The 5Rs approach to GCSE Maths resits

Evaluation Report

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JPMorgan Chase & Co.

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Executive summary

The project

The 5Rs approach to GCSE maths resits aims to enhance the support teachers give to students resitting GCSE maths to improve their attainment. It is targeted at 16- to 19-year-olds (Years 12 and 13 or equivalent) who have not achieved at least a standard pass (grade 4 or above) in GCSE maths. Teachers were required to attend one training day per term and to deliver the programme during timetabled maths lessons for three ten-week terms. Ideally, three one-hour lessons were delivered per week although alternative lesson time allocations were also accommodated. The programme includes a scheme of work, three initial diagnostic tests, lesson plans, a defined lesson structure, and access to online resources for teachers and students. Each 5Rs lesson is structured into five sections: Recall (recalling key maths facts), Routine (completing practice questions), Revise (revising one specific topic), Repeat (practising exam questions), and Ready (focusing on exam technique). The programme aims to enable maths resit students to avoid common mistakes and address misconceptions, practise and maintain their existing maths knowledge and skills, and increase motivation to revise outside of lessons using technology.

The evaluation was severely disrupted by the COVID-19 pandemic. It was a two-armed cluster randomised controlled trial evaluating the efficacy of the 5Rs programme in 88 colleges and schools with an estimated 4,486 students. However, due to school and college closures during the pandemic and the associated changes to the GCSE assessment process, no data was collected for the primary outcome in summer 2020 (GCSE maths marks in exam resits) or for the secondary outcomes (achievement of a pass in GCSE maths resits, attendance at exam sessions, and attitudes towards maths). Consequently, this evaluation could not estimate the impact of the 5Rs programme on these outcomes. The report presents descriptive results from the November 2019 GCSE resits and findings from the implementation and process evaluation of the 5Rs programme, which included lesson observations, case-study interviews, teacher surveys, training observations, and collection of training attendance data. Delivery of the 5Rs programme was unaffected by COVID-19 for the first two terms of the academic year, however, lessons planned for the third term and the final teacher training session in April 2020 were disrupted by school and college closures.

The 5Rs programme was developed by Julia Smith and delivered with the support of the Association of Colleges. The evaluation took place from March 2019 to July 2020 and was co-funded by JPMorgan Chase & Co.

Figure 1: Key conclusions

Key conclusions
1. The 5Rs programme was well-received by teachers and was implemented as intended up until the disruption caused by the COVID-19 pandemic. One exception was that the programme intended to increase student revision outside the classroom but this evaluation did not find evidence that the 5Rs programme had successfully encouraged this.
2. Less than half of teachers attended both of the first two training sessions. However, most teachers seemed to understand the 5Rs approach and its underlying philosophy well and to have applied the five-part structure to their lessons. They were less likely to follow the detailed lesson plans.
3. Teachers perceived the 5Rs programme to have improved students' mathematical knowledge, independent learning strategies, exam technique, and confidence in maths.
4. Some teachers felt that the 5Rs programme assumed lessons could focus on revision when in fact time often had to be diverted to teaching maths concepts instead of revising them. Additionally, engagement tended to wane over the course of longer lessons, which affected the last two elements of the lesson structure (Repeat and Ready). All teachers of GCSE maths resits face challenges such as these in motivating pupils who have previously failed to achieve a standard pass (grade 4 or above) in GCSE maths and so are often unwilling to engage with compulsory maths lessons.

Additional findings

The performance of the 5Rs programme must be considered in the particular context of GCSE maths resits. Many students are disengaged and demotivated having previously failed to achieve a standard pass in GCSE maths and subsequently required by legislation to resit the exam. There is often a high rate of non-attendance at GCSE maths resit lessons. There was no evidence that the 5Rs programme boosted class attendance although admittedly this was not a predicted outcome of the programme.

There was no notable difference in standardised November resit GSCE maths scores between students in the intervention and control groups. A higher percentage of students sitting the exam passed in the intervention group, however, these results are descriptive only and cannot provide a reliable impact measure for the 5Rs programme. This is because they represent results from only a third of the trial sample and pupils resitting the exam in November instead of the summer are unlikely to be a representative sample of all students resitting GCSE maths. We cannot be sure of the comparability of the intervention and control group students who were entered for the exam, especially given that more students sat the exam in the control group than in the intervention group.

Most teachers following the 5Rs programme said they would be ‘very likely’ or ‘quite likely’ to use the approach again. Reasons for wanting to continue with 5Rs included the consistent, repetitive structure, increased student engagement because of it being split into different sections, and having several topics rather than just one in each lesson. Those who were unlikely to deliver the 5Rs again wanted it to be more individualised, slower, and more in-depth. Although most teachers were positive about the 5Rs lesson structure and the resources available, there was also feedback that the approach was similar to those already in use and that the resources were not new to the teachers. While some staff welcomed the lesson plans and the recommended instructional videos, others felt they were too experienced to need such support.

The evaluation identified three main influences on students’ attitudes to their maths class: how they perceived its relevance to their future, their self-assessed likelihood to pass, and competition with their other workload. Students in both the intervention and the control group felt they received better explanations than in their previous school experience, and this was often linked to smaller class sizes and being given more exam-style questions than previously.

Teachers seemed to understand the 5Rs pedagogical approach well despite less than half having attended both of the first two training sessions. In most observed lessons, teachers followed the structure of the 5Rs, if not necessarily the detailed lesson plans. In comparison, most control teachers followed a three- or four-part structure. Some teachers in the intervention group lengthened earlier segments of the lesson structure (particularly the Revise element, which introduces the key lesson topic) in response to learner needs. This change to the timings combined with increasing student disengagement during longer lessons meant that the Repeat and Ready sections (exam questions and exam technique) towards the end of the lesson sometimes suffered.

Introduction

Due to the impact of the COVID-19 pandemic, particularly the closure of schools and colleges in March 2020 and associated changes to the summer 2020 GCSE grading system, the evaluation could not be completed as intended and most outcomes could not be collected. However, most of the programme delivery and implementation and process evaluation (IPE) fieldwork had been completed before the closure of schools and colleges. This report describes the intended evaluation, highlights what changes were made as a consequence of the COVID-19 pandemic, and reports those aspects of the trial that it was possible to complete.

Background evidence

Department for Education (DfE) funding regulations introduced in 2014/2015 require full time students aged 16 to 19 who gain a D/3 in GCSE maths to be enrolled on a GCSE maths course, alongside their other subjects, as a 'condition of funding' of their further education. Part-time students and those students who gain an E/2 or lower are also required to study maths but this can be the Functional Skills course rather than GCSE. These new regulations have required further education institutions to deliver a full GCSE maths course for a large number of students who often struggle with a lack of motivation and have divergent attitudes to learning (Higton et al., 2017). Specialist staff recruitment and student attendance can be affected by the socio-economic conditions of the location of colleges (Higton et al., 2017). Recent surveys by the Association of Colleges (AoC) identify pressures caused by maths resits as one of the greatest concerns for colleges (AoC, 2018a) and vacancies for maths teachers as the third most difficult to fill (AoC, 2018b).

In 2017, a new 'more demanding' maths GCSE was introduced along with the change in grading from A–G to 9–1 (Maughan et al., 2016). Only 22.6% of those aged 17+ taking GCSE maths achieved a pass (grade 4 or higher) in 2018—the lowest rate since the resit policy was introduced—adding to the disquiet among some stakeholders who argue that young people should be learning more relevant maths skills (Burke, 2018). There are a variety of settings for post-16 education and the provision in these different contexts varies. Sixth form colleges are more likely to have qualified maths teachers and an academic slant, whereas non-specialist maths teachers and students taking vocational courses will be more prevalent in Further Education (FE) colleges. A report from Hayward and Homer (2015) highlighted several differences between the two, including a higher proportion of maths teachers in FE colleges having only GCSE maths and being part-time.

Education research with 16- to 19-year-olds in the past has been particularly difficult and previous studies among those doing GCSE maths resits have reported attrition rates of 60% (Swan, 2006) and 65% (Hough et al., 2017) although the latter was across five data points (absence rates rising from 12% to 42% across the academic year). The 5Rs programme has been developed specifically for students aged 16 to 19 to improve standard pass rates for those resitting GCSE maths and case study evidence suggests that 5Rs has had a positive impact on student attendance at lessons and increased the proportion passing their GCSE maths resits. AQA (formerly the Assessment and Qualifications Alliance) has published a case study on West Suffolk College (WSC), for example:[1] this showed that resit standard pass rates rose from 17% in 2015 to 35% in 2017 (compared with national average standard pass rates of 31% and 29.5% respectively). The senior manager in charge of maths at WSC ascribed this to a change of delivery model in January 2016 that introduced the 5Rs approach and improved the tracking of student progress. It is unclear how widely the approach has been implemented; it is, for instance, available as a guide for teaching post-16 maths resits on the AQA website. A number of AQA centres attended training on the 5Rs approach, such was the support from the awarding body. 5Rs offers a pedagogical approach that draws on (a) a range of researched revision approaches from the influence of Dunlosky (Dunlosky et al., 2013), (b) incorporates the work of Craig Barton and his diagnostic questions, (c) works on many approaches of spaced and interleaved practice and effective teaching practice, and (d) fully incorporates digital technologies through QR codes and Padlet use.

