving
- Better understanding of pupils' abilities
- Better relationships with pupils
- None of these
- Other, please specify

Q44. Were there any negative consequences for you as a result of taking part in the Thinking Mathematically programme? Select all that apply.

- Reduced time or priority for other professional development opportunities
- Felt I was treating problem-solving as a standalone aspect of the curriculum
- Reduced confidence in teaching problem-solving
- None of these
- Other, please specify

Q45. Do you think there were any positive consequences for Year 7 pupils as a result of taking part in the Thinking Mathematically programme? Select all that apply.

- Improved mathematical problem-solving
- Improved communication
- Improved teamworking skills
- Improved ability in solving problems other than in maths

- None of these
- Other, please specify

Q46. Do you think there were any negative consequences for Year 7 pupils as a result of taking part in the Thinking Mathematically programme? Select all that apply.

- Reduced time for other curriculum and content
- Reduced enjoyment of maths
- Reduced confidence in discussing solutions to mathematical problems
- None of these
- Other, please specify

Q47. Do you think disadvantaged pupils in Year 7 had similar outcomes from the Thinking Mathematically programme compared to other participating pupils? We define disadvantaged pupils as pupils who are eligible for Free School Meals.

- Disadvantaged pupils benefitted more than others
- Disadvantaged pupils benefitted less than others
- Disadvantaged pupils benefitted the same as others
- Not sure

We would like to ask about the resources available in your school to help you teach mathematical problem-solving. When answering these questions, please include any resources that have been provided as part of the Thinking Mathematically programme.

Q48. How useful are these resources that are available to help you teach mathematical problem-solving?

- Not useful
- Only slightly useful
- Useful
- Very useful

Q49. How consistent would you say the approach to teaching mathematical problem-solving is across different classes and teachers in your school?

- Not at all consistent
- Only slightly consistent
- Consistent
- Very consistent
- I don't know

INTENTION TO SUSTAIN

We are interested in whether you will continue using some of the practices you have learned from the Thinking Mathematically programme.

Q50. Do you intend to continue using any of the following practices now that the Thinking Mathematically programme has ended? Select all that apply.

- Use of question bank
- Modelling your own thinking using a 'think aloud'
- Use of prompt questions to guide pupil thinking
- Pupils discussing and comparing solutions and approaches
- Something else, please specify
- None of these

Q51. Do you intend to <u>use</u> any of these practices or approaches that you have learnt from the Thinking Mathematically programme with other year groups (other than Year 7)?

- Yes – I already have
- Yes – intend to
- No
- I do not teach other year groups

ABOUT YOU

Lastly, we would like to ask you some questions about you. We are asking these questions so that we can understand how your experiences may differ according to your personal characteristics and your levels of experience. You can choose to skip any questions if you do not want to provide this information.

Q52. Would you describe yourself as a specialist maths teacher?

- Yes
- No, I qualified as a teacher of a different subject
- No, I mainly teach in another subject area
- No, I qualified as a teacher of a different subject and teach in another subject area

Q53. How long have you been a maths teacher for?

- Less than 1 year
- 1 – 2 years
- 3 – 4 years
- 5 – 10 years
- More than 10 years

Q54. What is the highest level of qualification that you have in any subject?

- Bachelor's degree
- Master's degree
- Doctoral degree
- Other, please specify

Q55. How old are you?

- 20 - 30
- 31 - 40
- 41 – 50
- 51 – 60

- Over 60

YOUR DETAILS

Q56. Please enter your name and email address so that we know who you are*

**We will only use your details to match your answers from this survey to your answers from the pre-delivery survey that we carried out in September/October 2024. Any reports we publish will not identify individuals who completed this survey by name. We will never give away your email to anyone else or use it for commercial purposes and we won't be asking you to complete any more surveys for the evaluation.*

- First name _____
- Last name _____
- Email address _____

Thank you

Thank you for completing this survey. Your answers will be really valuable to the evaluation and we appreciate your time.

If you have any questions, please contact the project director, Lydia Marshall, at TM-evaluation@oxfordmeasured.co.uk.

Appendix 10: Post-delivery survey Year 7 teachers

THINKING MATHEMATICALLY

Post-delivery survey – Year 7 teachers

Welcome to our post-delivery survey of the Thinking Mathematically programme. We are inviting all teachers who teach **Year 7 maths** in participating schools to complete this survey. The survey should take around **10-15 minutes** to complete.

There are no right or wrong answers – we are interested in how useful the programme has been for you and how well the programme has worked in your school. Please answer as honestly as you can. Your responses will only be visible to the evaluation team at Oxford MeasurEd.

You can find out more about our evaluation and the surveys in the email we sent you inviting you to take part in this survey. You can find out more about how we will use your data in the privacy notice.

If you have any questions or concerns about the evaluation, please contact the Project Director, Lydia Marshall, at TM-evaluation@oxfordmeasured.co.uk.

Q1. Are you happy to continue?

- Yes >> Q2
- No >> Thank you – opt out

Thank you – opt out

Thank you for your interest in the evaluation. If you change your mind about taking part in the survey, you can come back using the same link to complete the survey.

IN-SCHOOL TRAINING

Q2. Did you attend an internal training session on how to deliver the Thinking Mathematically programme at your school?

- Yes >> Go to Q4
- No >> Go to Q3, skip Q4 – Q8 and Q10

Q3. If not, please specify how you learned about how to deliver the Thinking Mathematically programme at your school.

Q4. How long was the internal training session?

- Less than 15 minutes
- 15 – 30 minutes
- 31 minutes – 1 hour
- More than 1 hour
- Don't know/can't remember

Q5. What activities took place during the internal training session? Select all that apply.

- Watching the training video
- Presentation by lead teacher/(s) using Power Point slides
- Receiving the programme handbook at the start of the session
- Other, please specify
- Don't know/can't remember

Q6. How useful would you say the internal training session was for you?

- Not useful
- Only slightly useful
- Useful
- Very useful

Q7. How much would you say you understood how the Thinking Mathematically programme should be delivered in the classroom after the internal training session?

- Not at all
- Somewhat
- Quite a bit
- A lot

Q8. How confident would you say you felt about delivering the Thinking Mathematically programme in the classroom after the internal training session?

- Not at all confident
- Only slightly confident
- Confident
- Very confident

Q9. Did anything make it hard for you to participate in the internal training session? Select all that apply.

- Lack of support from your Senior Leadership Team (SLT)
- Lack of support from lead teacher
- Lack of resources
- Lack of time

- Other commitments/priorities
- There was no internal training session at my school
- Other, please specify
- Nothing made it hard

Q10. Did anything make it easy for you to participate in the internal training session? Select all that apply.

- Support from your Senior Leadership Team (SLT)
- The time session was held (e.g. during departmental meeting)
- Programme handbook
- Training video
- Other, please specify
- Nothing made it easy

Q11. Did you have a one hour or more set aside before delivery started to explore the resources?

- Yes
- No
- Don't know/can't remember

DELIVERY

Now, we would like to learn about what the classroom delivery of Thinking Mathematically looked like in the Year 7 classrooms you teach. We want to know what worked well and less well in practice.

Q12. How often did Thinking Mathematically classroom sessions take place throughout the 20-week period of the pilot? Please think about the average number of times each of your Year 7 maths class had a session.

- More than once every week
- Every week
- At least every second week
- Fewer than every second week but at least once a month
- Less than once every month
- Never >> Skip Q13-Q17, Go to Q18, Skip Q19, Go to Q20, Skip Q21-Q24 and Q43

Q13. What proportion of the Thinking Mathematically sessions that you delivered took 20 minutes each?

- None of the sessions
- Less than half of the sessions
- Half of the sessions
- More than half of the sessions
- All of the sessions >> Go to Q15

Q14. Of those Thinking Mathematically classroom sessions that you delivered that did not take 20 minutes, how long were the sessions?

