5Rs Retrial
Evaluation Protocol

Evaluator (institution): University of York
Principal investigator(s): Dr Louise Tracey

5Rs Retrial	Using the 5Rs approach to improve GCSE Maths attainment, a two-armed cluster randomised control trial
DEVELOPER (INSTITUTION)	Julia Smith Ltd, working in partnership with the Association of Colleges (AoC)
EVALUATOR (INSTITUTION)	Department of Education & York Trials Unit, University of York
PRINCIPAL INVESTIGATOR(S)	Dr Louise Tracey
PROTOCOL AUTHOR(S)	Dr Louise Tracey, Dr Pam Hanley, Dr Erin Dysart, Elizabeth Coleman
TRIAL DESIGN	Two-arm cluster randomised controlled trial with random allocation at setting level
TRIAL TYPE	Efficacy
PUPIL AGE RANGE AND KEY STAGE	Aged 16-19; KS5
NUMBER OF SCHOOLS	80+ post-16 settings
NUMBER OF PUPILS	Maximum of 6400 (80 settings of 80 pupils) recruited to the evaluation - anticipated 3700 will be included in the analysis
PRIMARY OUTCOME MEASURE AND SOURCE	GCSE Maths raw score (from setting)
SECONDARY OUTCOME MEASURE AND SOURCE	All from Setting: GCSE Maths grade; binary measure 3 or below, 4 or above. Student attendance at each of the 2 or 3 exam sessions (depending on exam board); attended all, attended some, attended none. Student attitudes towards Maths – adapted Attitudes Toward Mathematics (ATMI) (Tapia & Marsh, 2000)

Protocol version history

VERSION	DATE	REASON FOR REVISION
1.2 [*latest*]		
1.1		
1.0 [*original*]		N/A

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Study rationale and background

Funding regulations (2014/15) mean that full-time students aged 16-19 with a grade 3 or below in GCSE maths must continue studying GCSE maths as a "condition of funding" of their education. Maths resit challenges are two-fold, impacting on both students and colleges. Recent surveys by the Association of Colleges identified pressures caused by maths resits as one of greatest concerns for colleges (AoC, 2018b) and vacancies for maths teachers as the fourth most difficult to fill (AoC, 2022). In 2019, only 21.5% of those aged 17 taking GCSE maths achieved a grade 4 or above (Ofqual, 2019). While students may understand the importance of reaching a grade 4 or above in maths, students have reported feeling like a 'failure' for not achieving this level and of finding maths difficult to understand (Playfair, 2019). This has potential knock-on effects such as lower confidence in maths, lower motivation and less engagement in (and outside of) maths lessons. Thus, the aim of 5Rs is to RE-Vision, that is to view maths concepts in a different and therefore more understandable way, to heighten a sense of achievement, motivation and confidence.

There is some case study evidence that 5Rs has had a positive impact on the proportion of students achieving a grade 4 or above (AQA, n.d.). Consequently, a 5Rs efficacy trial was commissioned by the EEF in 2019. However, the impact evaluation could not be completed because of school/college closures and exam cancellations as a result of the COVID-19 pandemic. The Implementation and Process Evaluation (IPE) (report available here) found enough evidence of promise to justify re-trialling the programme, including being well received and implemented by teachers, as well as perceived improvements in student mathematical knowledge, independent learning strategies, exam technique and student confidence. Though some questions arose around the effectiveness of 5Rs in promoting revision outside the classroom, only limited data could be collected on this because the pandemic prevented administration of the student survey.

There are particular challenges researching students in post-16 settings. Previous studies among those doing GCSE maths resits have reported attrition rates of up to 65% (Swan, 2006; Hough et al, 2017). Moreover, the contexts of post-16 settings vary considerably with Hayward and Homer (2015) highlighting several differences between Sixth Form colleges (more likely to have qualified maths teachers and an academic slant) and Further Education (FE) colleges (where non-specialist maths teachers and students taking vocational courses tend to be more prevalent). The previous 5Rs evaluation found that the more diffuse FE college structure sometimes made them challenging to liaise with. To address issues found in the last evaluation, and to minimise burden on participants, these measures have been put in place in the current evaluation: obtain a direct contact (phone number and/or email) for each of the teachers involved; remove collection of results from the November 2022 resits; remove interviews with heads of department during case study visits because often they are too remote from practice to be helpful. Moreover, in terms of the intervention itself, results from the previous trial indicated a need for more structure and further emphasis on maintaining engagement. As a result, the intervention in the current re-trial has been adapted: the online platform (the Padlet[1]) is more structured with a specific set of activities and resources for each day; the lesson plans are more structured and include details of what the lesson should cover and ideas around maintaining engagement. Further details on the changes between the previous evaluation and the current re-trial can be found in Appendix 1.

Due to general issues in recruiting post-16 settings for research purposes, the current trial will be run over two years with the intervention being delivered to two different cohorts; Cohort 1 from September 2022 and Cohort 2 from September 2023.

[1] The 5Rs Padlet is an online tool which contains maths learning activities and focuses on a different topic each day. The learning activities follow the 5Rs model and it uses a mix of videos, motivation ideas, revision suggestions and tips and tricks to support learning.

Intervention

5Rs is a manualised intervention, based on a five-point lesson structure (as outlined in Table 1), that aims to enhance the support teachers give to students re-sitting their GCSE Maths to improve their attainment. The lesson content is built on the 40 most common topics in GCSE examinations, and a key aspect of the programme is RE-Visioning the way maths is taught and learnt. It also draws on around 40 pre-existing (mostly free) materials, used to enhance the 5Rs learning objectives, accessible through the Padlet plus additional materials such as CorbettMaths 5-a-day, mathematical tea towels (which show alternative ways of performing calculations) and a Pomodoro timer so settings can follow the Pomodoro Revision technique (25 minutes studying followed by a five-minute break). Three initial diagnostic tests, which each contain nine questions, are used to determine any gaps within the nine basic maths skills (addition, subtraction, multiplication, division, fractions, decimals, percentage, scale and ratio), as these are targeted first within the 5Rs approach. The test was designed by Julia Smith, who originally designed the 5Rs programme for AQA.

Settings who sign up to the trial will be allocated to either the control group (business as usual) or the intervention group. Those allocated to the intervention will receive initial online training via a webinar delivered by Julia Smith, developer of the 5Rs programme. A maximum of five teachers per setting will be allowed to participate. The training will outline the method and theory behind the intervention and will take place in September 2022 for Cohort 1 and then September 2023 for Cohort 2). This will be followed by a further two training days, one at the beginning of each of the following two terms, which will incorporate a review of the previous terms' delivery, identify new resources and approaches, address problem solving for longer questions and consider remote learning in more detail. A helpline will also be available for further support for teachers throughout the academic year. Teachers should be able to start using the 5Rs model in the classroom after the first training day. Additionally, students will have access to various online resources via the Padlet application to facilitate their study both inside and outside the classroom. The lesson structure[2] takes a flexible approach and is outlined in Table 1 below.