This two-armed randomised controlled trial (RCT) of efficacy formed part of the EEF post-16 theme and, with co-funding from JPMorgan Chase & Co., was intended to inform whether the earlier case study findings could be repeated in a more rigorous and larger scale evaluation. The 88 settings recruited were located throughout England: half of those recruited were FE colleges and the remainder were school sixth forms or sixth form colleges. Randomisation was at the

[1] https://filestore.aqa.org.uk/resources/mathematics/AQA-GCSE-MATHS-POST16-CS-WSC.PDF

setting level and the intended primary outcome measure was the GCSE maths raw mark with secondary outcomes of GCSE maths standard pass rate, attendance at exam sessions, and student attitude towards mathematics.

Intervention

The 5Rs programme is a manualised intervention that aims to enhance the support teachers give to post-16 students resitting GCSE maths in order to improve their attainment. It consists of both a set lesson structure and lesson content. The lesson structure is divided into Recall, Routine, Revise, Repeat, and Ready—the 5Rs. The content is built on the 40 most common topics in GCSE exams but also draws on good, pre-existing (mostly free) materials like the Corbettmaths revision cards. Three initial diagnostic tests, which each contain nine questions, are used to determine any gaps within the nine basic skills of maths as these are targeted first within the 5Rs approach. The tests were designed by Julia Smith who developed the 5Rs programme with AQA.

Up to five teachers of maths resit classes per intervention setting were provided with three days of training. These training days presented the teaching staff with the 5Rs approach and introduced the resources, scheme of work, lesson plans, and Padlets. The training days covered the following:

- day 1—delivered the autumn term lesson plan materials, Padlet technologies and approaches, as well as the rationale behind the 5Rs;
- day 2—introduced the spring term lesson plan materials along with Top Tips; and
- day 3—covered the summer term up to and including exam time and more specific exam technique classroom work.

The first two sessions—in August or early September 2019 and late December 2019 or early January 2020—were carried out face-to-face as planned. The third, scheduled for April 2020, was replaced with a live webinar because of the COVID-19 restrictions. The webinar was run on two separate occasions and, for those who could not attend, a recording was made available afterwards to maximise the number of teachers able to access the training. Training was provided by Julia Smith and one other trainer recruited and trained by Julia.

The face-to-face training was delivered in five geographical hubs covering London, the South-West, the North-East, the North-West, and the Midlands. Those who were unable to attend were supported by their colleagues who had attended through the online support mechanism via the secure website and by Julia Smith who ran some online webinars or contacted the setting directly if necessary. The online support consisted of a contact page with FAQs and an online contact form that could be completed and, if necessary, further assistance was given by phone or email.

Teachers had access to, and were encouraged to use, the initial diagnostic tests provided as part of the programme to highlight existing gaps in numeracy that could be addressed early on.

In this trial, each participating setting nominated a designated project lead who took responsibility for the smooth running of the intervention as well as being the main contact with the delivery and evaluation teams.

Teachers delivering 5Rs were provided with schemes of work and lesson plans based around the structured format of the five key elements delivered during a one-hour lesson (Table 1).

Table 1: The 5Rs—schemes of work and lesson plans

5Rs	Description	Duration (minutes)
Recall of knowledge	This uses resources such as the Corbett cards (maths revision cards from Corbettmaths) and is a mix of different topics.	5
Routine maths practice	Practice questions/worksheets on a range of topics.	10
Revise a key topic	This focuses on one specific topic.	15
Repeat with exam questions	Exam questions to reinforce the learning from the topic covered in revise, initially modelled by a teacher.	15

Ready for exam	Focuses on good exam technique and commonly-made mistakes.	15

The schemes of work and lesson plans provided were not exam board specific but based on the DfE GCSE maths specification.

Teachers had access to a secure website that shared the intervention resources, videos demonstrating alternative methods and online support through a FAQ section.

It was intended that 5Rs would be delivered in all GCSE maths resits lessons for the whole academic year; however, this was not possible during the Summer Term 2020 because of the closure of schools and colleges due to the COVID-19 restrictions. Students did have continued access to the remote learning provided by the Padlets, which they could use independently while settings were closed.

Each setting was given one set of revision cards from Corbettmaths and students were given access to various online resources via the Padlet. The resources were a range of free websites including onmaths.com, mathsbot.com, corbettmaths.com, m4ths.com. There were approximately 25 resources available to students. Resources available included instructional videos, past papers and questions which were self-marked.

Three generic Padlets were designed by Julia Smith: one specific to the 5Rs evaluation, one for teachers and one for student access. Padlet is a digital noticeboard that provides an online space for users to share text, videos, images etc.

Each setting had access to its own copy of the teacher Padlet to which could be adapted for their own needs. It provided access to the lesson plans, suggested resources, FAQs and allowed teachers to share experiences with their colleagues and ask questions of the 5Rs team.

The student Padlet was created to provide access to resources outside the classroom to encourage independent learning. Each setting had access to its own copy of the Padlet and the developers adapted these on request for a number of settings during the course of the trial.

Table 2 uses the 'template for intervention description and replication' (TIDieR) adapted for EEF projects; it describes the 5Rs programme as intended and as implemented for this efficacy trial (Humphrey et al., 2016).

Table 2: 5Rs summarised using the TIDieR framework

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.	The 5Rs approach has been developed to improve maths skills and outcomes through a revision-focused curriculum. It aims to cover the mathematical basics, plug knowledge gaps, improve exam technique, and introduce students to alternative mathematical methods that they may not have encountered in school. It intends 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; • increased motivation; and • the ability to easily revise outside of lessons by using technology effectively. It has been designed to look and feel different to students' previous learning experiences and emphasises self-study outside lessons on the basis that this should

	increase success rates. The year-long approach is based on revision techniques and assumes that students already have skills and knowledge from previous learning. The curriculum model draws upon the work of awarding body chief examiners—specifically AQA and Edexcel annual GCSE maths exam reports, Ofsted commentary on maths resit classes—every Ofsted report will have a reference to GCSE maths resit classes, the DfE's assessment objectives, and a wealth of advice and guidance from a range of post-16 resit practitioners. The 5Rs is a structured format of five key elements delivered during a one hour lesson, namely: 1. Recall (the 90 key maths facts); 2. Routine (to keep topics fresh); 3. Revise (one topic per lesson); 4. Repeat (key exam questions); and 5. Ready (for the exam).
Who: Recipients of the intervention	All students in intervention settings aged 16 to 19 who had not yet achieved a standard pass (grade 4 or above) at GCSE maths and were studying to resit GCSE maths in either November 2019 or May/June 2020 were eligible to take part in the trial.
What: Physical or informational materials used in the intervention	Teachers of intervention classes involved in the trial were provided with: • three days of training; • initial diagnostic tests; • schemes of work and lesson plans; and • access to a secure website containing intervention resources and videos demonstrating alternative methods managed by Julia Smith. Students had access to Corbettmaths cards and online resources via Padlet. The resources are a range of free websites including onmaths.com, mathsbot.com, corbettmaths.com, and m4ths.com. There were approximately 25 resources available to students.
What: Procedures, activities and/or processes used in the intervention	• Teachers trained to deliver 5Rs to students. • Teachers given access to the online Padlet providing teaching resources and support through a FAQ section. • Students given access to Padlet and encouraged to self-study outside lessons.
Who: Intervention providers/implementers	The programme is designed to be delivered by the usual teaching staff for post-16 GCSE maths resits.
How: Mode of delivery	The programme was delivered to whole classes in the standard time slots for GCSE maths resits.
Where: Location of the intervention	Settings were recruited across England. 5Rs was delivered in the usual classroom space for GCSE resit lessons.
When and how much: Duration and dosage of the intervention	The 5Rs programme was delivered as a replacement for the standard GCSE resit lessons for an entire academic year, anticipated to be for approximately three hours a week.

	The intervention took place in classrooms until the closure of schools and colleges in March 2020.
Tailoring: Adaptation of the intervention	The structure of 5Rs lessons is well-defined and teaching staff were provided termly with a scheme of work and teaching resources. However, they could make surface adaptations in order to facilitate a sense of ownership and fit to learner context. Where the lesson slots did not equate to the one-hour sessions in the 5Rs model, teachers were advised how to adjust the content accordingly. For instance, the Revise/Repeat sections could be repeated with an additional core topic to fill a longer lesson.
How well (planned): Strategies to maximise effective implementation	In order to maximise the effectiveness of the implementation: • teaching staff took part in face-to-face training sessions each term; and • ongoing support was provided to teaching staff through the 5Rs website.

Issues around recruitment, implementation, and testing

In total, 88 settings were randomised into the trial, which exceeded the recruitment target of 80; however, ten settings withdrew post-randomisation.

The main reasons for withdrawal were staffing issues and workload.

Some settings were slow in providing class, teacher, and student details. Others could not provide class and student data for several weeks after the beginning of term because students were still choosing their courses; as a consequence, these settings started implementation later than expected.

The final day of training could not take place in March 2020 but some teachers did attend the replacement webinars.