- They were always less than 20 minutes long
- They were always more than 20 minutes long
- They varied (sometimes less than and sometimes more than 20 minutes long)

Q15. Did you use the problems in the order given in your Year 7 maths classes?

- No
- Yes, sometimes
- Yes, always
- Don't know

Q16. During the Thinking Mathematically classroom sessions you delivered, which of the following activities took place every time?

- Modelling your own thinking using a 'think aloud'
- Pupils working through the problem independently
- Pupils using prompts to guide their thinking
- Pupils discussing and comparing solutions and approaches
- Other, please specify

Q17. Place these activities in the sequence in which they typically took place during the Thinking Mathematically classroom sessions. Note: If some activities happened at the same time, please give them the same rank.

- <Display options selected in response to previous question>

Q18. Do you think anything made it hard for you to deliver the Thinking Mathematically classroom sessions? Select all that apply.

- Lack of support from Senior Leadership Team (SLT)
- Lack of resources
- Lack of time
- Timing of session, i.e., when the session was held
- Mixed ability classrooms
- Other commitments/priorities
- Other, please specify
- Nothing made it hard

Q19. Do you think anything made it easy for you to deliver the Thinking Mathematically classroom sessions? Select all that apply.

- Support from lead teachers
- Support from your Senior Leadership Team (SLT)
- Opportunities to rehearse
- Ongoing discussions about implementation
- Resources (e.g., worked examples, sample scripts etc.)
- Other, please specify
- Nothing made it easy

Q20. Did any of the following activities take place at your school?

- Teachers rehearsing 'think aloud' approach in pairs or small groups before delivery
- Lead teachers providing coaching support to teachers
- Lead teachers observing lessons and having follow-on discussions with teachers
- Staff having ongoing discussions about implementation during team/department meetings
- Other, please specify
- None of these

The next questions are about how you and your pupils felt about the programme.

Q21. How enthusiastic did you feel about delivering the Thinking Mathematically programme at the beginning of the programme?

- Not at all enthusiastic
- Only slightly enthusiastic
- Enthusiastic
- Very enthusiastic

Q22. How enthusiastic did you feel about delivering the Thinking Mathematically programme by the end of the programme?

- Not at all enthusiastic
- Only slightly enthusiastic
- Enthusiastic
- Very enthusiastic

Q23. How engaged would you say your Year 7 pupils were in the Thinking Mathematically sessions at the beginning of the programme?

- Not at all engaged
- Only slightly engaged
- Engaged
- Very engaged

Q24. How engaged would you say your Year 7 pupils were in the Thinking Mathematically sessions by the end of the programme?

- Not at all engaged
- Only slightly engaged
- Engaged
- Very engaged

ABILITY TO TEACH PROBLEM-SOLVING

Now, we would like to understand how you feel about teaching mathematical problem-solving.

Q25. How much would you say you understand about how teachers can explicitly teach problem-solving skills?

- I don't understand this at all
- I only understand this a little bit
- I mostly understand this
- I fully understand this

Q26. How confident would you say you feel, overall, about teaching mathematical problem-solving?

- Not at all confident
- Only slightly confident
- Confident
- Very confident

The next questions are about how confident you feel about particular aspects of teaching mathematical problem-solving to Year 7 pupils.

Q27. First, how confident would you feel if asked to identify appropriate mathematical problems that challenge your Year 7 pupils to think critically and apply problem-solving skills?

- Not at all confident
- Only slightly confident
- Confident
- Very confident

Q28. How confident would you feel if asked to model your thinking while solving a maths problem for Year 7 pupils?

- Not at all confident
- Only slightly confident
- Confident
- Very confident

Q29. How confident would you feel if asked to facilitate discussions where Year 7 pupils discuss and compare their problem-solving strategies?

- Not at all confident
- Only slightly confident
- Confident
- Very confident

YEAR 7S' UNDERSTANDING OF PROBLEM-SOLVING

The next questions are about your Year 7 maths pupils' ability to tackle mathematical problems.

Q30. Thinking about the average Year 7 pupil that you teach, how confident do you think they are to tackle unfamiliar maths problems?

- Not at all confident
- Only slightly confident

- Confident
- Very confident

Q31. Again, thinking about the average Year 7 pupil that you teach, how <u>able</u> do you think they are to tackle unfamiliar maths problems?

- Not at all able
- Only slightly able
- Able
- Very able

Q32. Again, thinking about the average Year 7 pupil that you teach, how much would you say they <u>enjoy</u> solving mathematical problems?

- Not at all
- Somewhat
- Quite a bit
- A lot

Q33. Thinking about the average Year 7 pupil that you teach, to what extent do they <u>reflect on how they approached a problem</u> once they have come up with a solution?

- Not at all
- Somewhat
- Quite a bit
- A lot

Q34. And once again, thinking about the average Year 7 pupil that you teach, how <u>confident</u> do you think they are to discuss mathematical problem-solving with their peers?

- Not at all confident
- Somewhat confident
- Quite a bit confident
- Very confident

Q35. Finally, what proportion of your current Year 7 pupils would you say understand that there can be <u>more than one way</u> to solve a mathematical problem?

- None of my pupils understand this
- Only a few of my pupils understand this
- Most of my pupils understand this
- All of my pupils understand this

Q35a. Which of the following best describes the type of Year 7 maths classes you currently teach?

- Classes with high ability learners

- Classes with low ability learners
- Mixed ability classes

OUTCOMES

Next, we want to ask you about the potential benefits and consequences for you, your Year 7 pupils and the school/department as a whole as a result of taking part in the Thinking Mathematically programme.

Q36. Were there any positive consequences for you as a result of taking part in the Thinking Mathematically programme? Select all that apply.

- Increased understanding of how to explicitly teach problem-solving skills
- Increased confidence about teaching mathematical problem solving
- Better understanding of pupils' abilities
- Better relationships with pupils
- None of these
- Other, please specify

Q37. Were there any negative consequences for you as a result of taking part in the Thinking Mathematically programme? Select all that apply.

- Reduced time or priority for other professional development opportunities
- Felt I was treating problem-solving as a standalone aspect of the curriculum
- Reduced confidence in teaching problem-solving
- None of these
- Other, please specify

Q38. Do you think there were any positive consequences for Year 7 pupils as a result of taking part in the Thinking Mathematically programme? Select all that apply.

- Improved mathematical problem-solving
- Improved communication
- Improved teamworking skills
- Improved ability in solving problems other than in maths
- None of these
- Other, please specify

Q39. Do you think there were any negative consequences for Year 7 pupils as a result of taking part in the Thinking Mathematically programme? Select all that apply.

- Reduced time for other curriculum and content
- Reduced enjoyment of maths
- Reduced confidence in discussing solutions to mathematical problems
- None of these
- Other, please specify

Q40. Do you think disadvantaged pupils in Year 7 had similar outcomes from the Thinking Mathematically programme compared to other participating pupils? We define disadvantaged pupils as pupils who are eligible for Free School Meals.

- Disadvantaged pupils benefitted more than others
- Disadvantaged pupils benefitted less than others
- Disadvantaged pupils benefitted the same as others
- Not sure

We would like to ask about the resources available in your school to help you teach mathematical problem-solving. When answering these questions, please include any resources that have been provided as part of the Thinking Mathematically programme.

Q41. How useful are these resources that are available to help you teach mathematical problem-solving?

- Not useful
- Only slightly useful
- Useful
- Very useful

Q42. How consistent would you say the approach to teaching mathematical problem-solving is across different classes and teachers in your school?

- Not at all consistent
- Only slightly consistent
- Consistent
- Very consistent
- I don't know

INTENTION TO SUSTAIN

We are interested in whether you will continue using some of the practices you have learned from the Thinking Mathematically programme.

Q43. Do you intend to continue using any of the following practices now that the Thinking Mathematically programme has ended? Select all that apply.