Table 1: The 5Rs model

5Rs Activities	Description
Recall of Knowledge	This uses resources to check current knowledge and is accessible via the Padlet, and additional resources such as Corbett Maths 5-a-day, mathematical tea towels and a Pomodoro timer so settings can follow the Pomodoro Revision technique, and is a mix of different topics
Routine maths practice	Practice questions on a range of topics focusing on the one- and two- mark questions seen at the start of the foundation GCSE maths paper
Revise a key topic	This focuses on RE-Visioning a specific topic i.e. presenting the topic, and related concepts, to students in a way it may not have been presented previously

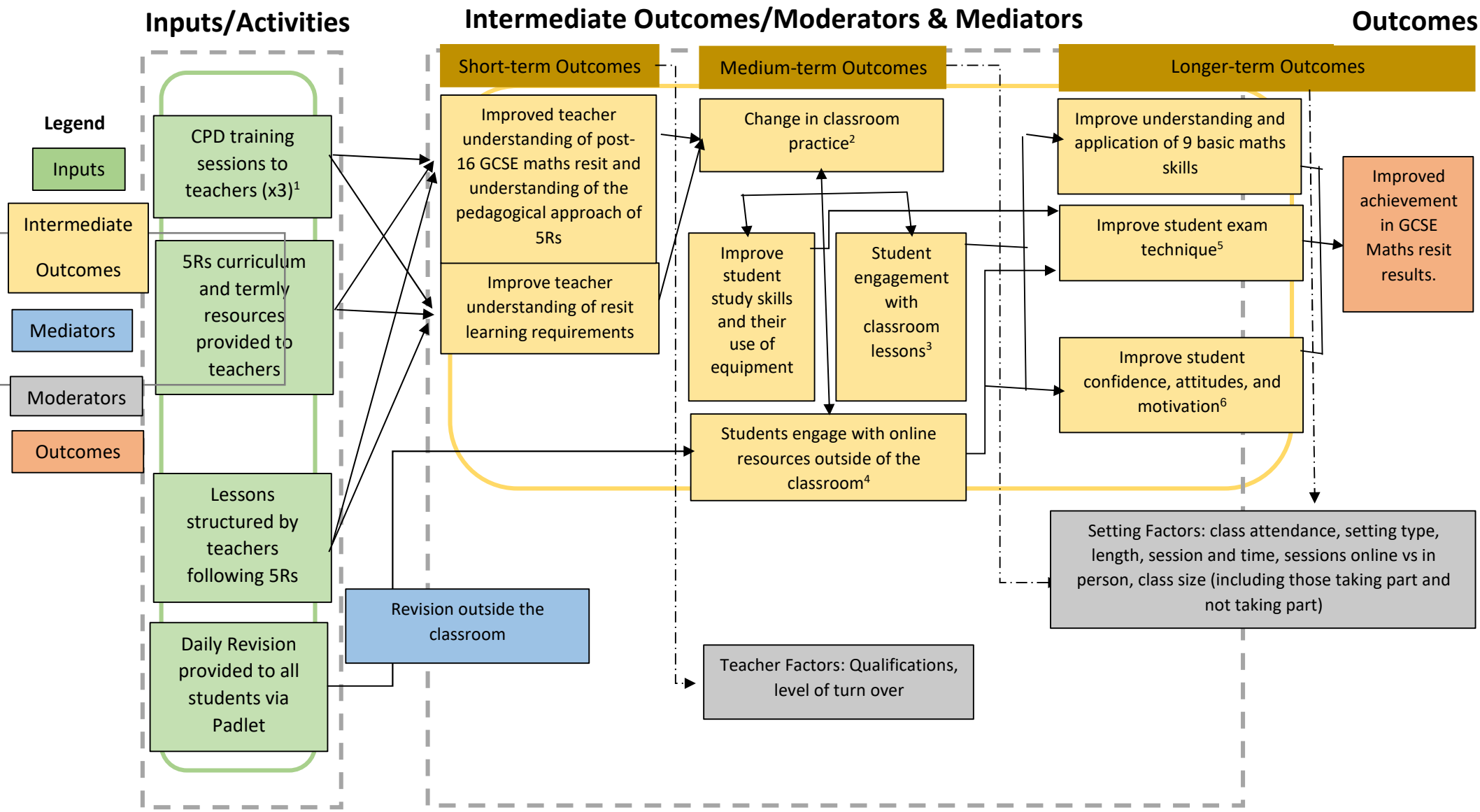
[2] The lesson structure has changed from the previous trial in that it is no longer limited to a pre-specified time structure and the 5Rs activities do not need to be done in order.

Repeat with exam questions	Exam questions to reinforce the learning from the topic covered in ‘revise’, initially modelled by a teacher
Ready for exam	Focuses on good exam technique and commonly made mistakes and misconceptions

The logic model (see Figure 1), developed by the evaluation team in conjunction with the 5Rs developer, outlines the mechanisms by which the intervention is expected to work. The 5Rs training and curriculum feed into improving teacher understanding of post-16 GCSE resit learning requirements and ensures that teachers understand the pedagogical basis of 5Rs. Teachers are encouraged to work via the student Padlet during each lesson and it is expected that this will improve their confidence in delivery (especially for non-specialist maths teachers) and level out teacher-factor moderators such as qualifications and level of turnover. In turn, it is anticipated that improving teacher understanding and knowledge will lead to changes in classroom practice, which is defined as following the 5Rs model routinely in an order which suits students' understanding (RE-Visioning maths).

The change of classroom practice is expected to lead to improvements in student study skills; developing good daily maths habits through using the materials and equipment available; improving student engagement with lessons; and enabling students to monitor and see improvements in their own learning through instant marking and checking their working-out to improve understanding and learning. The online resources are expected to enhance three further areas: student understanding and application of the nine basic maths skills; exam technique; and confidence, attitude and motivation towards maths. It is intended that this will be accomplished through encouraging and inspiring catchphrases, Tik Tok videos showing mathematical methods, and the design of 5Rs as a focused and fast-paced programme. Additionally, (in parallel with the provision of online resources) familiarity with the Padlet in classroom practice is expected to improve engagement with the Padlet resources outside of the classroom. It is thought that improving engagement outside of the classroom will further boost confidence and support attitude change towards maths which, in turn, will also support further engagement in classroom practice. Revision (as opposed to RE-Visioning) work undertaken outside the classroom will also mediate students' engagement with online resources outside of the classroom. Setting factors such as class attendance, session length and time (see Figure 1) may moderate these medium-term outcomes. For example, attending class regularly may have more positive effects on engagement in and out of the classroom. Altogether, these elements are intended to improve achievement in GCSE maths resits.

Figure 1 – 5Rs Logic Model



[1] support and guidance offered in between times on request [2]Following each of the 5Rs within each lesson and Re-Visioning maths. [3] Self-monitoring and instant marking and checking. [4]Through working on the Padlet in class and at home. [5/6] Through online videos, motivational mantras, and the overall design of the materials.

The programme will be delivered from early in the Autumn Term 2022 until the GCSE maths exam(s) in the Summer Term 2023 (Cohort 1) and in the Autumn Term 2023 until the GCSE maths exam(s) in the Summer Term 2024 (Cohort 2). Teachers are expected to use the 5Rs approach in every maths lesson during this period. The Padlet will provide an hour's worth of work for the students every weekday, for 30 weeks, as well as revision work during the holidays. The control group will receive no training and will undertake their teaching as usual within the evaluation year. Incentives are offered to both control group settings (£1000) and intervention group settings (£500) on completion of the evaluation. It is thought that these substantial monetary incentives will support both recruitment of settings and reduce attrition.

Table 2 summarises the specific facets of 5Rs for this evaluation via a Template for Intervention Description and Replication (TIDieR), as adapted for EEF projects (Humphrey et al., 2016).

Table 2: Aspect of TIDieR

Aspect of TIDieR	Exemplification relating to the evaluation
Brief name	5Rs (an approach for post-16 students studying and preparing to resit GCSE Maths, developed by Julia Smith)
Why: Rationale, theory and/or goal of essential elements of the intervention	5Rs is a manualised intervention that aims to enhance the support teachers give to students re-sitting their GCSE Maths to improve their attainment. The intervention aims to cover the mathematical basics, plug knowledge gaps, improve exam technique and introduce students to alternative mathematical methods (Re-Visioning) that they may not have encountered in school. It aims to give students: • the skills to avoid common mistakes and to address misconceptions; • the ability to ensure they practice and maintain their existing maths knowledge and skills; • an increase in motivation and the ease of ability to revise outside of lessons by using technology effectively. 5R's is a flexible structured format of five key components delivered during a one-hour lesson, namely: 1. Recall (the 9 key maths facts) 2. Routine (to keep topics fresh) 3. Revise (one topic per lesson) 4. Repeat (key exam questions) 5. Ready (for the exam)
Who: Recipients of the intervention	A maximum of five teachers of maths resits per setting will undergo three days of training each. All students in classes participating in the intervention aged 16 - 19 that have not achieved grade 4 or above at GCSE Maths and are studying to take GCSE Maths in the Summer Term 2023 (Cohort 1) or 2024 (Cohort 2).