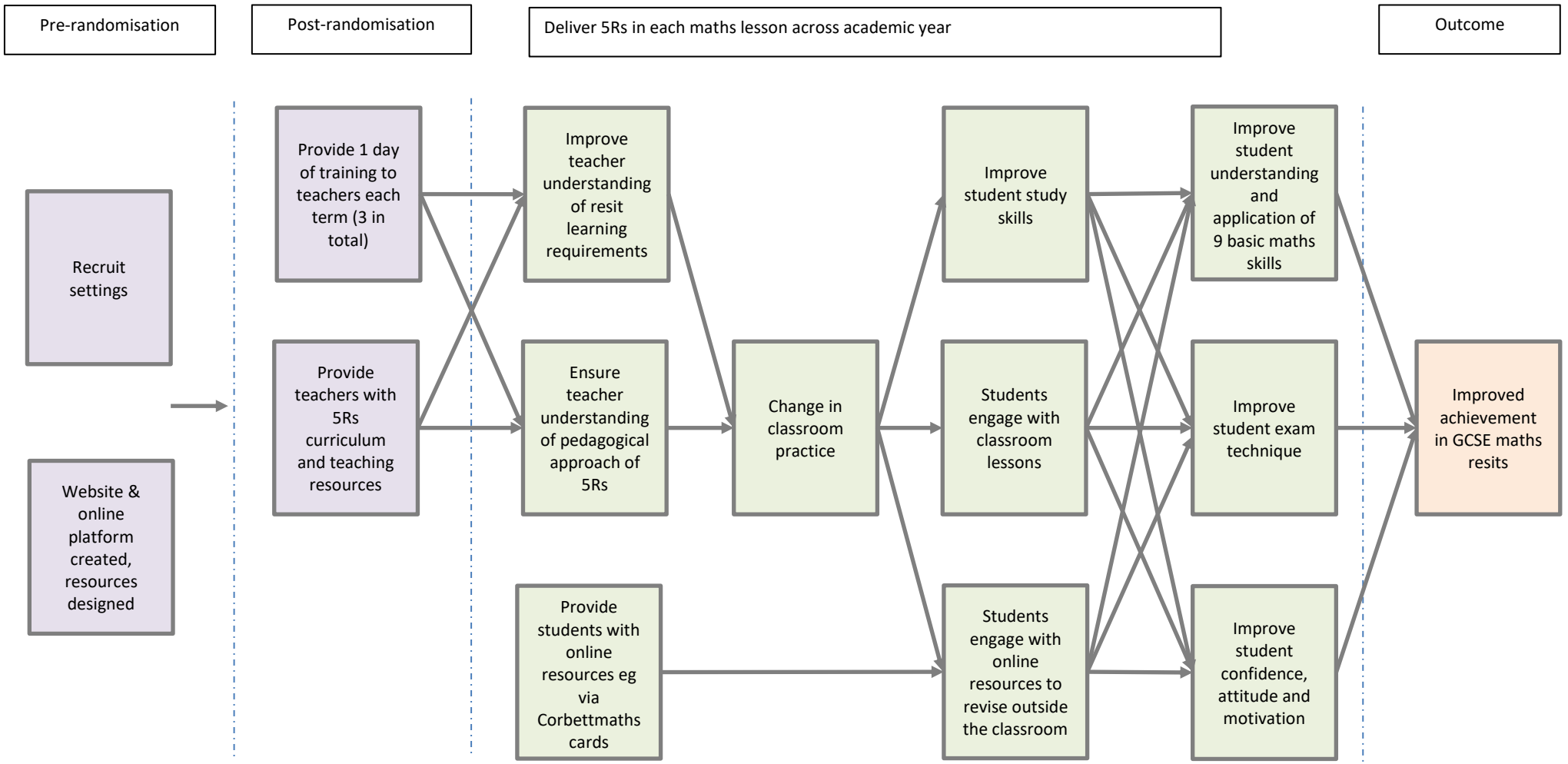
Implementation could not take place during the summer term as schools and colleges were closed due to the COVID-19 restrictions. However, students still had access to the Padlet and the developers recommended that teachers encouraged its continued use at home.

The GCSE results data, which was the primary outcome, could not be collected for the summer 2020 due to COVID-19-related exam cancellations and changes to the GCSE grading system.

Intervention logic model

The logic model in Figure 2 outlines the mechanism by which the intervention was expected to work. The 5Rs training and curriculum fed into improving teacher understanding of resit learning requirements, with the assumption that students had previous knowledge of all of the curriculum content and ensured that teachers understood the pedagogical basis of 5Rs. This in turn would lead to changes in classroom practice, resulting in improvements in student study skills, student engagement with lessons and (in parallel with provision of online resources) boosting students' engagement with online resources to revise outside the classroom. These were expected to enhance student understanding and application of maths skills; exam technique; and confidence, attitude and motivation towards maths, culminating in improved achievement in GCSE maths resits. Unfortunately, the cancellation of Summer GCSEs in 2020 and not being able to collect student attitude to maths data means that it is not possible to analyse whether the intended outcome was achieved.

Figure 2: 5Rs logic model



Evaluation objectives

The aim of the trial was to evaluate the impact of 5Rs on GCSE maths attainment for students aged 16 to 19 who were resitting GCSE maths to try to achieve a standard pass grade (a grade 4 or above). Unfortunately, the research questions below could not be answered due to the COVID-19 pandemic, the consequent cancellation of summer 2020 GCSEs, and the impracticality of administering the adapted Attitudes Toward Mathematics Inventory.

Primary research question:

RQ1: How effective is 5Rs compared to 'teaching as usual' in improving outcomes in GCSE maths scores for resit students aged 16 to 19?

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

RQ2: How effective is 5Rs in improving student pass rate for GCSE maths?

RQ3: Does 5Rs have an impact on student attitudes towards maths, as measured by the adapted Attitudes Toward Mathematics Inventory (ATMI)?

RQ4: 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 resit 16- to 19-year-old students:

RQ5: Does 5Rs have a greater benefit for students doing resits in May/June 2020 rather than November 2019?

RQ6: What is the effect of 5Rs on those who have ever been eligible for free school meals (FSM)?

The protocols (original and amended) and statistical analysis plan can be found on the EEF website.[2]

Ethics and trial registration

Ethical approval for this trial was granted in July 2019 by a subcommittee of the Health Sciences Research Governance Committee, University of York, HSRGC/2019/352/B.

All settings that took part in the trial completed a Memorandum of Understanding (MOU) during the recruitment phase. See Data Protection section below and Appendix 1 for more details.

The trial was registered in July 2019 with International Standard Randomised Controlled Trial Number (ISRCTN) ISRCTN23703392.[3]

Data protection

All personal data was processed under Article 6 (1) (e), 'processing necessary for the performance of a task carried out in the public interest', of the General Data Protection Regulation (GDPR) and the Data Protection Act 2018. The University of York was deemed to be a data controller (as defined by the data protection legislation) with regard to the personal data used for this project.

Settings were informed of the data requirements through the MOU (Appendix 1). A data sharing agreement (Appendix 2) was put in place between the University of York and each setting which included full details of the types of personal

[2]https://educationendowmentfoundation.org.uk/projects-and-evaluation/projects/the-5rs-approach-to-gcse-maths-resits/?utm_source=site&utm_medium=search&utm_campaign=site_search&search_term=5rs%20post-16
[3] https://doi.org/10.1186/ISRCTN23703392

data being shared, the purpose and duration of that sharing, and the responsibilities each party had in relation to that information.

At recruitment, all students in trial classes received a participant information sheet (Appendix 3) that outlined the information the evaluators would collect and how it would be used. It incorporated a 'participant withdrawal from research' form, which gave students the option of withdrawing from data collection and processing.

All electronic data transfer, to and from settings, was via encrypted spreadsheets sent through the University of York's secure DropOff service. The trial management system and trial data were held separately on secure University of York servers with access limited to specified members of the evaluation team.

All results have been anonymised so that no school or individual student will be identifiable in the report or dissemination of any results.

All data held by the evaluation team will be retained for three years after publication of the final report and then securely destroyed.

For the purpose of research, the student data was to be linked with information about the students from the National Student Database (NPD) and shared with the DfE, the EEF's archive manager, and, in a pseudonymised form, the Office for National Statistics and potentially other research teams. Further matching to NPD data may take place during subsequent research. Once the data is transferred to the EEF, the EEF becomes a data controller.

Project team

Delivery team:

Julia Smith, maths teacher, trainer, and author.

Morag Gallagher, Head of Projects, Association of Colleges.

Barbara Baidoo, Project Manager, Association of Colleges.

Evaluation team—York Trials Unit, University of York:

Pam Hanley, co-principal investigator, trial management, IPE fieldwork.

Louise Elliott, co-principal investigator, trial management, IPE fieldwork.

Elizabeth Coleman, statistician, conducted randomisation, SAP author, conducted statistical analysis.

Caroline Fairhurst, senior statistician, provided oversight of all statistical work.

Imogen Fountain, trial support officer, data collection, project support/admin, IPE fieldwork.

Andrew Haynes, trial support officer, data collection, project support/admin, IPE fieldwork.