- Use of question bank
- Modelling your own thinking using a 'think aloud'
- Use of prompt questions to guide pupil thinking
- Pupils discussing and comparing solutions and approaches
- Something else, please specify
- None of these

Q44. Do you intend to use any of these practices or approaches that you have learnt from the Thinking Mathematically programme with other year groups (other than Year 7)?

- Yes – I already have
- Yes – intend to
- No

- I do not teach other year groups

ABOUT YOU

Lastly, we would like to ask you some questions about you. We are asking these questions so that we can understand how your experiences may differ according to your personal characteristics and your levels of experience. You can choose to skip any questions if you do not want to provide this information.

Q45. Would you describe yourself as a specialist maths teacher?

- Yes
- No, I qualified as a teacher of a different subject
- No, I mainly teach in another subject area
- No, I qualified as a teacher of a different subject and teach in another subject area

Q46. How long have you been a maths teacher for?

- Less than 1 year
- 1 – 2 years
- 3 – 4 years
- 5 – 10 years
- More than 10 years

Q47. What is the highest level of qualification that you have in any subject?

- Bachelor's degree
- Master's degree
- Doctoral degree
- Other, please specify

Q48. How old are you?

- 20 - 30
- 31 - 40
- 41 – 50
- 51 – 60
- Over 60

YOUR DETAILS

Q49. Please enter your name and email address so that we know who you are*

**We will only use your details to match your answers from this survey to your answers from the pre-delivery survey that we carried out in September/October 2024. Any reports we publish will not identify individuals who completed this survey by name. We will never give away your email to anyone else or use it for commercial purposes and we won't be asking you to complete any more surveys for the evaluation.*

- First name _____
- Last name _____
- Email address _____

Thank you

Thank you for completing this survey. Your answers will be really valuable to the evaluation, and we appreciate your time.

If you have any questions, please contact the project director, Lydia Marshall, at TM-evaluation@oxfordmeasured.co.uk.

Appendix 11: Quantitative analysis tables

Table 1 Training attendance rates from programmatic data

Training attendance	Freq. *Percent*
23 September session	39
	70%
24 September session	2
	4%
26 September session	6
	11%
Online catch-up session	6
	11%
Face to face catch-up session	3
	5%
Online regional check-in 1	27
	48%
Online regional check-in 2	29
	52%
Online one-to-one sessions*	4
	12%

Base: All participating lead teachers (*N*=56)
Source: Programmatic data
*This information comes from the post-delivery survey. Base: All lead teachers responding to post-delivery survey (*N*=34)

Table 2 Cascading session fidelity

Did a training or cascading session on the Thinking Mathematically programme take place (or did you attend one)?*	Y7 teachers	Lead teachers	Total
	Freq *Percent*	Freq *Percent*	Freq *Percent*
No	7	0	7
	14%	*0%*	*8%*
Yes	44	34	78
	86%	*100%*	*92%*
Total	51	34	85
	100%	*100%*	*100%*
	Pearson chi2(1) = 5.0855 Pr = 0.024		

Base: All respondents of the post-delivery survey (Total, N=85, Y7 teachers, *n*=51, Lead teachers, *n*=34)
Source: Post-delivery survey
*This question was worded differently for Year 7 teachers and lead teachers. Lead teachers were asked whether a cascading meeting took place, while Year 7 teachers were asked whether they attended an internal training session. This distinction was made because Year 7 teachers were unlikely to be familiar with the term cascading.

Table 3 Cascading session length

Cascading session length	Y7 teachers	Lead teachers	Total
	Freq *Percent*	Freq *Percent*	Freq *Percent*
Less than 15 minutes	5	3	8
	12%	*9%*	*11%*
15-30 minutes	23	9	32
	56%	*27%*	*43%*
31 minutes - 1 hour	13	18	31
	32%	*55%*	*42%*
More than 1 hour	0	3	3
	0%	*9%*	*4%*
Total	41	33	74
	100%	*100%*	*100%*
	Pearson chi2(3) = 9.6797 Pr = 0.021		

Base: All respondents of the post-delivery survey who reported and recalled cascading session length (Total, N=74, Y7 teachers, *n*=41, lead teachers, *n*=33)
Source: Post-delivery survey

Table 4 Activities that took place during cascading

Activities during cascading	Y7 teacher	lead teacher	Total	
	Freq *Percent*	Freq *Percent*	Freq *Percent*	
Watching the cascading video	16	22	38	Pearson chi2(2) = 6.5091 Pr = 0.039
	36%	*65%*	*49%*	
Presentation by lead teacher/(s) using PowerPoint slides	40	28	68	Pearson chi2(2) = 1.3579 Pr = 0.507
	91%	*82%*	*87%*	
Teachers receiving programme handbook at the start of the session	8	12	20	Pearson chi2(2) = 3.0684 Pr = 0.216
	18%	*35%*	*26%*	

Base: All respondents of the post-delivery survey who reported that cascading took place (Total, N=78, Y7 teachers, *n*=44, lead teachers, *n*=34)
Source: Post-delivery survey

Table 5 Hour to explore resources

Were you given an hour to explore lesson resources before delivery?	Y7 teacher	lead teacher	Total	
	Freq *Percent*	Freq *Percent*	Freq *Percent*	
No/Don't know*	38	16	54	Pearson chi2(2) = 9.2301 Pr = 0.010
	76%	*47%*	*64%*	
Yes	12	18	30	
	24%	*53%*	*36%*	
Total	50	34	84	
	100%	*100%*	*100%*	

Base: All respondents of the post-delivery survey who responded to this question (Total, N=84, Y7 teachers, *n*=50, lead teachers, *n*=34)
Source: Post-delivery survey
*Categories have been combined to avoid risk of disclosure.

Table 6 Other activities that took place during delivery

Other activities that took place during delivery	Y7 teacher	lead teacher	Total	
	Freq *Percent*	Freq *Percent*	Freq *Percent*	
Teachers rehearsing 'think aloud' approach in pairs/small groups	10	7	17	Pearson chi2(1) = 0.0123 Pr = 0.912
	20%	21%	20%	
Lead teachers providing coaching support to teachers	20	13	33	Pearson chi2(1) = 0.0083 Pr = 0.928
	39%	38%	39%	
Lead teachers observing lessons and having follow-on discussions	7	7	14	Pearson chi2(1) = 0.6984 Pr = 0.403
	14%	21%	16%	
Staff having ongoing discussions about implementation during meetings	34	28	62	Pearson chi2(1) = 2.5432 Pr = 0.111
	67%	82%	73%	

Base: All respondents of the post-delivery survey (Total, N=85, Y7 teachers, *n*=51, lead teachers, *n*=34)
Source: Post-delivery survey

Table 7 Implementation support visit

How long did the visit last?	Freq Percent
Less than 2 hours	1
	14%
2-4 hours	6
	85%
Activities that took place during the implementation support visit	Freq *Percent*
A member of the BRS team observed a classroom session	7
	100%
A member of the BRS team provided tailored and constructive feedback	5
	71%

Base: Lead teachers who responded to the post-delivery survey and reported that an implementation support visit took place (*N*=7)
Source: Post-delivery survey

Table 8 Frequency of classroom sessions

How often did the sessions take place?	Y7 teacher	lead teacher	Total	
	Freq *Percent*	Freq *Percent*	Freq *Percent*	
Fewer than or at least every second week	6	6	12	Pearson chi2(3) = 2.3401 Pr = 0.505
	12%	*18%*	*14%*	
Every week or more than once every week	45	28	73	
	88%	*82%*	*86%*	
Total	51	34	85	
	100%	*100%*	*100%*	

Base: All respondents of the post-delivery survey (Total, N=85, Y7 teachers, *n*=51, lead teachers, *n*=34)
Source: Post-delivery survey

Table 9 Proportion of teachers using programme materials from programmatic data

Activities that took place during the implementation support visit	Freq *Percent*
All	147
	55%
Most (between 50 and 99%)	118
	44%
Few (below 50%) or none	2
	1%
Total	267
	100%