What: Physical or informational materials used in the intervention	Teachers will be provided with schemes of work and lesson plans. They will also have access to a secure website which will give them access to the intervention resources, videos demonstrating alternative methods and online support through an FAQ section with facilities for teachers to ask questions and to develop a community of practice. They will also have access to the student Padlet and will be encouraged to develop lesson plans based on the Padlet structure. They will also be provided with mathematical tea towels to encourage daily maths habits and a Pomodoro timer so settings can follow the Pomodoro Revision technique. This will be managed by Julia Smith. Students will have access to a number of resources such as CorbettMaths cards which are given in addition to online resources that are linked via the Padlet. The resources consist of a range of free websites including onmaths.com, mathsbot.com, corbettmaths.com, m4ths.com. There are approximately 40 resources available to students. These are core areas for student revision which allow them to watch video instruction or sit past papers and questions which also self-mark.
What: Procedures, activities and/or processes used in the intervention	• Teaching staff CPD – 1 day per term – the training will be delivered via online webinar. The training will familiarise teaching staff with the approach and introduce the resources, schemes of work, lesson plans and Padlets. • Day 1 delivers the Autumn Term lesson plan materials, Padlet technologies and approaches as well as the rationale behind the 5RS; Day 2 the Spring term includes the lesson plan materials and Top Tips; and Day 3 the Summer Term lesson plans up to and including exam time and more specific exam technique classroom work. • 5Rs schemes of work and lesson plans. The schemes of work are specific to the Department of Education GCSE maths specification and, as such, are not exam board specific. • Initial diagnostic tests to determine students' current level of knowledge/achievement. • Online support through the secure 5Rs website. This support consists of a contact page where there are FAQs, or an online form can be completed and a telephone helpline is also available for further assistance.
Who: Intervention providers/implementers	The programme is designed to be delivered by the usual teaching staff for post-16 GCSE resit maths. The teaching staff will receive three days training from Julia Smith. One person from each setting will be designated as the project lead and will take responsibility for its smooth running as well as acting as the main contact with the delivery and evaluation teams. This will be a member of staff who the college decides is in the best position to deliver what is required from the project lead (probably either a member of teaching staff, a senior manager, or an administrator).
How: Mode of delivery	The CPD will be delivered as online webinars, with an online presence for guidance and support and a helpline for further support. The programme itself will be delivered to whole classes in

	the standard time slots for GCSE resit maths. Students are also expected to work outside of the classroom on the Padlet.
Where: Location of the intervention	The CPD will be delivered online via webinar. 5Rs will be delivered in the usual classroom space for GCSE resit lessons. Settings (Sixth Form Colleges, School Sixth Forms and FE Colleges) will be recruited across England. 50% of the settings will be recruited from accelerator fund areas.
When and how much: Duration and dosage of the intervention	The CPD will be delivered in single online webinars at the beginning of each term. The 5Rs programme will be delivered as a replacement for the standard GCSE resit lessons for an entire academic year. It is anticipated that this will be around 3 hours a week in class plus additional work done elsewhere (up to one hour of content per day in total) via the Padlet over the course of one academic year.
Tailoring: Adaptation of the intervention	The structure of 5Rs lessons is well defined and teaching staff will be provided termly with a scheme of work and teaching resources. However, they may make surface adaptations to facilitate a sense of ownership and fit to learner context. Where the lesson slots do not equate to the one-hour sessions in the 5Rs model, teachers will be advised how to adjust the content accordingly. For instance, the Revise/Repeat sections can be repeated with an additional core topic to fill a longer lesson and use of the Padlet is encouraged so teachers can familiarise themselves with content and structure.
How well (planned): Strategies to maximise effective implementation	To maximise the effectiveness of the implementation, the following strategies will be adopted: • Teaching staff to take part in online training sessions each term • On-going support provided to teaching staff through the 5Rs website • One-to-one telephone support line for teachers

Impact evaluation

Research questions

The central aim of the trial is to evaluate the impact of 5Rs on GCSE maths attainment for students aged 16-19 who are resitting GCSE maths to try to achieve a grade 4 or above.

The primary research question is:

1. How effective is 5Rs compared to “teaching as usual” in improving outcomes in raw GCSE maths scores for resit students aged 16-19?

The secondary research questions, all framed in the context of comparing resit students aged 16-19 following the 5Rs programme with those receiving “teaching as usual”, are:

2. How effective is 5Rs in improving the proportion of students achieving a grade 4 or higher for GCSE maths?
3. Does 5Rs have an impact on student attitudes towards maths, as measured by an adapted Attitudes Toward Mathematics Inventory (ATMI)?

4. Does 5Rs have an impact on student retention rates as measured by exam attendance?

The final research questions explore the impact of 5Rs on subgroups of the 16-19 year old resit student population:

5. What is the effect of 5Rs on those students who have ever been eligible for free school meals (FSM)?
6. What is the effect of 5Rs on those students who have higher levels of previous attainment?

Design

Table 3: Trial design

Trial design, including number of arms		Two-arm, cluster randomised controlled trial (efficacy)
Unit of randomisation		Setting
Stratification variables (if applicable)		Type of setting (FE College, School Sixth Form, Sixth Form College); number of students (dichotomised at median)
Primary outcome	variable	GCSE Maths attainment
	measure (instrument, scale, source)	GCSE Maths raw score converted to a z-score for analysis (maximum mark varies by exam board, e.g., AQA & Edexcel 240, OCR 300)
Secondary outcome(s)	variable(s)	GCSE Maths grade Exam attendance rates Student attitudes towards maths
	measure(s) (instrument, scale, source)	GCSE Maths grade (9-1) – as a binary measure i.e. achieving a grade 3 or below, or 4 or above Student attendance at each of the exam sessions Adapted Attitudes Toward Mathematics (ATMI) (Tapia & Marsh, 2000)
Baseline for primary outcome	**variable**	Maths attainment
	measure (instrument, scale, source)	Maths grade at GCSE and KS2 Maths score (obtained from the setting)
Baseline for secondary outcome	**variable**	Student attitudes towards maths
	measure (instrument, scale, source)	Adapted Attitudes Toward Mathematics (ATMI) (Tapia & Marsh, 2000; completed by the student)

The achievement of a grade 4 or above is the primary aim of studying and re-sitting GCSE maths, but using GCSE grades directly allows for very little differentiation since most learners will obtain a grade 3 or 4 on their resit. Therefore, the GCSE raw mark - standardised for analysis as maximum mark varies by exam board - will be used as the primary outcome and achieving a grade 4 or above will be a secondary outcome. This will be more sensitive to change than a binary yes/no measure and will allow us to avoid a Type II error (wrongly concluding there is not an important difference when actually there is). From a policy perspective, whether a student achieves a grade 4 or above is the most important

outcome, and as such we will present this as a key secondary outcome. It was shown in the previous EEF evaluation that it is possible to collect this data from the settings directly (Hanley, Elliott, Coleman, Fairhurst, Fountain & Haynes, 2021).

Randomisation

Once eligible settings have signed the MOU and provided baseline data, they will be randomised. Settings will be allocated to either the intervention or act as a control (teaching as usual), using minimisation by type of setting and number of students. Type of setting will have three levels: FE college (including any University Technical Colleges (UTCs)), Sixth Form college or School Sixth form, and number of students will be dichotomised at the median - estimated from the 2021-2022 academic year's cohort. It is not anticipated that the characteristics of the settings will change between Cohort 1 and Cohort 2 – so the median from Cohort 1 will be used throughout. These minimisation factors have been chosen to achieve balance across the trial arms in terms of the type of setting as this may predict outcome, and to achieve roughly equal numbers of students in each arm. A statistician at the YTU will be responsible for conducting the minimisation via the software, MinimPY (Saghaei & Saghaei, 2011). The analysing statistician will not be blind to group allocation.

Participants

Post-16 education providers in England are eligible to take part in the trial. This includes FE colleges, Sixth Form colleges, School Sixth forms and UTCs. Settings are eligible to participate if the following criteria are met:

- They have a minimum of 15 students aged 16-19 re-taking GCSE maths in the year 2021-2022 (Cohort 1) / 2022/2023 (Cohort 2) and expect this number to stay constant or rise in 2022-2023 (Cohort 1) / 2023/2024 (Cohort 2).
- GCSE students are enrolled by September 2022 (Cohort 1) / September 2023 (Cohort 2) for the full academic year.