Professor David Torgerson, Director of York Trials Unit, supported the design of this trial.

Methods

Trial design

The evaluation was an efficacy RCT with randomisation at the setting level. Our sample included students aged 16 to 19 in further education settings retaking GCSE maths in November 2019 or May/June 2020.

Table 3: Trial design

Trial design, including number of arms		Two-armed cluster randomised controlled efficacy trial.
Unit of randomisation		Setting.
Stratification variable(s) (if applicable)		• Type of setting (further education college, school sixth form, sixth form college). • Number of students who resat maths in the academic year 2018/2019 (< 173, ≥ 173). • Participating in Basic Premium (BMP) (yes/no).
Primary outcome	Variable	GCSE maths attainment.
	Measure (instrument, scale, source)	GCSE maths raw score converted to z-score for analysis (as the scale varies by exam board, provided by the settings).
Secondary outcome(s)	Variable(s)	• GCSE maths standard pass. • Exam attendance. • Students' attitudes towards maths.
	Measure(s) (instrument, scale, source)	• Achievement of a grade 4 or above at GSCE resit (GCSE maths score, scaled 9–1, binary, yes/no, obtained from settings). • Attendance at exam sessions (two-levels; all 3, 0–2, obtained from settings). • Student attitude towards maths—Adapted Attitudes Toward Mathematics Inventory (ATMI).
Baseline for primary outcome	Variable	Previous maths attainment score.
	Measure (instrument, scale, source)	Key Stage 2 maths score (NPD: KS2_MATSCORE).
Baseline for secondary outcome(s)	Variable	Previous maths attainment score.
	Measure (instrument, scale, source)	Key Stage 2 maths score (NPD: KS2_MATSCORE).

This two-armed cluster randomised trial of schools and colleges within England was conducted to explore the efficacy of the 5Rs approach to teaching for improving GCSE maths resit results. All settings that had signed the MOU were randomised to receive either the intervention (5Rs approach) or to continue with their usual approach (control) for the academic year 2019/2020. In some instances, not all classes from an intervention setting would participate in the evaluation (if the setting was large then classes were selected at random for evaluation); teachers of these classes were allowed to use 5Rs with students in those classes if they wished to.

Although the research was designed to minimise the burden on participating settings, all settings were required to assist with data collection for both the impact and process evaluations. Intervention settings received the 5Rs programme and

training free of charge but also had to release staff for training so were provided with a financial payment of £300. Control settings were provided with a financial payment of £750 to cover administration costs.

Due to the impact of the COVID-19 pandemic—particularly the closure of schools and colleges in late March 2020 and the subsequent cancellation of the GCSE exams planned for May and June 2020—the evaluation could not be completed as intended. Following consultation between the evaluators, developers, and the EEF, it was unanimously agreed that any other way of calculating GCSE grades would be inadequate for use as an outcome in this trial on the grounds of both accuracy and reliability and no alternative outcome measure was available. This meant that the primary outcome (GCSE raw maths score) and two of the three secondary outcomes ('pass'/'fail' and exam attendance) were not available. Furthermore, school and college closures made it impossible to distribute the proposed student Attitude Toward Mathematics Inventory measure (the final secondary outcome) planned for the end of the academic year 2019/2020. Only the November 2019 GCSE maths resits, which preceded the pandemic, were completed as expected.

Setting and participant selection

All settings offering post-16 education and GCSE maths retake classes in England during the academic year 2019/2020 were eligible to participate in the trial. This included further education colleges, school sixth forms, sixth form colleges, and private training providers offering a full year of set maths lessons. All settings had to meet the following eligibility criteria:

- not already following the 5Rs approach;
- not participating in the EEF Maths4Life evaluation;
- not selected as a Centre for Excellence in Maths (CfEM); and
- had a minimum of 15 students aged 16 to 19 resitting GCSE maths in the cohort when the setting expressed an interest and expected this to remain the same or increase for the trial year.

The development team at the Association of Colleges were responsible for recruiting the different settings and liaised with the Association of Sixth Form Colleges, HOLEX, the Association of School and College Leaders, and the EEF to ensure settings other than colleges were recruited. AoC used a variety of marketing and communication channels along with social media platforms to promote the trial. These included AoC briefings, a letter from the chief executive sent to all maths leads and teachers in the 244 colleges in England, Twitter (both AoC and Julia Smith's accounts), and LinkedIn. Other methods included promoting the trial at various conferences and events targeted at maths and curriculum leads. A direct email was also sent towards the end of recruitment to any colleges that had not expressed an interest in the programme and were not involved in other maths trials to invite them to join this trial. Julia Smith also contacted some of these settings directly.

All settings that enquired about the trial were encouraged to learn more about the programme on the AoC's website. The webpage provided further information about the programme, eligibility criteria, and an email address to send an expression of interest to. Those settings that expressed an interest were sent an MOU to complete (see Appendix 1).

Eligible organisations were selected on a first-come-first-served basis.

It was anticipated that there would be a large variation in the size of the settings, so the number of students permitted to take part was restricted to between 15 and 80 per setting, with the expectation of an average of 60 per setting.

Settings that wanted to deliver 5Rs to more than 80 students provided the evaluation team with a list of classes and the number of students in each class. From this, the average class size was calculated to determine how many classes should be selected from that setting to have as close to 80 students as possible. This number of classes was then randomly selected from the corresponding setting and only the students in these classes were included in the evaluation but the others could still receive the intervention.

Students were not included in the trial (that is, data was not collected) if they were taking the Functional Skills exam (an alternative qualification to GCSEs for students obtaining a grade 2 or below at GCSE); however, there is a small chance that these students may have been in the classes where the 5Rs approach was used. The majority of students involved in the trial intended to take the GCSE in May or June 2020 but those who sat the November resit in 2019 were also included (as well as those who failed in November and intended to take it again in May/June 2020).

Outcome measures

Baseline measures

KS2 maths score, which is a standard assessment test measuring maths ability and is mandatory, was planned to be used as the baseline measure of maths ability for the primary and secondary outcomes. This was to be collected via the National Student Database (NPD) but due to the limited analysis that could ultimately be undertaken in this evaluation, and the small sample of students (only those who resat in November), it was decided not to collect this data.

Primary outcome

The primary outcome for the 5Rs evaluation was the GCSE maths raw score for those who were resitting having failed previously to achieve a grade 4 or higher (a standard pass). The raw score, rather than the grade awarded, was used as the primary outcome to allow detection of finer changes in achievement. If a student's previous result was a grade 3 and this was unchanged, though their raw score increased, then it would be impossible to measure any progress or effect from the intervention. It was intended to collect this for participating students from both exam sittings in November 2019 and May/June 2020. Since the summer 2020 GCSE exams were cancelled, we only collected the marks for the November 2019 resits. Scores were collected directly from the settings after the exam results had been awarded since they are not available via the NPD. Since the exam board used varied by setting, and the scale of scores differs by exam board, the scores were standardised to allow them to be directly comparable. A 'standard' (z) score was created, that is, for student *i*, who sat exam board b, their z-score (z_{ib}) was calculated as:

$$z_{ib} = \frac{x_{ib} - \mu_b}{\sigma_b}$$

where $x_{ib}$was the student's raw score, μ_b was the mean score of those who sat the exam with board b, and σ_b was the standard deviation of the population that sat the exam with board b. Both μ_b and σ_b were estimated using a sample mean and standard deviation using observed data.

Secondary outcomes

Achievement of grade 4 or above at resit (that is, achieving a 'pass')

The GCSE maths score can be evaluated in a binary way as a pass or fail where a pass is defined as achieving a grade 4 or above and fail is achieving a grade 3 or lower. This could be deduced directly from the scores—but was also provided by the settings.

Student attendance at exam session

The number of exam sessions that a student attended was collected from the settings; this gave attendance at each of the two or three papers sat by the student. While it was a requirement of funding that full time students aged 16 to 19 who gained a D/3 in GCSE maths had to be enrolled on a GCSE maths course, attendance at the exam could not be assured so exam attendance was used as a proxy for engagement and motivation to achieve a pass and also to understand whether students did not pass because they sat, but failed, the exam or because they did not sit any, or the full number, of exam papers.

Student attitudes towards maths—adapted Attitudes Toward Mathematics Inventory

To assess attitudes towards maths, it was planned that the students were to complete an adapted ATMI at the end of the academic year 2019/2020. The original ATMI (Tapia, 1996, see Appendix 4) was adapted for use in this evaluation, with the agreement of the originator (Martha Tapia), by adjusting the North American language, where needed, and by removing any questions that were not relevant to the trial. To maximise the validity of the shortened instrument, the entire Motivation and Value subscales were removed. This meant that the Self-confidence and Enjoyment subscales remained as they were deemed most suitable, leaving 25 questions.

The questions in the ATMI have a five-point Likert response scale: 1, 'strongly disagree' to 5, 'strongly agree' with 3 being neutral. The responses were to be summed to calculate a score and any negative questions reverse scored. In the version that was to be used in this evaluation, there were 15 positively worded questions, and ten negatively worded questions producing a total score between 25 and 125, where a higher score indicates a more positive attitude.