Base: Number of fortnightly delivery logs submitted over the course of 20 weeks(*N*=267)
Source: Fortnightly delivery logs

Table 10 Proportion of classroom sessions that took 20 minutes each

What proportion of the sessions that you delivered took 20 minutes each?	Y7 teacher	lead teacher	Total	
	Freq *Percent*	Freq *Percent*	Freq *Percent*	
None or less than half of the sessions	20	7	27	
	39%	*21%*	*32%*	
Half of the sessions	10	8	18	
	20%	*24%*	*21%*	
More than half of the	14	13	27	Pearson chi2(4) = 4.5632 Pr = 0.335
	27%	*38%*	*32%*	
All of the sessions	7	6	13	
	14%	*18%*	*15%*	
Total	51	34	85	
	100%	*100%*	*100%*	

Base: All respondents of the post-delivery survey (Total, N=85, Y7 teachers, *n*=51, lead teachers, *n*=34)
Source: Post-delivery survey

Table 11 Length of classroom sessions reported in fortnightly delivery logs

How much of your lesson did the session take up?	Freq *Percent*
Up to 20 minutes	149
	57%
21-30 minutes	103
	39%
31-40 minutes or whole lesson	9
	3%
Total	261
	100%

Base: Number of fortnightly delivery logs submitted over the course of 20 weeks where this question was answered (*N*=261)
Source: Fortnightly delivery logs

Table 12 Length of classroom sessions

Of those sessions that you delivered that did not take 20 minutes, how long were they?	Y7 teacher	lead teacher	Total	
	Freq *Percent*	Freq *Percent*	Freq *Percent*	
Always less than 20 minutes	20	4	24	Pearson chi2(2) = 11.2994 Pr = 0.004
	45%	*14%*	*33%*	
Always more than 20 minutes	4	10	14	
	9%	*36%*	*19%*	
Varied (sometimes less and sometimes more than 20 minutes)	20	14	34	
	45%	*50%*	*47%*	
Total	44	28	72	
	100%	*100%*	*100%*	

Base: Respondents of the post-delivery survey who reported not all sessions lasted 20 minutes (Total, N=72, Y7 teachers, *n*=44, lead teachers, *n*=28)
Source: Post-delivery survey

Table 13 Order fidelity

Did you use the problems in the order given?	Freq *Percent*
Not always*	4
	5%
Yes, always	81
	95%
Total	85
	100%

Base: Lead teachers who responded to the post-delivery survey and reported that an implementation support visit took place (*N*=7)
Source: Post-delivery survey
*This includes the options 'No' and 'Sometimes'. Categories have been combined to avoid risk of disclosure.

Table 14 Activities that took place during classroom delivery

During the sessions, which of the following activities took place every time?	Y7 teacher	lead teacher	Total	
	Freq *Percent*	Freq *Percent*	Freq *Percent*	
Modelling your own thinking using a 'think aloud'	38	27	65	Pearson chi2(1) = 0.2724 Pr = 0.602
	75%	*79%*	*76%*	
Pupils working through the problems independently	45	31	76	Pearson chi2(1) = 0.1864 Pr = 0.666
	88%	*91%*	*89%*	
Pupils using prompts to guide their thinking	33	21	54	Pearson chi2(1) = 0.0762 Pr = 0.783
	65%	*62%*	*64%*	
Pupils discussing and comparing solutions and approaches	41	26	67	Pearson chi2(1) = 0.1879 Pr = 0.665
	80%	*76%*	*79%*	

Base: All respondents of the post-delivery survey (Total, N=85, Y7 teachers, *n*=51, lead teachers, *n*=34)
Source: Post-delivery survey

Table 15 Understanding and confidence following initial training from BRS

How much did you understand about how the programme should be delivered after initial training from BRS?	Freq. Percent
Not a lot*	16
	53%
A lot	14
	47%
How confident did you feel about delivering the programme after initial training from BRS?	**Freq. Percent**
Not very confident**	15
	50%
Very confident	15
	50%
Total	30
	100%

Base: All lead teachers responding to the post-delivery survey who report that they attended the initial face-to-face training (*N*=30)
Source: Post-delivery survey
*This includes the options 'Somewhat' or 'Quite a bit'. Categories have been combined to avoid risk of disclosure.
**This includes the options 'Only slightly confident' or 'Confident'. Categories have been combined to avoid risk of disclosure.

Table 16 Usefulness of resources available to teach problem-solving

How useful are the resources available to help you teach problem-solving?	Pre-delivery	Post-delivery
	Freq. Percent	Freq. Percent
Less than useful*	33	11
	39%	*13%*
Useful	47	50
	55%	*59%*
Very useful	5	24
	6%	*28%*
Total	85	85
	100%	*100%*
Sign test	**Observed Freq.**	**Expected Freq.**
Positive	22	11.5
Negative	1	11.5
Zero (tied)	17	17
Pr(#positive >= 22 or #negative >= 22) = 0.0000		

Base: All respondents of the post-delivery survey who responded to this question (*N*=24)
Source: Post-delivery survey
*This includes the options 'Not useful at all' or 'Only slightly useful'. Categories have been combined to avoid risk of disclosure.

Table 17 Usefulness of resources reported in fortnightly delivery logs

What proportion of Y7 teachers are finding the material useful?	Freq *Percent*
All	174
	65%
Most (between 50 and 99%)	89
	33%
Few (below 50%) or None	3
	1%
Total	266
	100%

Base: Number of fortnightly delivery logs submitted over the course of 20 weeks where this question was answered (*N*=266)
Source: Fortnightly delivery logs

Table 18 Usefulness of training and support provided by BRS

How useful has the training and support from BRS been?	Freq *Percent*
Less than Useful*	7
	22%
Useful	14
	44%
Very useful	11
	34%
Total	32
	100%

Base: All lead teachers responding to the post-delivery survey who reported they attended any training sessions (N=32)
Source: Post-delivery survey
*This includes the options 'Not useful' or 'Only slightly useful'. Categories have been combined to avoid risk of disclosure.

Table 19 Usefulness of resources available to teach problem-solving by FSM proportion of schools

How useful has the training and support from BRS been?	Below average FSM	Above average FSM
	Freq. Percent	Freq. Percent
Useful or Less than useful*	10	10
	71%	*59%*
Very useful	4	7
	29%	*41%*
Total	14	17
	100%	*100%*
Pearson chi2(1) = 0.5328 Pr = 0.465		

Base: All lead teachers responding to the post-delivery survey who reported they attended any training sessions (N=32)
Source: Post-delivery survey
*This includes the options 'Not useful at all', 'Only slightly useful' or "Useful". Categories have been combined to avoid risk of disclosure.

Table 20 Understanding and confidence following training by FSM proportion of schools

How much did you understand about how the programme should be delivered after training?	Below average FSM	Above average FSM	Total	
	Freq. Percent	Freq. Percent	Freq. Percent	
Somewhat	3	3	6	
	9%	*9%*	*9%*	
Quite a bit	18	17	35	Pearson chi2(2) = 0.1675 Pr = 0.920
	55%	*50%*	*52%*	
A lot	12	14	26	
	36%	*41%*	*39%*	
How confident did you feel about delivering the programme after initial training from BRS?	Freq. Percent	Freq. Percent	Freq. Percent	
Not very confident*	23	19	42	
	70%	*56%*	*63%*	Pearson chi2(1) = 1.3663 Pr = 0.242
Very confident	10	15	25	
	30%	*44%*	*37%*	
Total	33	34	67	
	100%	*100%*	*100%*	

Base: All lead teachers responding to the post-delivery survey who report that they attended the initial face-to-face training (*N*=30)
Source: Post-delivery survey
*This includes the options 'Only slightly confident' or 'Confident'. Categories have been combined to avoid risk of disclosure.