Settings will not be eligible if any of the following apply:

- They operate roll-on roll-off recruitment of students.
- They or their staff have previously been trained in, or used, the 5Rs programme, including accessing the 5Rs materials available on the AQA website. AQA have agreed to check potential participants against their records and will confirm whether or not they have been previously involved (data protection regulations do not allow the researchers direct access to this information).
- They were involved in the 2019-2020 trial and were in the group that received the 5Rs programme (those settings that followed teaching-as-usual – the "control group" [3]– will be eligible for 2022-2023 (Cohort 1). Those who were selected as control group for 2019-2020 and 2022-2023 will not be eligible to minimise drop out.

Settings will be recruited by the Association of Colleges delivery team, with support from the evaluation team at York. They will be recruited through mass mail-outs, publicity through professional bodies and at talks and conferences, through personal contacts, as well as using social media to advertise the opportunity.

Students will be eligible to participate provided they have not already achieved a grade 4 or above at GCSE maths and are studying to re-sit GCSE maths in Summer 2023 (Cohort 1) / Summer 2024 (Cohort 2). There are two tiers to GCSE maths: foundation (targeted at grades

[3] We acknowledge that this is not ideal however, due to a limited recruitment pool, this was deemed necessary.

1 to 5), and higher (targeted at grades 4 to 9). The higher tier paper is not recommended for students who are not expected to achieve grade 6 or above. It is anticipated that the majority of students we will include in this trial will sit the foundation tier paper, however, we will include students sitting either tier. A sensitivity analysis will explore the impact of excluding any students who do sit the higher tier paper (further details will be provided in the statistical analysis plan (SAP)).

Incentives

Whilst the research is designed to minimise burden on participating settings, settings will be required to assist with data collection for both impact and process evaluations. Intervention settings will receive the 5Rs programme and training. Settings allocated to intervention are expected to release specified staff for training. With this in mind, intervention settings will be provided with a financial payment of £500. Control settings will be provided with a financial payment of £1000.

Incentives to both control and intervention settings will be paid after final data submission of GCSE raw scores and grades for the Summer 2023 exams (Cohort 1) or Summer 2024 exams (Cohort 2) to the Evaluation Team.

Sample size calculations

Sample size calculations are presented in Table 4.

OVERALL

For this efficacy trial, due to a limited recruitment pool for post-16 settings taking Maths resits, plus additional restrictions on recruitment areas due to the accelerator fund[4] and exclusion of intervention schools from the previous trial, the aim is to recruit 80 settings over two years (Cohort 1 and Cohort 2) using 1:1 allocation. A maximum of 80, and a minimum of 15-20, students per setting will be enrolled into the trial. From the previous trial we saw an average cluster size of 49 and will use an expected average cluster size of 50 for this trial.

Within the evaluation we will not include any students who achieve a grade 4 or higher in November 2022 (see Appendix 1 for further details). As such, we need to account for any students in these clusters that may sit the exam at this timepoint and subsequently achieve a grade 4 or higher. In the previous efficacy trial, 28.8% (1293/4486) of the students sat the maths GCSE exam in November 2019, with 24.4% achieving a grade 4 or higher (315 of 1293). Therefore, we will conservatively assume 30% will sit the exam in November 2022, and 25% of those will achieve a grade 4 or higher - and account for these before accounting for student level attrition of 15%, as was done in the previous trial.

There is likely potential variation in cluster size between settings and a large variation in cluster sizes has the potential to increase the minimum detectable effect size (MDES). It is possible to account for variation in cluster size in the calculation of the MDES by considering the coefficient of variation of cluster size in the design effect (DE) as per Eldridge et al. (2006). The DE is the factor by which the sample size (at analysis) for a comparable

[4] The accelerator fund focuses on supporting schools using evidence-based maths and literacy programmes to aid recovery from the Covid-19 pandemic. The fund targets three Regional School Commissioner (RSC) regions particularly impacted by the pandemic: the North; East Midlands and Humber; and the West Midlands.

individually randomised trial should be multiplied to estimate the required sample size (at analysis) for a cluster RCT. A simple yet conservative estimate of the DE accounting for variable cluster sizes is:

$$DE = 1 + \{(cv^2 + 1)\tilde{m} - 1\}\rho$$

Where the coefficient of variation (cv) is the ratio of the standard deviation of the cluster sizes, sm, to the mean cluster size, $\tilde{m}$. The average cluster size at randomisation is assumed to be 50; however, if we account for those who pass in November, and pupil-level attrition at post-test (ie. pupils withdrawing from sitting the exam) then we might expect an average of 39 pupils per setting at analysis ($\tilde{m}$ = 39).

Since we do not know this information in advance, this can be estimated by dividing the likely range of cluster sizes (at analysis) by 4 (so (63-12)/4=12.75) (Eldridge et al, 2006). Therefore, we assume a cv of 12.75/39 = 0.33.

The symbol ρ represents the intracluster correlation coefficient (ICC). Allen et al. (2018) indicate that the ICC for maths increases with each Key Stage. At Key Stage 4, they calculated an ICC of 0.15 for Maths based on over 500,000 pupils from 3,058 schools. An estimate of ICC from the previous 5Rs trial found an ICC of 0.15. However, we shall conservatively assume a slightly increased ICC of 0.17.

Within the analysis for this trial, we shall adjust for KS2 maths score (as this is a more discriminating baseline measure than previous GCSE result, given that most previous results will be grade 3). This will correlate with the outcome to increase the power of the trial (i.e. decrease the MDES the trial is able to detect). There are limited data to estimate a correlation between maths KS2 and GCSE resit score for pupils who fail their initial GCSE attempt. However, there is data to suggest that, nationally, the correlation between KS2 maths and GCSE maths is high (0.763). We shall conservatively assume a correlation of 0.6.

Therefore, we anticipate recruiting 4,000 students (80 settings with average of 50 students per setting), which will reduce to 3,145 at analysis after removing those who achieve a grade four or higher in November 2022, and accounting for 15% attrition. This would be the equivalent of a sample size of 589 for an individually randomised trial. With 80% power, this sample size would give us a MDES of approximately 0.23 in the analysis (calculated in Stata v16).

<u>FSM</u>

Data from the Sixth Form Colleges Association (2021) indicate that 22% of students attending Sixth Form colleges and 16-19 academies are ‘disadvantaged’; defined as “those who were eligible for free school meals at any point in the previous six years or have been looked after by their local authority”. Due to a lack of evidence on FSM prevalence in students specifically resitting GCSE maths, we will conservatively assume it to be 22%. If we recruit 80 settings with an average of 50 students, we might therefore expect to have at least 691 FSM students in the analysis, assuming 66 of these would achieve a grade four or higher in November (25% achieving a grade 4 or higher, of 30% sitting), and 15% attrition. Assuming the same ICC and correlation as above, and accounting for variable cluster sizes, we would have 80% power to detect a MDES of 0.27.

Table 4: Sample size calculations

		OVERALL	FSM
Minimum Detectable Effect Size (MDES)		0.23	0.27
Pre-test/ post-test correlations	level 1 (pupil)	0.60	0.60
	level 2 (class)	-	-
	level 3 (setting)	-	-
Intracluster correlations (ICCs)	level 2 (class)	-	-
	level 3 (setting)	0.17	0.17
Alpha		0.05	0.05
Power		0.8	0.8
One-sided or two-sided?		Two	Two
Average cluster size (at randomisation)		50	11
Number of settings	Intervention	40	40
	Control	40	40
	Total	80	80
Number of students	Intervention	2000	440
	Control	2000	440
	Total	4000	880

Outcome measures

PRIMARY OUTCOME

The primary outcome measure is the GCSE maths resit raw mark from the Summer 2023 exams (Cohort 1) / Summer 2024 exams (Cohort 2) which will be obtained directly from settings. Any student who sits the exam in November 2022 (Cohort 1) or November 2023 (Cohort 2), and achieves a grade 4 or above, will not be included in the analysis, and the sample size reflects this possible loss of students. As settings may sit exams from different boards (e.g. Edexcel, OCR and AQA) which have differing scoring systems and grade boundaries, the raw marks will not be comparable. It will therefore be necessary to identify which exam board each setting uses and to convert the raw marks to 'standard' (z) scores for analysis - for each Cohort separately (i.e., the relevant parameters from 2023 exams will

be used to standardise Cohort 1, and those from 2024 for Cohort 2). Let x_{ij} be the score for student i sitting exam board j, then their z-score is:

$$z_{ij} = \frac{(x_{ij} - \mu_j)}{\sigma_j}$$

where μ_j is the mean of the population sitting the exam with board j, and σ_j is the standard deviation of the population sitting the exam with board j. These parameters will be obtained from the exam boards if possible, or else the sample mean and standard deviation from the data collected will be used.