This instrument was not administered because, at the time it was to be completed, settings were teaching online due to the COVID-19 pandemic. The ATMI was due to be completed during lesson time because it was predicted that if students were asked to complete it in their own time (either via an online link or completing paper copies) it would reduce the response rate and increase bias towards more engaged students. Given the unusual circumstances, the online option was reconsidered when teaching was moved online but again rejected because any findings risked being unreliable and misleading. This was for three main reasons: (a) only the more engaged settings would forward the link to students (and in the intervention group, this might be more likely to include those who were positive about 5Rs), (b) only a small subsample would respond, and (c) this subsample would probably be heavily skewed towards students who were more engaged with their resit maths course and education in general.

Sample size

The programme developers pre-specified that they would have capacity to provide the 5Rs intervention to a maximum of 40 settings; therefore, with one-to-one allocation, there could be a maximum of 80 settings involved. We specified that settings needed to have a minimum of 15 students resitting and a maximum of 80 students could be selected to take part in the evaluation per setting. We assumed an average of 60 students per setting (total of 4,800 at recruitment) but anticipated that there would be variation in cluster size between the types of setting (FE colleges tend to be larger than school sixth forms). As variation in cluster size has the potential to increase the minimum detectable effect size (MDES) that the trial can detect, we accounted for some variation in the calculation of the MDES by considering the coefficient of variation (cv) in cluster size in the design effect (DE), as per Eldridge et al (2006). We used a simple estimate of the DE:

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

where cv was assumed to be 0.27 (the standard deviation of the cluster size was approximated to be 13.75), $\tilde{m}$ is the average cluster size (60), and ρ is the ICC which was conservatively assumed to be 0.17. (Allen et al., 2018, found an ICC of 0.15 at KS4.) The correlation between KS2 maths score (baseline measure) and GCSE maths results score was assumed to be 0.6: 0.76 is the national correlation between KS2 maths and GCSE maths.[4] A sample size of 4,800 at recruitment, assuming 15% student-level attrition at follow-up, would therefore have 80% power to detect an MDES of 0.22 at analysis.

The Sixth Form Colleges Association estimates that 21% of students attending further education 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'.[5] Assuming 80 settings with 60 students each, we anticipated 856 FSM students at analysis (assuming 15% attrition). Assuming the same setting-level ICC (0.17) and pre-post test correlation (0.6), with this sample size we would have 80% power to detect an effect size of 0.25—accounting for variable cluster sizes as above. Full details of the sample size are given in the Statistical Analysis Plan, which is available on the EEF website (Coleman and Fairhurst, 2020).

Randomisation

Once recruited, a York Trials Unit statistician, Elizabeth Coleman, used MinimPY (Saghaei and Saghaei, 2011), a dedicated computer programme, to randomise the settings to either receive the 5Rs programme (intervention arm), or to be in the control group (to undertake their teaching as they saw fit). Randomisation was performed in one batch once all settings had provided the information needed for randomisation. Naïve minimisation with base probability 1.0 was conducted, that is 1:1 deterministic minimisation. Minimisation is a dynamic form of allocation where settings are allocated to one of the two groups (intervention or control) using an algorithm that aims to maintain balance of the

[4] http://www.cambridgeassessment.org.uk/Images/181034-exploring-the-value-of-gcse-prediction-matrices-based-upon-attainment-at-key-stage-2.pdf
[5] https://sfcawebsite.s3.amazonaws.com/uploads/documents/Sixth-form-colleges-Key-facts-and-figures-2018.pdf?t=1545390007

minimisation factors across the two groups. This method is predictable; however, as the randomisation was undertaken in one batch, it was decided that naïve minimisation would be sufficient as there were no concerns around predictability and, on that basis, a random element—which would have aided non-predictably by sometimes allocating a setting to the opposite group to that which would have maintained best balance—was not required. The minimisation used the following factors:

- type of setting—three levels: further education college, sixth form college, or school sixth form;
- number of students who resat maths in the academic year 2018/2019—two levels: < 173 or ≥ 173 (173 was the median among the recruited schools); and
- Participating in Basic Maths Premium (BMP), which provided a financial incentive for students retaking GCSE maths—two levels: yes or no.

These factors were used as it was believed they may influence the implementation of the 5Rs intervention and therefore students' attainment, and to minimise the numerical imbalance in students participating in the evaluation between the two groups.

Statistical analysis

Due to the COVID-19 pandemic, the summer 2020 exam period was cancelled and, instead, centre-assessed grades (CAGs) were given for all exams that were due to be sat. These grades were then subject to central moderation to standardise them across settings in line with previous years. It was hypothesised that the way in which the grades were awarded for the May resits might have diluted any possible effect from the 5Rs programme; if the 5Rs programme was effective at increasing the proportion of grade 4 standard passes then the algorithm used to standardise the grades may have removed these as they were not consistent with previous trends for that setting. However, following release of the GCSE results in August 2020, the decision to award these standardised results was partially rescinded, and students' grades were returned to their original CAG if the algorithm had subsequently down-graded them. Even in this case the results would not have been reliable as each setting would have approached the setting and moderating of their CAGs differently. In any event, we are unsure that CAGs would have been made available for researchers to use. Therefore, the planned primary outcome could not be obtained.

However, the November 2019 resit session was unaffected by the COVID-19 pandemic and, as such, the results were collected as planned. The November students are a subgroup of those participating in the 5Rs evaluation and are, in all likelihood, not representative of the whole population. The decision to enter students in the November resits varied by setting, including some who had a policy of entering no students. Consequently, no formal analysis was planned because a relatively small sample was anticipated that was possibly biased towards the higher achievers. As such, it might misrepresent the efficacy of the programme.

A SAP was produced prior to any analysis being conducted: this detailed the analysis initially planned and analysis actually conducted. A summary of the planned analysis is given as Appendix 5. Analyses of the limited data that was collected from the November resit are descriptive in nature and no formal statistical comparisons were conducted. Analyses were conducted in Stata v15 (StataCorp., 2017) using the principles of intention to treat, including all students and settings in the arm they were randomised to, regardless of whether they received the intervention or not.

Analysis

Raw grades, exam boards, and tiers

The GCSE raw mark was standardised, as previously described, to allow for a comparison between the exam boards; these standardised scores are summarised by trial arm. The number of students sitting each exam board, and the number sitting the foundation and higher paper within each exam board, are detailed by trial arm.

Achieving a pass

The number of students who achieved a grade 4 or above (that is, passed) and those who did not are summarised by trial arm and exam board.

Student attendance at exam sessions

The number and percentage of the available papers to be sat are presented by trial arm and categorised as ‘all papers’, ‘some of the papers’, and ‘none of the papers’—this is due to one of the exam boards (Eduqas) having only two papers while all of the other exam boards (OCR, AQA, Edexcel) had three papers; this is not noted in the SAP.

Student attitude towards maths

Since the ATMI was not collected, there is no data to report.

Missing data, non-compliance, subgroups, and sensitivity analysis

The amount of missing data for the raw GCSE mark is reported. No analysis was undertaken to assess the impact of non-compliance, however the attendance of the teachers at the training sessions is summarised. Unfortunately, it was not possible to conduct either of the planned subgroup analyses or the sensitivity analysis due to lack of data on FSM status (as the NPD was not accessed) and only having November resit data.

Implementation and process evaluation

As outlined in the protocol, the implementation and process evaluation (IPE) addressed the following research questions:

- RQ1 How closely does the 5Rs as implemented follow the intended model, for instance in structure, content, and frequency of delivery? 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 Is there any variability between different types of setting in fidelity, delivery, or attitudes towards the programme (for example, between FE colleges and school sixth forms)?
- RQ4 What are the barriers and enablers to adopting the programme? Has 5Rs been adapted during the trial? How and why (including whether it has been adapted for delivery to functional maths classes)?
- RQ5 What is the level of compliance with the programme (measured as attendance at training)?
- RQ6 How are students engaging with 5Rs and what impact does it have on their attitudes to maths (those elements not covered in the ATMI questionnaire)? How much work do they complete on their own, outside lessons?
- RQ7 How are teachers engaging with 5Rs? What are their opinions about the training provision and subsequent support?
- RQ8 What is the nature of the 'business as usual' approaches? How does 5Rs compare to existing practice in post-16 maths resit classes?
- RQ9 What can be learned from the IPE to inform a larger trial in terms of possible changes to the intervention and trial design?

Research methods

The IPE was designed to test the workings of the logic model to check whether the intervention was operating as hypothesised. It used mixed methods, including teacher surveys, training attendance data, interviews with teachers, students, and departmental heads, and observations of training events and lessons. Because of COVID-19, it was not possible to carry out two intended elements of the IPE: the student survey and analysis of lesson attendance. Also, the post-intervention survey for teachers was much shorter than originally anticipated to minimise burden and maximise response rate at a time of COVID-19-related challenges in educational settings. As a result, some of the research questions could not be explored as thoroughly as intended. This particularly affected the following:

- RQ2: student attendance rate was based on teacher report only;
- RQ3, RQ4, and RQ6: the student input to these questions was limited to the case study visits; and
- RQ4: the shortened post-intervention teacher survey did not include any questions about functional maths.