Table 21 Trajectory of usefulness of resources available to teach problem-solving

Trajectory of usefulness of resources available to teach problem-solving	Below average FSM	Above average FSM
	Freq. Percent	Freq. Percent
Positive	8	14
	42%	*67%*
Negative	1	0
	5%	*0%*
Zero (tied)	10	7
	53%	*33%*
Total	19	21
	100%	*100%*
Pearson chi2(2) = 3.0735 Pr = 0.215		

Base: All teachers who reported pre-delivery availability of problem-solving resources and were matched at post-delivery (*N*=40)
Source: Pre- and post-delivery survey
*This includes the options 'Not useful at all', 'Only slightly useful' or "Useful". Categories have been combined to avoid risk of disclosure.

Table 22 Facilitators for initial training from BRS

Facilitators for initial training from BRS	Freq *Percent*
Support from BRS	19
	56%
Support from SLT	9
	26%
Resources	25
	74%

Base: All lead teachers responding to the post-delivery survey who reported they attended training session (N=34)
Source: Post-delivery survey

Table 23 Facilitators for cascading

Facilitators for cascading*	Y7 teacher	lead teacher	Total	
	Freq *Percent*	Freq *Percent*	Freq *Percent*	
Initial training from BRS (lead teachers only)		23	23	
		68%	*68%*	
Support from SLT	3	6	9	Pearson chi2(1) = 2.2034 Pr = 0.138
	7%	*18%*	*12%*	
The time the session was held	37	13	50	Pearson chi2(1) = 17.5260 Pr = 0.000
	84%	*38%*	*64%*	
Programme handbook	5	13	18	Pearson chi2(1) = 7.8017 Pr = 0.005
	11%	*38%*	*23%*	
Training video	8	21	29	Pearson chi2(1) = 15.5978 Pr = 0.000
	18%	*62%*	*37%*	

Base: All respondents of the post-delivery survey who reported cascading took place (Total, N=78, Y7 teachers, *n*=44, lead teachers, *n*=34)
Source: Post-delivery survey
*This question asked respondents to report facilitators for delivering the cascading session (lead teachers) or participate in the internal training session (Year 7 teachers)

Table 24 Barriers for cascading

Barriers for cascading*	Y7 teacher	lead teacher	Total	
	Freq *Percent*	Freq *Percent*	Freq *Percent*	
Lack of time	9	11	20	Pearson chi2(1) = 2.4519 Pr = 0.117
	18%	*32%*	*24%*	
Other commitments/priorities	7	4	11	Pearson chi2(1) = 0.0696 Pr = 0.792
	14%	*12%*	*13%*	

Base: All respondents of the post-delivery survey (Total, N=84, Y7 teachers, *n*=50, lead teachers, *n*=34)
Source: Post-delivery survey
*This question asked respondents to report facilitators for delivering the cascading session (lead teachers) or participate in the internal training session (Year 7 teachers)

Table 25 Facilitators for classroom delivery

Facilitators for classroom delivery	Y7 teacher	lead teacher	Total		Small schools	Large schools	
	Freq *Percent*	Freq *Percent*	Freq *Percent*		Freq *Percent*	Freq *Percent*	
Support from SLT	3	5	8	Pearson chi2(1) = 1.8628 Pr = 0.172			
	6%	*15%*	*9%*				
Support from lead teacher (Y7 teachers only)	24		24				
	47%		*47%*				
Opportunities to rehearse	6	6	12	Pearson chi2(1) = 0.5822 Pr = 0.445	8	4	Pearson chi2(1) = 3.9510 Pr = 0.047
	12%	*18%*	*14%*		*26%*	*9%*	
Ongoing discussions about implementation	19	18	37	Pearson chi2(1) = 2.0420 Pr = 0.153			
	37%	*53%*	*44%*				
Resources	42	32	74	Pearson chi2(1) = 2.5061 Pr = 0.113			
	82%	*94%*	*87%*				

Base: All respondents of the post-delivery survey (Total, N=85, Y7 teachers, *n*=51, lead teachers, *n*=34)
Source: Post-delivery survey

Table 26 Barriers for classroom delivery

Barriers for classroom delivery	Y7 teacher	lead teacher	Total	
	Freq *Percent*	Freq *Percent*	Freq *Percent*	
Lack of resources	3	5	3	Pearson chi2(1) = 0.0576 Pr = 0.810
	6%	*15%*	*4%*	
Lack of time	20	5	25	Pearson chi2(1) = 5.9028 Pr = 0.015
	39%	*15%*	*29%*	
Mixed ability classrooms	6	9	15	Pearson chi2(1) = 3.0357 Pr = 0.081
	12%	*26%*	*18%*	
Other commitments/priorities	4	3	7	Pearson chi2(1) = 0.0259 Pr = 0.872
	8%	*9%*	*8%*	

Base: All respondents of the post-delivery survey (Total, N=85, Y7 teachers, *n*=51, lead teachers, *n*=34)
Source: Post-delivery survey

Table 27 Unintended consequences for teachers

Unintended consequences	Less than 10 years experiences	More than 10 years experience	Total	
	Freq *Percent*	Freq *Percent*	Freq *Percent*	
Better understanding of pupils' abilities	23	26	49	Pearson chi2(1) = 0.0779 Pr = 0.780
	56%	*59%*	*58%*	
Better relationships with pupils	13	15	28	Pearson chi2(1) = 0.0546 Pr = 0.815
	32%	*34%*	*33%*	
Reduced time or priority for other PD opportunities			5	
			6%	
Felt I was treating problem-solving as a standalone aspect	21	11	32	Pearson chi2(1) = 6.2155 Pr = 0.013
	51%	*25%*	*38%*	

Base: All respondents of the post-delivery survey (Total, *N*=85, Less than 10 years experience, *n*=41, More than 10 years experience, *n*=44)
Source: Post-delivery survey

Table 28 Unintended consequences for pupils

Unintended consequences	Freq *Percent*
Improved communication	56
	66%
Improved teamworking skills	31
	36%
Improved ability in solving problems other than in maths	32
	38%
Reduced time for other curriculum and content	38
	45%

Base: All respondents of the post-delivery survey (*N*=85)
Source: Post-delivery survey

Table 29 Availability of problem-solving resources pre-delivery

Are there any resources available in your school to teach problem-solving?	Freq *Percent*
No	21
	16%
Yes	85
	66%
Don't know	23
	18%
Total	129
	100%

Base: All respondents of the pre-delivery survey (*N*=129)
Source: Pre-delivery survey

Table 30 Usefulness of problem-solving resources pre-delivery

How useful are the resources that are available to help teach problem-solving?	Freq *Percent*
Not useful or only slightly useful*	33
	39%
Useful	47
	55%
Very useful	5
	6%
Total	85
	100%

Base: All respondents of the pre-delivery survey who reported problem-solving resources were available (*N*=85)
Source: Pre-delivery survey
*Categories have been combined to avoid risk of disclosure.

Table 31 Standardised/department-wide guidelines to teach mathematical problem-solving pre-delivery

Are there standardised/department-wide guidelines, frameworks or strategies to teach mathematical problem-solving?	Freq *Percent*
No	74
	57%
Yes	39
	30%
Don't know	16
	12%
Total	129
	100%

Base: All respondents of the pre-delivery survey (*N*=129)
Source: Pre-delivery survey

Table 32 Consistency in approaches to problem-solving pre- and post-delivery

How consistent would you say the approach to teaching problem-solving is across different classes and teachers in your school?	Pre-delivery	Post-delivery
	Freq *Percent*	Freq *Percent*
Not at all consistent	31	25* *29%*
	24%	
Only slightly consistent	61	
	48%	
Consistent	21	37
	16%	*44%*
Very consistent	5	14
	4%	*16%*
I don't know	10	9
	8%	*11%*
Total	128	85
	100%	*100%*

Base: All respondents of the pre-delivery survey (*N*=129)
Source: Pre-delivery survey
*Categories have been combined to avoid risk of disclosure.