SECONDARY OUTCOMES

The secondary outcome measures are:

- achievement of grade 4 or above at resit GCSE as a binary measure obtained from the exam board via the settings;
- student attendance at exam sessions obtained from the exam board via the settings;
- student attitudes towards maths using an adapted version of the Attitudes Toward Mathematics Inventory (ATMI) (Tapia & Marsh, 2000).

After comparing the ATMI with other attitude instruments available, it was decided that with modifications, this would be the most appropriate outcome measure for this study. Where necessary, the language has been anglicised (the original being North American) and the instrument shortened, with full agreement of the originator (Martha Tapia). The original instrument (Tapia & Marsh, 2000) has 40 items (each with a 5-point agree/disagree likert scale) split into four sub-scales (Self-confidence, Value, Enjoyment, and Motivation). The estimated completion time is 20 minutes, which was too long for practicality in this study, so it was necessary to create an abridged version. When statements less relevant to the evaluation were removed, 29 questions remained, primarily from the Self-confidence and Enjoyment sub-scales. Since retaining (or losing) entire sub-scales maximises the validity of the shortened instrument, the Motivation and Value scales were removed and Self-confidence and Enjoyment kept intact. The deleted subscales were of less direct relevance to 5Rs and its logic model - the Motivation statements tend to be about maths in general (rather than motivation to get through the resits) and Value relates more to attitudes towards maths that were not considered of central importance to our target population.

Students will be asked to complete the ATMI and baseline survey (combined into one survey) online during a maths lesson, and they will be encouraged to complete it by the teachers (see IPE research methods and methods overview, Table 6). The online surveys will automatically be sent to the evaluation team via Qualtrics to the teachers involved. Where students are absent the link for the survey will be emailed to them by the teachers and they will be asked to complete the survey from home. Summary scores will be obtained by summing the item scores for each subscale and as a total score (sum of the two subscale scores). This will be done automatically through setting the Qualtrics survey to assign scores to each answer so no double scoring or blinding will be required.

Compliance

The definition of ‘compliance’ has been agreed with the delivery team and the EEF as teacher attendance at the first two of the three webinar training sessions (or equivalent if a teacher joins partway through the trial and has to be trained on a catch-up basis - i.e., watching the recorded sessions). Therefore, compliance will be on a class-level, rather than

student or setting level. The approach to compliance analysis will be specified in detail in the SAP.

Longitudinal follow-ups

There are no planned longitudinal follow-ups for this trial, although as the data will be archived with the EEF, the data may be linked with other datasets for further analysis in the future, to this project.

Analysis

A detailed SAP will be prepared within three months of randomisation of Cohort 2, following the most recent EEF guidance. The proposed analysis is provided in brief below.

The main analysis will take place after completion of the 2023-2024 academic year to capture the results of the Summer 2023/2024 GCSE maths resits. All analyses will be conducted on an intention to treat basis, using two-sided significance at the 5% level, using Stata v17 (or later). Baseline data will be summarised by trial arm and presented descriptively both for settings and as randomised, and as included in the primary analysis. No formal comparison of baseline data will be undertaken, except that Hedges' g effect sizes for the difference between the groups for measures of prior attainment will be presented with 95% confidence intervals (CI).

The correlation between the KS2 maths score with the outcome GCSE score will be investigated. The ICC for KS2 maths score associated with school and class will be presented with a 95% CI.

PRIMARY ANALYSIS

Raw marks (within exam boards) and overall z-scores will be summarised by randomised group – overall, and for each Cohort. The primary analysis will investigate any difference in z-scores between intervention and teaching as usual groups for the students' summer exam. Mixed-effect linear regression will be used at the student level. Group allocation, KS2 maths score, type of setting, size of setting (in continuous form), and cohort (1 or 2) will be included as fixed effects in the model. Setting will be included as a random effect to account for the clustering. The predicted adjusted mean difference in scores between the two groups with an associated 95% CI and p-value will be presented.

The treatment effect size between the groups at post-test will be calculated by dividing the adjusted mean difference obtained from this model with the pooled, unconditional variance obtained from an unadjusted model that includes only the treatment group and accounts for clustering at setting level. The 95% CI for the effect size will be obtained by dividing the 95% confidence limits for the adjusted mean difference by this same variance. The ICC for the primary outcome associated with school and class will be presented with a 95% CI.

SENSITIVITY ANALYSES

The primary analysis will be repeated excluding any student who sits the higher tier paper (as opposed to the foundation tier paper). Students are typically entered into the foundation paper if they are anticipated to be lower achievers, and this is the group of pupils that the intervention is most suited for. iIn the previous trial about 2% of those who resat in

November 2019 sat the higher tier paper - although this may be higher in the Summer exam given that not all settings choose to enter students into November resits.

MISSING DATA

Baseline characteristics of students who are included in the primary analysis will be compared with those not included in the model (due to missing outcome data). A mixed-effects logistic regression model with presence or absence of GCSE raw mark data as the outcome and including all baseline variables will be run to explore potential predictors of missingness. The impact of missing data on the primary analysis will be assessed by repeating the analysis on a data set where missing data has been completed using multiple imputation, in the case where more than 5% of cases are excluded from the primary analysis due to missing data.

SUBGROUP ANALYSIS

A subgroup analysis is planned to explore the effect of the intervention on students who have ever been eligible for free school meals (FSM). This will be assessed both via inclusion of FSM status as an interaction term between FSM status and allocation in the primary analysis model, and by repeating the primary analysis on the subgroup of ever eligible for FSM students.

A second subgroup analysis will be conducted to explore whether those with better prior attainment benefit more from the intervention.

These subgroup analyses will be underpowered and thus exploratory only.

SECONDARY ANALYSIS

A mixed-effects logistic regression, adjusted as the primary analysis was, will be used to compare the likelihood of students in the intervention and teaching as usual groups achieving a pass (grade 4 or above) at resit. The number of exam sessions the student attends (up to a maximum of 3) will be summarised by trial arm and will be dichotomised as: sat all papers; vs sat some or no papers (dependent on the exam board) and analysed using a mixed-effects logistic regression, adjusted as for the primary outcome. The majority of exam boards have three papers, but not all, and the above categorisation takes this into account by being analysed in relation to the proportion of papers sat, rather than specific number of papers sat.

The total ATMI score will be analysed as described for the primary outcome of GCSE maths raw mark. The Self-confidence and Enjoyment subscale scores will be summarised descriptively but will not be formally analysed, as the validity and reliability of the measure may not hold for individual subscales.

Implementation and process evaluation

Research questions

RQ1 How closely does the 5Rs as implemented follow the intended model, as outlined in the TiDIER? How well is it being delivered?

RQ2 What is the dosage (how often do teachers deliver 5Rs lessons and how long do they last; what is the student attendance rate across lessons)?

RQ3 What factors, as perceived by teacher, influence any variability in fidelity, delivery, or attitudes towards the programme (e.g., setting and teacher factors)?

RQ4 What are the barriers and enablers to adopting the programme? What are the barriers and enablers to adopting the programme specifically for disadvantaged pupils? Has 5Rs been adapted during the trial? How and why?

RQ5 What is the level of compliance with the programme (measured as attendance at training)? What are the reasons for any non-attendance?

RQ6 How are students engaging with 5Rs and what impact does it have on their attitudes to maths? How much work do they complete on their own, outside lessons?[5]

RQ7 How are teachers engaging with 5Rs? Are teachers understanding the needs of resit students in terms of re-visioning maths and if so, is this influenced by the programme? What are teachers' opinions about the training provision and subsequent support?