Table 4 shows how the different elements of the IPE (column one) addressed the research questions (column two) and outlines what each instrument covered with reference to the theoretical underpinning of how 5Rs was expected to work (column three).

Table 4: IPE methods mapped to research questions and logic model

Data collection methods	Research questions addressed	Implementation/logic model relevance
Completed		
Baseline setting survey (MOU)	N/A	To ascertain setting context (type, size, expected cohort size).
Online pre-survey (teachers/project leads)	RQ7, RQ8	To establish usual practice; teacher background and experience, motivation and engagement.
Online post-survey (teachers)	RQ2, RQ4, RQ6, RQ7, RQ8, RQ9	To explore practice; motivation and engagement of teachers and students; reported implementation of 5Rs intervention including enablers and barriers.
Training attendance registers (teachers)	RQ5	Compliance measured as attending days one and two of three.
Observation of training events (one per term)	RQ1, RQ7, RQ9	To establish the expected model and fidelity in terms of different trainers' approaches; gauge teacher engagement.
Case study visits: lesson observations	RQ1, RQ4, RQ7, RQ8, RQ9	Classroom practice including fidelity, adaptations and barriers, engagement.
Case study visits: teacher interviews	RQ2, RQ4, RQ6, RQ7, RQ8, RQ9	5Rs implementation, enablers/barriers, engagement, views on training.
Case study visits: friendship pairs of students	RQ2, RQ6, RQ8, RQ9	Reaction to approach vs previous GCSE maths; activity outside lessons.
Case study visits: departmental heads interviews (if possible)	RQ2, RQ4, RQ6, RQ7, RQ8, RQ9	Context about delivering maths resit lessons and overview of 5Rs.
Not completed (COVID-19)		
Post-intervention student survey	RQ2, RQ4, RQ6, RQ9	Teaching methods experienced, self-study, confidence in maths.
Student class attendance data	RQ6	Dosage and engagement.
Not completed (unavailable in useful form)		
Teacher usage of resources from download data	RQ7	Proxy for teacher engagement with 5Rs.

Development of IPE design

As a precursor to the IPE, interviews were conducted with a GCSE maths resit teacher in an FE college and one in a school sixth form setting to explore the feasibility of the proposed approaches to data collection. A 5Rs lesson was observed at the FE college (which was not involved in the trial) to allow the researchers to see the programme in practice and to inform the design of the lesson observation schedule.

Case study visits

The six intervention and four control case study settings that were visited as part of the IPE represented a mix of types of setting and were regionally spread. Further details are shown in Table 5.

. The visits were undertaken by a team of four researchers. Each researcher conducted their first one or two visits in a pair so that ratings and observations could be discussed and moderated where necessary. Subsequently, researchers made the visits on their own.

Table 5: Characteristics of settings visited

Setting Type	Arm	Visit Date	Region	Lesson length observed (mins)	Students present	Interviews completed (Lead, Teacher, Students)
FE college	Intervention	Jan 2020	NW	120	10	L, T
School sixth form	Intervention	Jan 2020	London	60	9	L, T, S
Sixth form college	Intervention	Jan 2020	NW	60	6	L, T, S
FE college	Intervention	Feb 2020	NE	90	11	L, T, S
FE college	Control	Feb 2020	NE	60	7	L, T, S
Sixth form college	Control	Feb 2020	London	90	18	L, T, S
FE college	Intervention	Mar 2020	SW	90	13	T, S
School sixth form	Intervention	Mar 2020	SW	50	9	L, T, S
School sixth form	Control	Mar 2020	NE	55	3	L, T, S
FE college	Control	Mar 2020	Midlands	50	10	L, T, S

Training observations

Day one and day two of the training were each observed by two members of the evaluation team. They used a combination of schedule and fieldnotes to record impressions of the event. Because of the COVID-19 lockdown arrangements, day three was adapted from a planned in-person event to a webcast with the facility to ask questions in the chat function or to access later without the chat option. This was observed by one member of the evaluation team. The day one observation schedule is appended (Appendix 6); the other schedules were similar but tailored as appropriate to the different training content. The content of the third training session changed from that initially planned to focus more on providing immediate support to teachers and discussing how to deliver the programme online during school closures.

Research with teachers

Towards the beginning of the intervention (October 2019), an online survey was distributed to the teachers involved in the trial (Appendices 7 and 8). The project leads in each setting were asked to disseminate the link to the relevant staff members and, in the intervention settings, they were asked to complete it themselves regardless of whether they were teaching a class involved in the trial (hence the 25 non-teaching project leads in Table 6).

Questions covered teacher demographics, attitudes to teaching resit maths, perceptions of student attitudes and behaviour, and resources and teaching approaches used. Those in intervention settings were also asked about their attendance at, and experience of, the first day of training.

A post-intervention survey (Appendices 9 and 10) was distributed to project leads for forwarding to all the teaching staff involved in the trial in May 2020. Unlike the pre-survey, project leads were only asked to complete it themselves if they had been teaching a class in the evaluation. The main questions covered maths timetabling and lesson structure, resources used, perception of student ability, skills, and behaviour, and training. Those teaching 5Rs were also asked about student study outside the classroom (including use of the Padlet) and whether they would want to use the 5Rs programme again.

As part of the case study visits, each teacher was interviewed after the observed lesson. The semi-structured interview of intervention teachers (Appendix 11) asked about the lesson observed, the 5Rs programme overall (difference to previous practice, positives and negatives, and any adaptations), responses to the five specific elements, feedback on

the resources, perceptions of the student reaction, and estimated programme costs. Interviews with teachers in the control settings covered similar ground but with reference to how resit maths was taught in their context (Appendix 12).

Research with project leads and departmental heads

Each setting in the trial had a nominated project lead who acted as the main contact for the evaluation team. Some of them also taught resit maths to the classes included in the trial but this was not a prerequisite. As such, they may have been involved in the IPE as teachers (see previous section).

All project leads in the intervention settings were asked to participate in the pre-survey. If they were not teaching a class that had been selected for the trial, they were only asked what impact they were hoping the 5Rs programme would have on their students and the school or college. Projects leads in the control settings only completed the pre-survey if they were also teachers in the trial. The post-survey was designed only for those who were teachers in the trial.

Where possible, the heads of maths or project leads were interviewed during the case study visit to get an overview of resit maths within the setting (Appendices 13 and 14). They were asked about the attitudes to resit maths, the approach to teaching it, any policies on homework and resource use, and how the setting determined which students would be entered for November resits. In intervention settings, they were also asked about their own reaction to the 5Rs programme and how they thought teachers and students were responding to it.

Research with students

During each case study visit (barring one where timetabling made it impossible), two students were interviewed in a friendship pair. This approach was chosen to overcome possible problems with group dynamics while retaining the interactive element. All the students were asked to reflect on the observed lesson, including how typical it was, which parts were particularly useful, and whether they had learnt anything new. The interview explored how lessons in the current academic year compared with previous lessons as well as their relative confidence and preparedness for the exams. They were also asked about any work they did outside the lessons. Students in intervention settings were asked about the five elements of the lesson and their use of the Padlet specifically (Appendices 15 and 16).

It had been intended to dispatch a survey to settings for students to complete in class soon after the Easter break. Informed by the case study interviews, it was anticipated that it would cover teaching approaches used in their lessons, what elements they found most helpful, rating of classroom experience, and their engagement, motivation, and confidence. They would also be asked for a self-report estimate of frequency of class attendance and time spent in self-study. This would have provided another source of evidence about implementation fidelity and allowed comparison of the experiences and attitudes of students in intervention and control settings. Unfortunately, due to the COVID-19 lockdown it was not possible to conduct this element of the IPE.

Lesson observations

The finalised observation schedule for 5Rs lessons had two main sections (Appendix 17). The lesson overview recorded the timing and nature of the different elements (Recall, Routine, Revise, Repeat, and Ready) of the 5Rs programme. The second section was a rating, using a four-point scale (from ‘never’ to ‘always/whenever appropriate’), of a number of different features of the lesson. Some related to the teacher, including evidence of preparation, appropriateness of pace, classroom management, modelling of skills, resource use, mention of Padlet and work outside lessons, adaptations to the 5Rs structure, and teachers’ apparent awareness of their students’ understanding. Observers also noted the level of student engagement during the five different lesson elements and their apparent familiarity with the 5Rs lesson structure. An equivalent observation schedule was used in the control settings (Appendix 18). The observer noted any similarities to the 5Rs lesson elements as well as completing a similar second section rating features of the lesson on the same four-point scale. In all cases, observers also made comprehensive accompanying notes.

Analysis

Quantitative survey data was analysed using Stata v15. Results are presented descriptively. A chi-squared test was used to compare responses to one set of questions in the teacher post-survey between the intervention and control settings. This is described more fully in the results section.

The transcribed interview data and relevant elements of the surveys and observations were analysed thematically using a combination of deductive and inductive techniques. The steps in the logic model were used to construct a preliminary framework (for example, pedagogical approach, changes in teaching practice, student study skills, and student engagement) and these were enhanced using codes that arose from the data. Anonymised quotes from the interviews and free-text survey questions have been cited in the report as appropriate to illustrate the findings. They are identified by participant role (teacher, project lead, or student), setting type (FE or sixth form college, or school sixth form), and trial arm (intervention or control).