Table 33 Enthusiasm about delivering the programme

How enthusiastic did you feel about delivering the programme?	At the beginning			At the end		
	Y7 teacher	lead teacher	Total	Y7 teacher	lead teacher	Total
	Freq *Percent*	Freq *Percent*	Freq *Percent*	Freq *Percent*	Freq *Percent*	Freq *Percent*
Less than enthusiastic*	14	3	17	15	11	26
	27%	*9%*	*20%*	*30%*	*32%*	*31%*
Enthusiastic	31	22	53	29	13	42
	61%	*65%*	*62%*	*58%*	*38%*	*50%*
Very enthusiastic	6	9	15	6	10	16
	12%	*26%*	*18%*	*12%*	*29%*	*19%*
Total	51	34	85	50	34	84
	100%	*100%*	*100%*	*100%*	*100%*	*100%*
	Pearson chi2(2) = 6.0895 Pr = 0.048			Pearson chi2(2) = 4.8386 Pr = 0.089		

Base: All respondents of the post-delivery survey (Total, N=85, Y7 teachers, *n*=51, lead teachers, *n*=34)
Source: Post-delivery survey
*This includes the options 'Not at all enthusiastic' or 'Only slightly enthusiastic'. Categories have been combined to avoid risk of disclosure.

Table 34 Enthusiasm about delivering the programme by type of class taught

How enthusiastic did you feel about delivering the programme?	At the beginning				At the end			
	Low ability	Mix of low ability and high ability	High ability	Total	Low ability	Mix of low ability and high ability	High ability	Total
	Freq *Percent*	Freq *Percent*	Freq *Percent*	Freq *Percent*	Freq *Percent*	Freq *Percent*	Freq *Percent*	Freq *Percent*
Less than enthusiastic*	7	6	2	15	5	10	4	19
	58%	*17%*	*17%*	*25%*	*45%*	*29%*	*33%*	*33%*
Enthusiastic or more than enthusiastic**	5	29	10	44	6	25	8	39
	42%	*83%*	*83%*	*75%*	*55%*	*71%*	*67%*	*67%*
Total	12	35	12	59	11	35	12	58
	100%	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*
	Pearson chi2(2) = 8.6059 Pr = 0.014				Pearson chi2(2) = 1.0853 Pr = 0.581			

Base: All respondents of the post-delivery survey who reported the type of class they teach (*N*=59)

Source: Post-delivery survey

*This includes the options 'Not at all enthusiastic' or 'Only slightly enthusiastic'. Categories have been combined to avoid risk of disclosure.

**This includes the options 'Enthusiastic' or 'Very enthusiastic'. Categories have been combined to avoid risk of disclosure.

Table 35 Understanding and confidence following training

How much did you understand about how the programme should be delivered after training?	Y7 teachers	lead teachers	Total	
	Freq. Percent	Freq. Percent	Freq. Percent	
Less than a lot*	31	16	47	
	70%	*53%*	*64%*	Pearson chi2(1) = 2.2564 Pr = 0.133
A lot	13	14	27	
	30%	*47%*	*36%*	
How confident did you feel about delivering the programme after training?	Freq. Percent	Freq. Percent	Freq. Percent	
Not very confident**	32	15	47	
	73%	*50%*	*64%*	Pearson chi2(1) = 3.9759 Pr = 0.046
Very confident	12	15	27	
	27%	*50%*	*36%*	
Total	44	30	74	
	100%	*100%*	*100%*	

Base: All respondents of the post-delivery survey who reported they attended training/cascading session (Total, N=74, Y7 teachers, *n*=44, lead teachers, *n*=30)

Source: Post-delivery survey

*This includes the options 'Somewhat' or 'Quite a bit'. Categories have been combined to avoid risk of disclosure.

**This includes the options 'Only slightly confident' or 'Confident'. Categories have been combined to avoid risk of disclosure.

Table 36 Pre-post trajectory of teacher outcomes

	Understanding how to teach problem-solving		Confidence teaching problem-solving		Confidence identifying appropriate problems		Confidence modelling thinking		Confidence facilitating discussions	
	Observed	Expected	Observed	Expected	Observed	Expected	Observed	Expected	Observed	Expected
Positive	26	14	32	18.5	26	16	23	16	36	20
	42%	*23%*	*52%*	*30%*	*42%*	*26%*	*37%*	*26%*	*59%*	*33%*
Negative	2	14	5	18.5	6	16	9	16	4	20
	3%	*23%*	*8%*	*30%*	*10%*	*26%*	*15%*	*26%*	*7%*	*33%*
Zero (tied)	34	34	25	25	30	30	30	30	21	21
	55%	*55%*	*40%*	*40%*	*48%*	*48%*	*48%*	*48%*	*34%*	*34%*
Total	62	62	62	62	62	62	62	62	61	61
	100%	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*
	Pr(#positive >= 26 or #negative >= 26) = 0.0000		Pr(#positive >= 32 or #negative >= 32) = 0.0000		Pr(#positive >= 26 or #negative >= 26) = 0.0005		Pr(#positive >= 23 or #negative >= 23) = 0.0201		Pr(#positive >= 36 or #negative >= 36) = 0.0000	

Base: All respondents of the pre-delivery survey who were matched at post-delivery (*N*=62)
Source: Pre- and post-delivery survey

Table 37 Self-reported teacher outcomes

Teacher outcomes	Y7 teachers	lead teachers	Total	
	Freq. Percent	Freq. Percent	Freq. Percent	
Increased understanding of how to explicitly teacher problem-solving	25	22	47	Pearson chi2(1) = 2.0306 Pr = 0.154
	49%	*65%*	*55%*	
Increased confidence about teaching problem-solving	28	27	55	Pearson chi2(1) = 5.3662 Pr = 0.021
	55%	*79%*	*65%*	

Base: All respondents of the post-delivery survey (Total, N=85, Y7 teachers, *n*=51, lead teachers, *n*=34)
Source: Post-delivery survey

Table 38 Pupil engagement with the programme

How engaged were your Y7 pupils in the sessions?	At the beginning			At the end		
	Y7 teacher	lead teacher	Total	Y7 teacher	lead teacher	Total
	Freq *Percent*	Freq *Percent*	Freq *Percent*	Freq *Percent*	Freq *Percent*	Freq *Percent*
Less than engaged*	11	9	20	10	8	18
	22%	*27%*	*24%*	*20%*	*24%*	*21%*
Engaged	32	20	52	33	16	49
	64%	*59%*	*62%*	*65%*	*47%*	*58%*
Very engaged	7	5	12	8	10	18
	14%	*15%*	*14%*	*16%*	*29%*	*21%*
Total	50	34	84	51	34	85
	100%	*100%*	*100%*	*100%*	*100%*	*100%*
	Pearson chi2(3) = 0.2876 Pr = 0.962			Pearson chi2(2) = 3.0650 Pr = 0.216		

Base: All respondents of the post-delivery survey (Total, N=85, Y7 teachers, *n*=51, lead teachers, *n*=34)
Source: Post-delivery survey
*This includes the options 'Not at all engaged' or 'Only slightly engaged'. Categories have been combined to avoid risk of disclosure.