RQ8 What is the nature of "teaching as usual" approaches? How does 5Rs compare to existing practice in post-16 maths resit classes?

Research methods

The IPE will use mixed methods (for full details see Table 5), incorporating the following:

- **Pre-intervention teacher survey** of all settings to collect information about existing "teaching as usual" practices (such as student engagement, use of resources, and usual teaching techniques), setting factors and teacher contextual factors such as teaching experience which may act as moderators to the intervention. The survey will be developed by the evaluation team and distributed via Qualtrics. This aspect will address RQ8 with regards to usual practice and comparisons to 5Rs delivery. This method of data collection will allow for an overall descriptive analysis of 'usual practice'. The survey will be distributed via Qualtrics between September to October 2022 (Cohort 1) and September to October 2023 (Cohort 2).
- **Pre-intervention student survey** of all students in all settings to collect information on students' reasons for re-taking GCSE Maths and their maths skills and habits. The survey also incorporates the Attitudes Toward Mathematics Inventory (ATMI) (Tapia & Marsh, 2000). This aspect will address RQ6 of the IPE and will also be used as part of the Impact evaluation. The surveys will be administered via Qualtrics between October - November 22 (Cohort 1) and October - November 2023 (Cohort 2)
- **Training attendance data** (compliance measured as attending the first two of the three webinars) will be given to the evaluation team via Julia Smith, and **student attendance for maths lessons** as a measure of dosage will be sought from settings. This aspect will address RQ5 with regards to level of compliance. Training attendance data will be collected at the end of each final training webinar (April 2023 – Cohort 1 / April 2024 – Cohort 2).
- **Observations of training webinars** (one per term) will be conducted by two members of the ET. An observation record will be produced by the evaluation team, with support from Julia Smith and the AoC. The observation record will measure

[5] This aspect will be given more emphasis given the findings of the previous trial (see page 5 of the previous 5Rs report). As this is an inherent aspect of the programme (as outlined in the logic model) we feel this is important to explore further.

clarity, quality, and fidelity to the programme training objectives and will also assess similarities and differences in training between cohorts. The training deliverer will also be interviewed. The observations and interview will address RQ1 one with regards to how well 5Rs training is delivered and how closely it is implemented in line with the intended model. Training observations will take place in line with training events. The interview will take place at the end of the intervention period.

- Six **setting visits** by members of the ET (one or two settings will be visited by two ET members for quality assurance purposes). Six settings have been chosen to represent two of each setting type. Settings will represent a mix of setting types (further education colleges, school sixth form, sixth form colleges) and a regional spread. Each visit will involve **a lesson observation** to record how faithfully teachers adhere to the lesson plan and how students engage with the lessons (addressing RQs 1, 3, 4, 7 & 8); a semi-structured **teacher interview** to unpick different elements of the lesson structure, delivery, timing, perceived usefulness of each element, enablers and barriers and student reaction (addressing RQs 1, 2, 3, 4, 5, 6, 7 & 8); and six semi-structured **focus groups** of three to four students. This size of group has been chosen because, although paired interviews worked quite well in the previous trial, discussion was occasionally inhibited. Having four participants allows for broader input whilst enabling each group member to have their say. Teachers will be asked to select students from across the spectrum of ability and attitude to maths, with a recognition that those who are willing to take part will not necessarily be typical of their classes. Discussion will centre on engagement outside of the lessons, particularly the use of the Padlet, usefulness of engagement, and students' reactions to the observed lesson (addressing RQs 1, 2, 3, 4, 6 & 8). These "case study" schools will be chosen to represent a range of contexts (e.g. FE college, Sixth Form college, School Sixth form; size of cohort). Ideally, the teacher interviews would be with the teacher delivering the observed lesson who would also coordinate volunteers to participate in the student focus group. The ET will develop the focus group schedules and the observation records will be developed by the ET and Julia Smith. Setting visits will take place during February 2023 and April 2023 (Cohort 1) and November 2023 and April 2024 (Cohort 2)
- **Post-intervention teacher survey** which will repeat some questions from the pre-evaluation survey (e.g. teaching approaches), whilst other questions will relate to 5Rs specifically and only be asked to those in intervention settings e.g. feedback on training including reasons for non-attendance, fidelity, enablers and barriers to implementation. Teachers will also be asked about the perceived effect of 5Rs on students, including engagement, motivation and confidence. This aspect will address RQs 1, 2, 3, 4, 5, 6, 7 & 8. The surveys will be administered via Qualtrics between May - June 23 (Cohort 1) and May - June 2024 (Cohort 2)
- **Post-intervention student survey** which will cover lesson attendance, experience of teaching approaches, ratings of motivation and confidence. Students will be asked to estimate the time spent in self-study, usage of the Padlet (intervention-only) and other revision support will be probed. A maths attitude instrument (the ATMI, Tapia & Marsh, 2000) covering self-confidence and enjoyment will also be administered. Students will be given an ID, allowing their responses to be linked to FSM status and prior attainment. This aspect will address RQ's 1, 2, 3, 4, 6 & 8. The surveys will be administered via Qualtrics between April - May 23 (Cohort 1) and April - May 2024 (Cohort 2)
- **Control group semi-structured telephone interviews** will be conducted with six teachers (three from Cohort 1 and three from Cohort 2) from control settings to

establish usual practice. Settings will represent a mix of setting types and a regional spread. The semi-structured interview schedule will be developed by the ET and will focus on common practices in settings and programmes that may be being delivered in control settings – where programmes are being delivered in control settings, we will investigate any similarities to the 5Rs programme. This aspect will address RQ8 with regards to usual practice and comparing 5Rs to existing practice. The interviews will take place during April - May 2023 (Cohort 1) and April - May 2024 (Cohort 2).

Analysis

The IPE has been designed to test the workings of the logic model (Figure 1), to check whether the intervention is operating as hypothesised. Table 5, below, shows how the findings will be used to support or counter the logic model and its constituent elements.

Table 5: IPE elements mapped to logic model

IPE element	Aspect of the logic model	Logic Model Outcomes
Training observations Teacher interviews Online teacher surveys	Teacher understanding of resit learning requirements	Short-term Outcomes Moderated by Teacher factors
Training observations Teacher interviews Online teacher surveys	Teacher understanding of post-16 GCSE maths resit and (intervention-only) understanding of the pedagogical approach of 5Rs	Short-term Outcomes Moderated by Teacher factors
Teacher interviews Lesson observations Online teacher/student surveys	Change in classroom practice	Medium-term Outcomes Moderated by setting factors
Teacher/student interviews Online teacher/student surveys	Change in student study skills	Medium-term Outcomes Moderated by setting factors
Teacher/student interviews Lesson observations Online teacher/student surveys	Student engagement during maths lessons	Medium-term Outcomes Moderated by setting factors
Teacher/student interviews Online teacher/student surveys	Student engagement with maths learning outside lessons	Medium-term Outcomes Moderated by setting factors
Teacher/student interviews Online teacher/student surveys	Change in understanding and application of 9 basic maths skills	Longer-term Outcomes Moderated by setting factors

Teacher/student interviews Online teacher/student surveys	Change in exam technique	Longer-term Outcomes Moderated by setting factors
Teacher/student interviews Lesson observations Online teacher/student surveys	Perceived change in student confidence, attitude and motivation	Longer-term Outcomes Moderated by setting factors
Teacher/student interviews Online teacher/student surveys	Perceived change in achievement	Longer-term Outcomes Moderated by setting factors

Table 6 summarises the range of methods that will be used, and how it relates to the research questions. The final column indicates what data will be collected. Each case study visit will be completed within a single day to minimise the burden on settings. Future refinements to the methods and instruments will be suggested as appropriate, as well as possible amendments to the intervention based on teacher and student feedback and researcher observation. Recommendations for the overall design of a prospective larger-scale trial will also be made.

Process evaluation data will be transcribed and coded in NVivo using a mix of inductive and deductive analysis to build themes and identify patterns within the data where applicable. The deductive analysis will use the steps in the logic model as a preliminary thematic framework, e.g., teacher understanding of 5Rs; pedagogical approach; changes in teaching practice; student study skills; student engagement and so on. Transcription and coding will be conducted by more than one researcher and quality assurance processes will be put in place to ensure inter-rater reliability.