Table 6: IPE methods, sample and analysis overview

Data collected	Data collection methods	Participants/data sources	Data analysis methods
Baseline setting information	Survey appended to MOU	School/college staff (78)	Descriptive analysis
Usual practice	Online pre-survey	Teachers (189: 93 intervention, 96 control), non-teaching project leads (25 intervention only)	Descriptive/thematic analysis
Response to intervention	Online post-survey	Teachers (145: 80 intervention, 65 control)	Descriptive/thematic analysis
Teacher attendance at training	Training registers (collected by trainers)	Training registers (from all events)	Descriptive analysis
Training observations	Observation of training events using schedule and fieldnotes	Training events (one per term)	Descriptive/thematic analysis
Case study visits: lesson observations	Lesson observations (observation sheet co-designed with development team and fieldnotes)	One lesson per school (10/10)	Descriptive analysis
Case study visits: teacher feedback	Semi-structured interview (one-to-one)	Teachers (10/10)	Descriptive/thematic analysis
Case study visits: student feedback	Semi-structured interview (friendship pairs of students)	Students (9/10 pairs = 18/20 students)	Descriptive/thematic analysis
Case study visits: departmental head feedback	Semi-structured interview (one-to-one)	Heads of department (9/10)	Descriptive/thematic analysis

Costs

Cost data is not being reported for the following reasons:

- there is no impact assessment due to the primary outcome not being collected—any data could not be used to calculate cost effectiveness; and

- costs may have been affected by teaching changes due to the pandemic and are likely to be unrepresentative.

Information relating to costs gathered as part of the IPE can be found in **Costs: time and consumables** below.

Timeline

The timeline has been updated to reflect the changes due to COVID-19. Activities that could not be completed have been highlighted in grey.

Table 7: Timeline

School year	Specific date	Evaluation team	5Rs/AOC
2018/**2019**	March–July	Setting recruitment led by AOC/5Rs with input from the evaluation team.	
	July 2019	Randomisation of settings to the intervention or control group.	
2019/2020	September	Pre-evaluation teacher survey.	
	September		Teacher training session one.
	September	Collection of student data from settings.	
	October	Intervention delivery starts.	
	November–April	Visits by evaluators to selected settings.	
	January	Collection of November GCSE maths raw mark and grade from settings.	
	January		Teacher training session two.
	March–April	Student survey/attitude to maths questionnaire.	
	March–April	Post-evaluation teacher survey	
	March		Teacher training session three.
	May	Intervention period ends (in practice, settings were closed from March).	
	June	Request access to NPD data (KS2 and GCSE grade (previous attempt 2019).	
2020/21	August–September	Collection of student attendance data from settings.	
	August–September	Collection of summer GCSE maths raw mark and grade from settings.	
	September–December	Analysis.	
	February	Submission of draft report.	
	End July	Final report submitted and data uploaded to the EEF archive, managed by FFT.	

Impact evaluation

Participant flow including losses and withdrawals

A total of 262 settings were contacted to participate in the 5Rs trials; 80 did not reply, and 94 were excluded due to their participation in the EEF Maths4Life project. In total, 88 settings were randomised into the trial, 44 to each of the two arms (intervention and control). Figure 3 shows the flow of settings and students through the trial. Of the 88 settings randomised, 78 (41 intervention and 37 control) continued participation in the trial—the other ten settings withdrew after randomisation and group allocation (three intervention and seven control).

As there was only one university technical college and one independent training provider setting it was decided for randomisation purposes, as type of setting was a stratification variable, to include them under the FE College umbrella. There were, therefore:

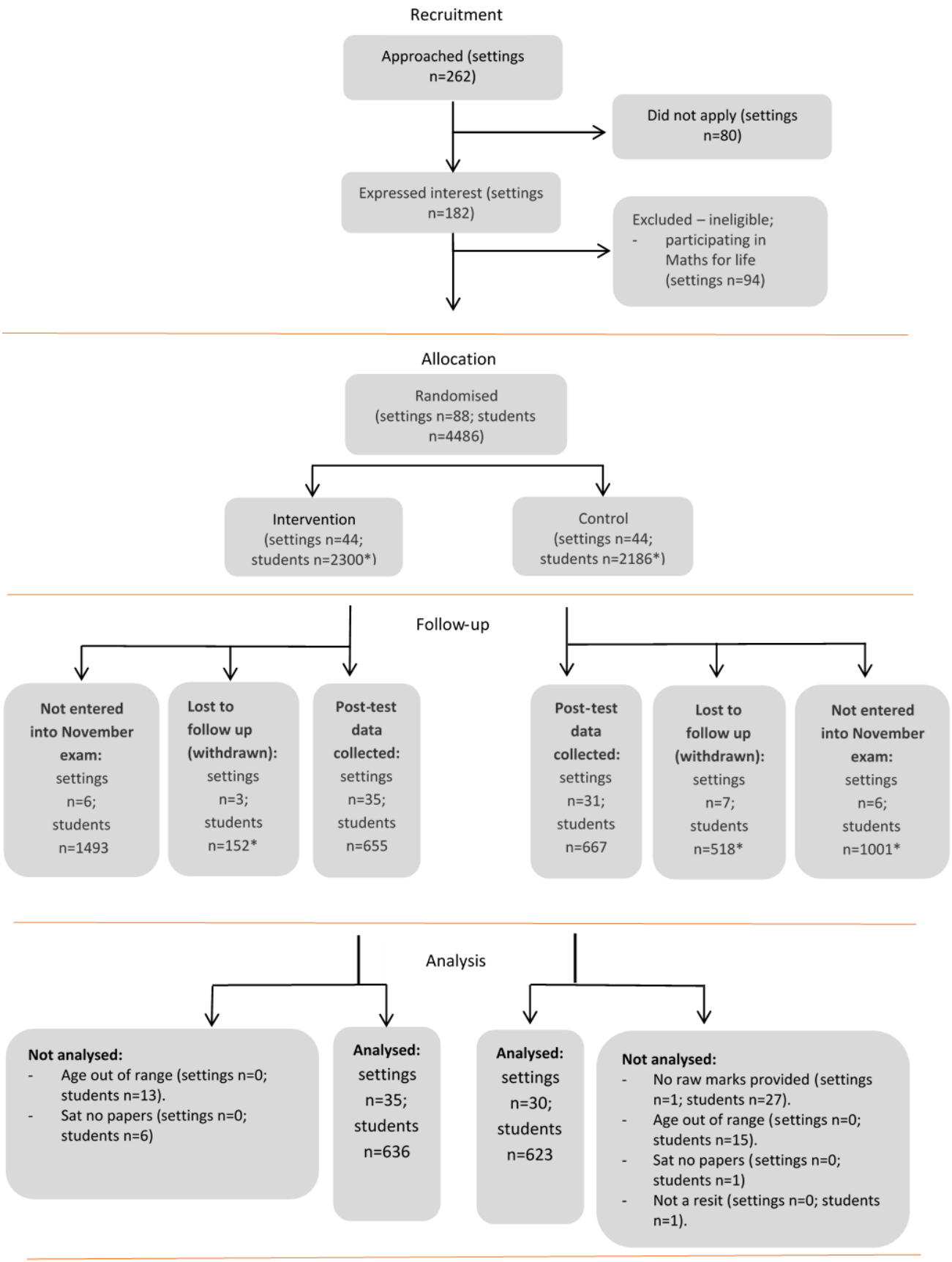
- 46 FE colleges—23 intervention, 23 control (five of which were withdrawn);
- 14 sixth form colleges—seven intervention (2 of which were withdrawn), seven control (one of which was withdrawn); and
- 28 school sixth forms—14 intervention (one of which was withdrawn), 14 control (one of which was withdrawn).

There was a large variation in setting size; those having more than 80 students in their cohort resitting GSCE maths were asked to provide a list of class sizes (35 settings, 39.8% of those randomised). This was used to calculate the average class size at each setting to determine how many classes should be selected to have as close to 80 students as possible; this number of classes was then randomly selected for that setting using Stata v15 (StataCorp., 2017).

After class selection had been undertaken where required, a total of 3,816 students were involved in the trial (2,148 intervention, 1,668 control). The cluster size (number of students participating per setting) ranged from three to 108 (mean 48.9; SD 26.3)—exceeding the maximum of 80 students per setting in some instances, however the classes were selected on expected number of students so this was always a possibility. Students within the settings were given the opportunity not to participate (not to share their data) and as a result some settings (15) also had less than the minimum pre-specified.

When using the number of students resitting in 2018/2019 as a proxy for the number of number of students resitting in 2019/2020 for those ten settings that withdrew post randomisation, capped to a maximum size of 80, we can estimate that the number of students would have been 4,486 (2,300 intervention and 2,186 control).