Table 39 Pre-post trajectory of pupil outcomes

	Confidence tackling unfamiliar maths problems		Ability tackling unfamiliar maths problems		Enjoyment of solving maths problems		Extents of reflection		Confidence discussing solutions		Understand different ways to solve problems	
	Observed	Expected	Observed	Expected	Observed	Expected	Observed	Expected	Observed	Expected	Observed	Expected
Positive	34	19.5	13	17	27	19.5	36	19	37	19.5	35	18
	55%	*31%*	*21%*	*27%*	*44%*	*31%*	*59%*	*31%*	*61%*	*31%*	*56%*	*29%*
Negative	5	19.5	21	17	12	19.5	2	19	2	19.5	1	18
	8%	*31%*	*34%*	*27%*	*19%*	*31%*	*3%*	*21%*	*3%*	*31%*	*2%*	*29%*
Zero (tied)	23	23	28	28	23	23	23	23	22	22	26	26
	37%	*37%*	*45%*	*45%*	*37%*	*37%*	*38%*	*37%*	*36%*	*36%*	*42%*	*42%*
Total	62	62	62	62	62	62	61	61	62	62	62	62
	100%	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*
	Pr(#positive >= 34 or #negative >= 34) = 0.0000		Pr(#positive >= 21 or #negative >= 21) = 0.2295		Pr(#positive >= 27 or #negative >= 27) = 0.0237		Pr(#positive >= 36 or #negative >= 36) = 0.0000		Pr(#positive >= 37 or #negative >= 37) = 0.0000		Pr(#positive >= 35 or #negative >= 35) = 0.0000	

Base: All respondents of the pre-delivery survey who were matched at post-delivery (*N*=62)
Source: Pre- and post-delivery survey

Table 40 Teacher-reported pupil outcomes

Pupil outcomes	Y7 teachers	lead teachers	Total
	Freq *Percent*	Freq *Percent*	Freq *Percent*
Improved problem-solving	34	25	59
	67%	*74%*	*69%*
	Pearson chi2(1) = 0.4525 Pr = 0.501		

Base: All respondents of the post-delivery survey (Total, N=85, Y7 teachers, *n*=51, lead teachers, *n*=34)
Source: Post-delivery survey

Table 41 Intention to continue programme practices

Do you intend to continue using the practices?	Freq *Percent*
Use of question bank	43
	51%
Modelling your own thinking using a 'think aloud'	60
	71%
Use of prompt questions to guide pupil thinking	52
	61%
Pupils discussing and comparing solutions and approaches	63
	74%

Base: All respondents of the post-delivery survey (*N*=85)
Source: Post-delivery survey

Table 42 Teacher confidence teaching problem-solving and intention to continue using prompts

	Less than confident teaching problem-solving*	Confident or very confident teaching problem-solving**	Total
	Freq *Percent*	Freq *Percent*	Freq *Percent*
Do not intend to continue using prompts	28	5	33
	50%	*17%*	*39%*
Intend to continue using prompts	28	24	52
	50%	*83%*	*61%*
Total	56	29	85
	100%	*100%*	*100%*
	Pearson chi2(1) = 8.6325 Pr = 0.003		

Base: All respondents of the post-delivery survey (Total, N=85, Y7 teachers, *n*=51, lead teachers, *n*=34)

Source: Post-delivery survey

*This includes the options 'Not at all confident' or 'Only slightly confident'. Categories have been combined to avoid risk of disclosure.

**This includes the options 'Confident' or 'Very confident'. Categories have been combined to avoid risk of disclosure.

Table 43 Trajectory of consistency in approaches to problem-solving pre-delivery

	Only slightly consistent or less*	Consistent or more**	Total
	Freq *Row Percent*	Freq *Row Percent*	Freq *Row Percent*
Only slightly consistent or less*	15	24	39
	38%	*62%*	*100%*
Consistent or more**	0	13	13
	0%	*100%*	*100%*
Total	15	37	52
	29%	*71%*	*100%*
	Pearson chi2(1) = 7.0270 Pr = 0.008		

Base: All respondents of the pre-delivery survey who were matched at post-delivery and did not respond 'I don't know' to this question at any time point (*N*=62)

Source: Pre- and post-delivery survey

*This includes the options 'Not at all consistent' or 'Only slightly consistent'. Categories have been combined to avoid risk of disclosure.

**This includes the options 'Consistent' or 'Very consistent'. Categories have been combined to avoid risk of disclosure.

Appendix 12: Review of outcome measures

Review of outcome measures

This note outlines the methodology for and findings from our review of the availability and suitability of different numeracy outcome measures for a potential trial of Thinking Mathematically (TM).

The aim of the review was to address **research question 14** and the following success criterion under readiness for trial:

> *Outcome measure(s) identified that is/are*
> *a) aligned to intended outcomes,*
> *b) able to measure changes that we expect to see and*
> *c) convenient to administer in secondary schools*

Methodology

The following section outlines our methodology for reviewing outcome measures. The different stages comprising our methodology are illustrated in the diagram below.

Appendix Figure 4 Outcome measure review methodology

Identification and shortlisting of outcome measures

The first stage in our review was to identify potential numeracy outcome measures that are designed for use with Year 7 pupils (11 to 12 years old). We included outcome measures that covered mathematical problem-solving: either entirely focused on problem-solving or containing a sub-scale that focused on problem-solving.

We identified potential outcome measures from multiple sources:

- the **EEF outcome measures and database**.
- commercial assessment providers such as **GL Assessment** and **Hodder Education**.
- outcome measures used in previous evaluations of numeracy for Year 7 pupils[4]

Assessing suitability and quality

Next, we documented the potential outcome measures in a screening tool, recording information that we could use to assess their suitability and quality. The screening tool had three components:

- **Assessment details,** including practical details about how it is administered, what age group the outcome measure had been developed for and used with, whether it had been administered in the UK before and its suitable for use in a UK context (e.g., anglicised language), and which numeracy domains are captured in the assessment.

[4] Identified from published evaluation reports and the wider academic literature. This was not an exhaustive search.

- **Quality of tool**, including whether the assessment was developed with a representative sample, whether the test items cover relevant numeracy domains, reliability, and any other statistical or qualitative information relevant to quality.
- **Previous use of tool** (i.e., ongoing assessment, to inform teacher practice, national benchmarking or evaluation).

Selection of preferred outcome measure

After populating the screening tool, we reviewed the identified outcome measures based on their relative suitability and quality.

We determined ***suitability*** according to whether the assessment had been developed for use with pupils in this age group, whether it covered the numeracy domain of interest (mathematical problem-solving) and whether it was designed for use in the UK. We also considered logistical considerations such as how the test needs to be administered (for example, oral or paper administration), and who can administer the test (such as school staff or an external assessor).

We determined ***quality*** with reference to the sample the measure was previously developed/tested with and information on validity and reliability.

We shortlisted three potential outcome measures that met our thresholds for suitability and quality. We then reviewed the comparative strengths and limitations of these three outcome measures. We presented these strengths and limitations and our recommendation for a preferred measure and next steps to the EEF and the delivery team for approval.

Validity review of test content

We carried out a further review of the validity of the content of the preferred outcome measure. This included determining how problem-solving is defined by the programme, and then reviewing the extent to which the items in the test covered this type of problem-solving appropriately. We identified items capturing problem-solving proficiency and considered a) whether these items identified measured problem-solving in a way aligned with the programme definition and b) the variety of relevant items included.

Detailed technical information on the statistical properties of the assessment and its items was not available for review. We make recommendations on how to overcome this limitation in our findings.

Findings

Identified and shortlisted outcome measures

We identified and reviewed nine relevant outcome measures:

- Progress Test in Maths
- TOMA-3: Test of Mathematical Abilities-Third Edition
- Comprehensive Mathematical Abilities Tests–Second Edition (CMAT-2)
- KeyMaths3 UK
- WIAT-III UK
- Woodcock-Johnson III Tests of Achievement
- Dynamo Math
- Progress in Understanding Mathematics Assessment (KS3)
- Cognitive Abilities Test (CAT4)

We shortlisted three outcome measures based on their **suitability** and **quality** (see definitions above). These were the Progress Test in Maths, TOMA-3 and CMAT-2.

Selection of preferred outcome measure

We outline the strengths and weaknesses for the three shortlisted outcome measures in the table below.