Data from the different sources (i.e., survey data, outcome data, interviews, focus groups and observations) will be collected together and summarised by research question. Where appropriate, data will be triangulated to build a fuller picture of how GCSE maths resit lessons are being delivered and the level of teacher and student engagement.

Table 6: IPE methods overview

Research methods	Data collection methods	Participants/ data sources (type, number)	Data analysis methods	Research questions addressed	Implementation/ logic model relevance
Baseline setting context	MOU	ALL settings (80)	Frequency counts; Descriptive/thematic analysis	NA	Ascertain setting context (type, size, expected cohort size); exam board; details of participating teachers.
Teacher existing practice	Survey	ALL teachers (80+)	Frequency counts; Descriptive/thematic analysis (using inductive and deductive coding)	8	Establish usual practice; teacher background and experience, motivation and engagement.
Student early experience	Survey	ALL students (c4000)	Frequency counts; Descriptive/thematic analysis (using inductive and deductive coding)	6	Establish students' previous and current experience of maths teaching; student background; motivation and engagement; self-confidence and enjoyment.
Training attendance	Attendance registers (from trainer)	ALL training registers	Descriptive analysis	5	Compliance will be measured as attending days 1 and 2 of three CPD webinars.
Training events	Observation sheets	3 sessions (one per term)	Descriptive analysis (of schedule and fieldnotes)	1	Establish the expected model and fidelity in terms of different trainers' approaches.

Student lesson attendance	Attendance data (from setting)	ALL student records (c4000)	Descriptive analysis	6	Measure dosage and engagement.
Case study maths lessons	Observation sheet co-designed with development team	6 (intervention settings)	Descriptive analysis (of schedule and fieldnotes)	1, 3, 4, 7, 8	Explore what 5Rs looks like in the classroom – fidelity to lesson plan including timings; how different elements are received by students; adaptations and barriers; student engagement.
Case study teachers	Semi-structured interviews	6 (intervention teachers)	Thematic analysis (using inductive and deductive coding)	1, 2, 3, 4, 5, 6, 7, 8	Explore teacher opinions on different elements of 5Rs; adaptations, enablers and barriers; perceived student reaction; teacher response to training; perceived value of the approach.
Case study students	Focus groups	6 (intervention student groups, 18-24 students)	Thematic analysis (using inductive and deductive coding)	1, 2, 3, 4, 6, 8	Establish student reaction to the lessons and the different elements of 5Rs, especially in relation to previous GCSE maths teaching; activity outside lessons eg interaction with Daily Maths resource.
Usual practice	Semi-structured phone interviews	6 (control teachers)	Thematic analysis (using inductive and deductive coding)	8	Explore usual practice and how similar/different that is to the 5Rs approach

Post-intervention year feedback	Survey	ALL teachers (80+) and departmental heads (80)	Frequency counts; Descriptive/ thematic analysis (using inductive and deductive coding)	1, 2, 3, 4, 5, 6, 7, 8	Explore current practice; teacher motivation and engagement; perceptions of student engagement, motivation and confidence (including work outside lessons). 5Rs specific: feedback on training, frequency and scheduling of delivery, fidelity, opinion of different elements, any non-5Rs delivery, enablers and barriers to implementation. HoDs: reasons for being interested in 5Rs; satisfaction with programme (intervention group only).
Post-intervention year student feedback	Survey	ALL students (c4000)	Frequency counts; Descriptive/ thematic analysis (using inductive and deductive coding)	1, 2, 3, 4, 6, 8	To investigate teaching approaches used; opinion of different elements; confidence in maths; frequency of class attendance and time spent in self-study.

Cost evaluation

The cost evaluation will follow the most recent guidance from the EEF. All cost analyses will be conducted from the perspective of the settings. The costs will be broadly classified into three main categories as follows:

• Pre-requisites – this will include cost items already accessible to school staff such as computers and physical space.

• Start-up costs – this will include the necessary components required to start the programme such as training costs.

• Recurring costs – this will include resources required for each year of the programme for example any printouts.

Cost data will be collected from relevant staff members by the evaluation team at different time-points throughout the trial. The collection of this data will be integrated into the IPE data collection methods. All nominated teachers will be asked about specific cost-related data within the Summer 2023 (Cohort 1) or 2024 (Cohort 2) teacher survey which will capture the amount of time (staff working hours) spent completing the relevant training components of the programme and the cost of any cover staff; any start-up, prerequisites costs (e.g., computer or internet connectivity); unexpected or hidden costs associated with training. he survey will also capture the amount of time (staff working hours) involved in continuing to deliver the programme (e.g., the time spent accessing the websites and planning lessons), any recurring implementation costs (e.g., materials, print outs, resources), unexpected or hidden costs.

In addition to collecting data via surveys, in-depth cost data will be collected during case studies. Staff will be made aware in advance of questions relating to costs prior to interview(s) so they can prepare if necessary.

The total cost per school for a programme as implemented over three consecutive years, and the cost per-pupil-per-school-year will be presented. Costs will be estimated for the programme as it was implemented during the trial. Costs will be estimated using market values (i.e., not including any subsidies provided by the EEF for the purposes of the trial). Published unit costs will be utilised where possible, for example salary costs. Costs will be valued as per the year of analysis (expected 2023). Sensitivity analyses will be conducted to account for any uncertainty in the costing estimates. Sensitivity analyses will also be conducted to estimate the cost impact of variations to implementation delivery.

Ethics and registration

This trial comes under the ambit of the University of York's Department of Education Ethics Committee. Ethical approval was given on 2nd February 2022, reference Z4855807.

All participating settings will sign a Memorandum of Understanding that covers information about the study, and the respective responsibilities of setting, evaluation team and development team. It also covers the acquisition of NPD data and data archiving. Teachers will give informed consent to be observed and to take part in interviews. Student consent will be sought via the online survey.

The student participants will be treated as capable of making their own decisions about

participation since they are aged 16-19. They will be given the chance to withdraw from data collection. For ethical reasons we will request opt-in consent from those students taking part in the student focus groups.

This trial will be registered with the ISRCTN on agreement of the protocol.

Data protection

Data will be handled in accordance with the General Data Protection Regulations (GDPR). Personal data will be processed under Article 6 Section (e) of the GDPR ('Tasks carried out in the public interest') as the research is being conducted to support education provision in the UK (and, if applicable, Special Category data under Article 9(2)(j)). A Data Protection Impact Assessment (DPIA) will be conducted and Data Sharing Agreements will be put in place with settings. Information sheets, with the option to withdraw from the research, will be provided to potential participants as appropriate.

The participant information sheet will be compliant with the requirements of the GDPR, including a clear statement of the university's legal basis for processing personal data, which will be for the performance of a task carried out in the public interest (Article 6 (1) (e)). This is in line with the University's charter which states learning and knowledge will be advanced through teaching and research. If any special category data is processed by the University then this would be under the legal basis of archiving purposes in the public interest, or scientific and historical research purposes or statistical purposes.

The University of York will be the Data Controller and will also process data. Data subjects are the participants in the evaluation, which includes students and teachers in participating settings.

Personal data will be processed under Article 6 (1) (e) (*Processing necessary for the performance of a task carried out in the public interest*) and Special Category data under Article 9 (2) (j) (*Processing necessary for ... scientific ... research purposes)* of the General Data Protection Regulation (GDPR; 2018).

All participant data will be treated with the strictest confidence and will be stored in accordance with the GDPR. Identifiable information about participants will be shared by the evaluation team, with the EEF's archive manager and, in a pseudonymised form, with the Office for National Statistics and potentially other research teams. Matching to the National Pupil Database and other administrative data may take place during this and subsequent research. There will be no international data transfers outside of the EU.

Student participants will be informed about the research through an information sheet provided by the evaluation team. Participants will be asked to return a signed 'withdrawal from research' form if they are unwilling to share their data with the evaluation team and/or they do not wish to take part in any assessments or surveys. They will be asked to give informed consent for focus groups.