Appendix Table 1 Strengths and weaknesses of shortlisted outcome measures

Outcome measure	Strengths	Weaknesses
Progress Test in Maths	• UK norms • Normed on a large sample size • Equivalent forms available for baseline and endline • Digital and paper options available • Whole class administration • Does not need to be self-scored • Reasonably priced • Excellent validity and reliability	• Sampling criteria not evident • Subtest cannot be administered in isolation • c. 60 minutes on administration
TOMA-3: Test of Mathematical Abilities-Third Edition	• Includes subtest on attitudes towards maths which can be used if of interest • Normed on a large sample size • Whole class administration • Economical - c. £9 per test • Normed on a representative population • Excellent validity and reliability	• Not UK normed • Only one test available for different timepoints • 60-90 minutes of administration time • Not clear if subtests can be administered separately
Comprehensive Mathematical Abilities Tests–Second Edition (CMAT-2)	• As few as 2 subtests can be administered • Normed on a large sample size • Equivalent forms available for baseline and endline • Reasonably priced • Normed on a representative population • Excellent validity and reliability	• Not UK normed • Online administration only

We presented these strengths and weaknesses and broader findings of the review to the EEF and the TM delivery team. We proposed the Progress Test in Maths as our preferred option, given its UK norms testing, robust statistical properties, and alignment with the outcomes listed in the TM Theory of Change. As well as an overall maths attainment score, The Progress Test in Maths provides an 'Understanding and applying mathematical processes through reasoning and problem solving' sub-score. The EEF and delivery team agreed with our recommendations and approved this measure as the preferred choice.

We collectively decided against conducting a pilot of the tool on the basis that a pilot would mainly serve to gather information on the acceptability of the process of collecting data and the format of data collected rather than statistical properties or impact data. We determined that such piloting would not be required because:

- the outcome measure review already addressed how the data would be collected (i.e., mode of administration and time required)

- the Progress Test in Maths has been effectively used in previous EEF trials, indicating its feasibility for our purposes
- the burden on schools of collecting this data outweigh the potential benefits

Validity review of test content

For the TM programme, problem-solving has been defined loosely, limited to solving problems without a ready-made solution.

Reflecting this broad definition, the Progress Test in Maths seems to have good coverage of problem-solving. It includes 12 items[5] that we consider to assess problem-solving proficiency, covering a range of difficulty levels. We expect that this range of difficulty in items should allow for a fairly nuanced understanding of problem-solving abilities and allow a trial to be able to detect changes that one would expect to result from the TM intervention.

A notable strength of the measure is that some of the more complex items require the marker to assess not only the correctness of the final answer but also the problem-solving process, providing a more holistic view of the pupils' problem-solving abilities. However, we do not yet have access to a scoring rubric to understand how this is assessed. Without a detailed rubric, markers might impose their preferred problem-solving methods, leading to potential bias and inconsistency in scoring. A well-defined rubric would standardise the scoring process, ensuring that all approaches are fairly evaluated.

While we know that the Progress Test in Maths provides an 'Understanding and applying mathematical processes through reasoning and problem solving' sub-score, we have been unable to procure information on how this is calculated.

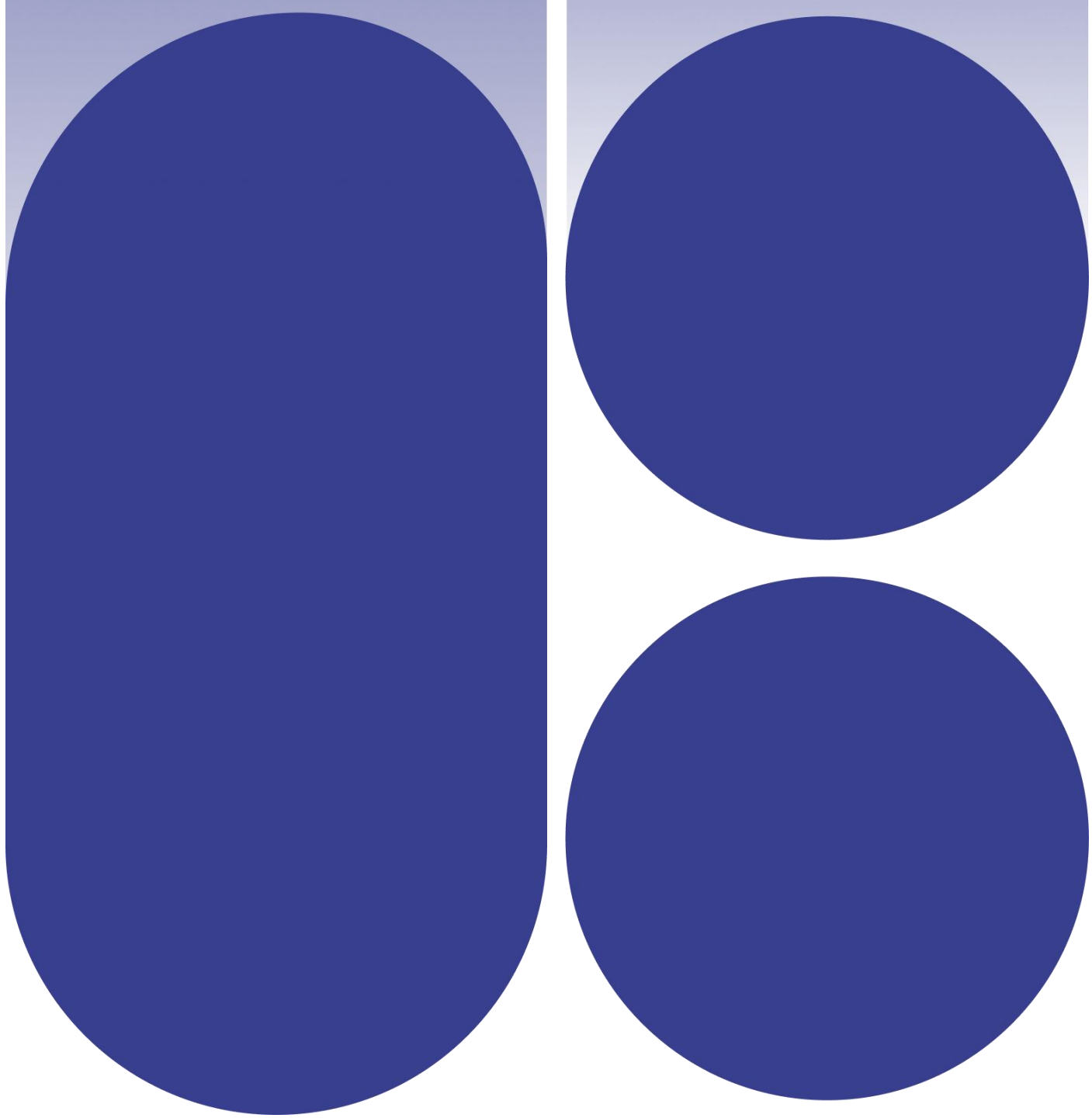
Conclusions and next steps

We conclude that the success criteria for identifying a suitable outcome measure has been met. The Progress Test in Maths is aligned to the intended outcomes articulated in the TM Theory of Change (pupils are more successful in solving mathematical problems and have improved maths attainment), in that it is a comprehensive measure of overall maths attainment, with a good range of items and item difficulties to test problem-solving proficiency (and a relevant sub-score available). Its use in other educational trials, including for the EEF, suggests that it will be sensitive enough to be able to measure changes that are expected to be seen as a result of TM, and that it will be logistically feasible to administer in a large number of secondary schools.

We propose the following next steps are undertaken before a final decision is made about *how* the Progress Test in Maths should be used in a trial of TM (e.g., which scores should be used as primary vs. secondary outcomes):

- A review of the scoring criteria for more complex problem-solving items (see above).
- Further exploration of the strength of evidence underpinning the 'Understanding and applying mathematical processes through reasoning and problem solving' sub-score. For example, any factor analysis that might have been carried out would help confirm whether the problem-solving items share enough commonalities to suggest they constitute a distinctive dimension. Empirical studies demonstrating the sub-score's reliability and validity would also strengthen its credibility.

[5] Of a total 40 items in the test.



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