For the purposes of the research, details of participating students (e.g. name, date of birth, UPN/ULN, GCSE maths scores/grades) will be collected from settings and shared with the Department for Education, the EEF's archive manager and, in an anonymised form, the Office for National Statistics and potentially other research teams. Further matching to NPD data may take place during subsequent research. The details will be fully specified in the Data Sharing Agreement (DSA) which will be put in place between the University of York and each setting and will include the details of the types of personal data being shared, the purpose and duration of that sharing and the responsibilities each party has in relation to that information. The DSA will be put in place with participating settings before data transfer.

Settings will transfer data directly to the evaluation team on an encrypted spreadsheet via the University of York's secure file transfer service (DropOff).

A unique trial identification number (Trial ID) will be generated for each participant when their details are entered into the trial management system.

The trial management system and all electronic data will be held on secure University of York servers with access limited to specified members of the evaluation team. Paper documents will be held securely in a controlled access area in locked cabinets.

The dataset for statistical analysis will hold pseudonymised data and no settings, teachers or students will be identifiable in the report or the dissemination of any results.

Electronic data and paper documents, including identifiable personal student data, will be securely archived and disposed of by the Evaluation Team 5 years after the end of the study. All results will be pseudonymised so that no setting or individual student will be identifiable in the report or dissemination of any results. Pseudonymised electronic data and paper documents will be kept indefinitely.

The University of York's data protection policy is publicly available at:
https://www.york.ac.uk/records-management/dp/

All student data and any other personal data used for the project will be treated with the strictest confidence and will be used and stored in accordance with the General Data Protection Regulation (2018) and the Data Protection Act (2018).

Personnel

Delivery team:
Julia Smith, Maths Teacher Trainer and Author
Shireen Al-khalili/Beth Bishop, Head of Projects, Association of Colleges
Matthew Hinchley, Project Manager, Association of Colleges

Evaluation Team:
Dr Louise Tracey (PI)

Louise worked on numerous RCTs (feasibility studies, efficacy, and effectiveness trials), primarily in a PI or CI role. She led on the EEF ParentChild+ evaluation and Lexia. Louise will ensure overall delivery of the project.

Dr Pam Hanley (Co-I)
Pam has worked on several previous EEF trials, was Co-PI of the previous 5Rs trial, and has experience researching pedagogy and recruitment/retention problems in FE colleges. She will advise on research design.

Dr Erin Dysart (Co-I)
Erin currently project manages the EEF evaluation of ParentChild+. She will liaise with settings to ensure timely data collection, help design research instruments and conduct fieldwork, and establish/maintain the project database.

Elizabeth Coleman (Co-I)
Elizabeth is a statistician who has worked on a range of education and health trials, including the previous 5Rs trial. Her responsibilities will include writing the SAP and conducting the randomisation and statistical analysis.

During busy periods, there will be additional trial support.

Risks

Risk	Preventative measures	Likelihood
Insufficient post-16 settings recruited	• Allow recruitment of settings from the control arm of the previous Covid-19 impacted trial • GCSE maths resits are problematic for settings so there should be interest in exploring potential solutions • Emphasise that 5Rs is a promising intervention • Emphasise it includes 3 days staff development (might be attractive for non-specialists) • Stress ease of use and available support for non-specialist teachers • Work closely with the development team to combine experience of recruitment and knowledge of settings • Provision of incentives to settings	Medium
Attrition of settings	• At recruitment all settings will be required to sign a MOU which clearly specifies setting requirements and terms. Thus, settings are fully aware of the requirements. • Ensure buy-in at all levels of setting (principal, departmental heads, teaching staff) • Ensure training burden is low • Provide regular communication with key contacts throughout the project • Provision of incentives to settings which will only be given on completion of the research	Low
Attrition of teachers	• Training burden is low and online (and could be an attraction, particularly for non-specialists) • Provision of lesson plans and other resources made available through 5Rs should reduce workload • Check staff changes regularly with key contact • New staff to receive training as soon as possible • Well manualised intervention	Medium

Attrition of students	● We expect attrition to be high in the student survey and we will try to minimise this by minimising the length of the instrument and delivering it online ● In contrast we expect attrition for the primary and key secondary outcomes (i.e., GCSE maths performance and attendance) to be low as these will be sent to the research team by the settings	High/Low
High attrition from intervention or poor implementation	● Termly training and consistent support from trainers designed to assist strong implementation and mitigate against withdrawal ● Surface adaptation to suit context is permitted but will be monitored via observations	Low
Project staff turnover	● Department of Education/York Trials Unit have a range of experienced staff who could be drafted in if necessary ● All procedures will be documented to allow new personnel to takeover if needed	Low
Delays in settings providing student details and GCSE results	● The evaluation team has extensive experience of liaising with settings to obtain data ● The team will have additional staff to chase information during busy periods ● Settings will be given financial incentives after providing required data	High
Setting closures (Covid-19 or similar)	● Settings have more strategies in place to provide ongoing tuition if necessary	Medium

Timeline

Table 7: Timeline for Cohort 1

Activity	Jan – Feb 22	March – April 22	May – June 22	July – Aug 22	Sept – Oct 22	Nov – Dec 22	Jan – Feb 23	March – April 23	May – June 23	July – Aug 23	Sept – Oct 23	Nov – Dec 23	Jan – March 24
Ethical Approval obtained													
Grant agreement and budget finalised													
Recruitment													
Protocol													
ISRCTN registration													
Randomisation													
Gather MOU information and student data													
Teacher training session 1													
Intervention starts													
Student survey (baseline) - Secondary outcomes + IPE													

Teacher survey (baseline)													
Control group interviews													
Teacher training session 2													
Setting observations, interviews and focus groups													
Student survey (endline) – secondary outcomes + IPE													
Teacher training session 3													
Collect student attendance data													
Collect GCSE raw mark and grades from settings													

Evaluation Team

Delivery Team

EEF

Table 8: Timeline for Cohort 2

Activity	Jan – Feb 23	March – April 23	May – June 23	July – Aug 23	Sept – Oct 23	Nov – Dec 23	Jan – Feb 24	March – April 24	May – June 24	July – Aug 24	Sept – Oct 24	Nov – Dec 24	Jan – March 25
Recruitment													
SAP													
Randomisation													
Gather MOU information and student data													
Teacher training session 1													
Intervention starts													
Student survey (baseline) - Secondary outcomes + IPE													
Teacher survey (baseline)													
Control group interviews													
Teacher training session 2													
Setting observations, interviews and focus groups													

Access NPD for KS2 results, previous GCSE mark and FSM status													
Student survey (endline) – secondary outcomes + IPE													
Teacher training session 3													
Collect student attendance data													
Collect GCSE raw mark and grades from settings													
IPE analysis													
Impact evaluation analysis													
Submission of draft report													
Submission of final report													

Evaluation Team

Delivery Team

References

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Appendix 1: Changes since the previous EEF evaluation

Appendix Table 1: Changes since the previous evaluation

	Feature	Efficacy to retrial efficacy stage
Intervention	Intervention content	Teachers will use the Padlet to inform teaching; a more enhanced support package for teachers in which one to one support is available; and more motivational elements to the scheme of work. As a result of previous trial: online platform is more structured with specific set of activities and resources for each day; materials e.g. posters will emphasise importance of daily maths; teacher helpline to support training/delivery; lessons plans will be more structured and detailed and including ideas about maintaining engagement to end of lesson
	Delivery model	The following changes have also been made to the intervention since the last trial, which was affected by Covid: teacher training will now be done via webinar rather than face to face; there is now a more flexible approach to delivery of 5Rs (see intervention section below) to allow for settings to spend more time on areas they feel are most needed for students; daily maths will be provided on the Padlet to encourage the habit of daily maths practice.
	Intervention duration	No change
Evaluation	Eligibility criteria	Describe any changes in the eligibility criteria for participation in the evaluation (schools, year groups, pupils etc.).
	Level of randomisation	No change
	Outcomes and baseline	The decision not to collect November resit data was made to reduce the burden on settings. It also recognises concerns about the robustness of data given that (a) settings vary considerably in their November entry policies; and (b) the intervention will only have been running a maximum of 8 weeks, often less, once students are assigned to classes.

Control condition	No change