Figure 3: Participant flow diagram



*Number of students is estimated as the Settings who withdrew did not provide student details

Table 8: Minimum detectable effect size at different stages

		Protocol		Randomisation		Analysis[1]	
		Overall	FSM	Overall	FSM	Overall	FSM
MDES		0.22	0.25	0.23	0.26	-	-
Pre-test/post-test correlations	Level 1 (students)	0.6	0.6	0.6	0.6	-	-
	Level 2 (class)	-	-	-	-	-	-
	Level 3 (setting)	-	-	-	-	-	-
Intracluster correlations (ICCs)	Level 2 (class)	-	-	-	-	-	-
	Level 3 (setting)	0.17	0.17	0.17	0.17	-	-
Alpha		0.05	0.05	0.05	0.05	-	-
Power		0.8	0.8	0.8	0.8	-	-
One-sided or two-sided?		Two	Two	Two	Two	-	-
Average cluster size		60	13	51	9	19	-
Number of settings	Intervention	40	40	44	44	35	-
	Control	40	40	44	44	30	-
	Total:	80	80	88	88	65	-
Number of students[2]	Intervention	2400	504	2300	483	636	-
	Control	2400	504	2186	459	623	-
	Total:	4800	1008	4486	942	1259	-

[1] Reflects those included in the descriptive results only.
[2] Number of students at the randomisation stage is estimated as actual number of students unknown as settings were randomised prior to academic year starting; ten settings withdrew and never provided students numbers.

Follow-up and exclusions

It was anticipated that not all students would be entered for the November resit exam—although it was not possible to estimate what proportion this would be as the policies for entering students in November varied by setting. For instance, in the ten settings visited as part of the IPE, three entered all students (two sixth form colleges and a school sixth form), one (an FE college) entered none, and the others all entered a limited number of candidates determined by their previous performance and, in some instances, their willingness to attend extra sessions or complete additional work.

From the 3,816 students that were to be involved in the evaluation—that is, those from the 78 settings that provided student level details—1,322 (34.6%) were entered into a November resit. Of these, 29 students were excluded from all analyses: 27 were found to be older than 19, one was younger than 16, and one had recently moved to the U.K. and was sitting the exam for the first time. Therefore, 1,293 students (97.8% of those entered; 28.8% of those randomised) are included in the evaluation at the November resit (642 intervention and 651 control). Of these, 1,259 have been included in the analysis (97.4% involved; 636 intervention and 623 control). Thirty-four could not be analysed as one setting in the control arm did not provide raw marks for their 27 students, and seven students did not sit any papers (six in the intervention group and one in the control group). Most of the settings did enter some students into the November resit; 65 settings were involved in the analysis—83.3% of the 78 involved in the evaluation and 73.8% of the 88 that were randomised. On average, there were 19 students from each setting in the analysis (SD 18.2, range 1 to 82).

In this evaluation, 12 settings (15.4% of the 78) did not enter any students for the November resit and thus the data we could collect, and analyse, was limited. However, it should be noted that of those who were entered into the November resit, 97.4% were included in the analysis (99.1% for intervention, 95.7% for control)—one setting that did enter students in the November resit provided no raw marks for their students and some students entered sat none of the papers, so could not be included in the analysis. Further details on follow-up and data collection rates can be found in Table 9.

Table 9: Student numbers at randomisation and at November resit

	Intervention	Control	Total
Number of students randomised	2300*	2186*	4486*
Number of students participating in evaluation	2148	1668	3816
Percentage of those randomised	93.4	76.3	85.1
Number of students involved in the November resit	642	651	1293
Percentage of those randomised	27.9	29.8	28.8
Percentage of those in the evaluation	29.9	39.0	33.9
Number of students included in analysis	636	623	1259
Percentage of those randomised	27.7	28.5	28.1
Percentage of those in the evaluation	29.6	37.4	33.0
Percentage of those who resat in November	99.1	95.7	97.4

*Number of students is estimated as the settings that withdrew did not provide student details.

Student and setting characteristics

The setting characteristics as randomised and for those settings that entered students for the November 2020 exams are presented in Table 10. KS2 results and percentage of students eligible for FSM are not included in this table as it was decided not to obtain the data from the NPD due to the small, unrepresentative sample of settings/students entered for the November exams and the time it would have taken to obtain the data, which would have delayed the submission of the report.

There was balance between all of the minimisation factors at randomisation; however, when looking at the number of students resitting in 2018/2019, there were more in the intervention group (mean 348 students) compared to the control group (mean 268). The minimisation factors are still well balanced when considering just those settings where at least one student was entered into a November exam; similarly, the average number of students in 2018/2019 was higher in the intervention group (mean 334) compared to the control group (mean 190).

Overall, 1,293 students (33.9% of those involved) were entered for a resit in November; there was a higher proportion from the control arm (39.0%, n = 651) than the intervention arm (29.9%, n = 642). When looking at the proportion of students at each setting that were entered for a resit, on average, 48.1% of students were entered for a November resit, ranging from 1.2% to 100%. The average was slightly lower in the intervention arm (45.6%) than in the control arm (51.0%). Further details can be found in Table 11.

Table 10: Baseline setting-level characteristics of groups as randomised and as analysed

	Intervention group		Control group	
As randomised				
School-level (categorical)	n/N (missing)	(%)	n/N (missing)	(%)
Type of setting				
Further education college	23/44 (0)	52.3	23/44 (0)	52.3
School sixth form	14/44 (0)	31.8	14/44 (0)	31.8
Sixth form college	7/44 (0)	15.9	7/44 (0)	15.9
Number of students resitting 2018/2019				
<173	22/44 (0)	50.0	22/44 (0)	50.0
≥173	22/44 (0)	50.0	22/44 (0)	50.0
Participation in Basic Maths Premium				
Yes	5/44 (0)	11.4	5/44 (0)	11.4
No	39/44 (0)	88.6	39/44 (0)	88.6
Setting-level (continuous)	n/N (missing)	Mean (SD)	n/N (missing)	Mean (SD)
Number of students resitting 2018/2019	44/44 (0)	347.9 (410.1)	44/44 (0)	268.2 (295.7)
As included in analysis (i.e. entered a student for November resit)				
School level (categorical)	n/N (missing)	(%)	n/N (missing)	(%)
Type of Setting				
Further Education College	17/35 (0)	48.6	13/31 (0)	41.9
School Sixth Form	13/35 (0)	34.1	12/31 (0)	38.7
Sixth Form College	5/35 (0)	14.3	6/31 (0)	19.4
Number of students resitting 2018/2019				
<173	19/35 (0)	54.3	19/31 (0)	61.3
≥173	16/35 (0)	45.7	12/31 (0)	38.7
Participation in Basic maths Premium				
Yes	4/35 (0)	11.4	3/31 (0)	9.7
No	31/35 (0)	88.6	28/31 (0)	90.3
School level (continuous)	n/N (missing)	Mean (SD)	n/N (missing)	Mean (SD)
Number of students resitting 2018/2019	35/35 (0)	334.0 (434.3)	31/31 (0)	190.2 (253.3)

Table 11: Number and proportion of students resitting in November 2019

	Control	Intervention	Overall
Number of students involved in the trial	1668	2148	3816
Students who resat in November, n (% of those involved)	651 (39.0)	642 (29.9)	1293 (33.9)
Percentage per setting of students involved who were submitted for a November resit			
Mean (SD)	51.0 (34.5)	45.6 (34.8)	48.1 (34.5)
Median (Min, Max)	51.4 (1.2, 100.0)	44.3 (1.3, 100.0)	47.5 (1.2, 100.0)

Outcomes and analysis

The number of students who resat in November is presented by arm and overall in Table **11**; this is further reported by number resitting each exam board, and within each exam board how many sat the foundation and higher papers in Table 12.

Only 35.1% (n = 1,293) of the students who were involved in this evaluation were entered into the November resit; of these, 1,259 (97.4%) were included in the analysis (623 control and 636 intervention). The most common exam board used was Edexcel (67.4% for control, 64.0% for intervention), and the majority of students (96.6%) resat a foundation paper.

Table 12: Details on which exam board and tier of paper were sat by the students, by arm and overall

Exam board	**Control (n = 651)**	**Intervention (n = 642)**	**Overall (n = 1293)**
AQA, n (% of resits)	156 (24.0)	166 (25.9)	322 (24.9)
Foundation, n (% of paper)	151(96.8)	157 (94.6)	308 (94.7)
Higher, n (% of paper)	5 (3.2)	9 (5.4)	14 (5.3)
Edexcel, n (% of resits)	439 (67.4)	411 (64.0)	850 (65.7)
Foundation, n (% of paper)	415 (94.5)	405 (98.5)	820 (96.5)
Higher, n (% of paper)	2 (0.5)	6 (1.5)	8 (0.9)
Missing, n (% of paper)	22 (5.0)	0 (0.0)	22 (2.6)
OCR, n (% of resits)	12 (1.8)	61 (9.5)	73 (5.7)
Foundation, n (% of paper)	12 (100.0)	61 (100.0)	73 (100.0)
Higher, n (% of paper)	0 (0.0)	0 (0.0)	0 (0.0)
Eduqas n (% of resits)	44 (6.8)	4 (0.6)	48 (3.7)
Foundation, n (% of paper)	44 (100.0)	4 (100.0)	48 (100.0)
Higher, n (% of paper)	0 (0.0)	0 (0.0)	0 (0.0)
Paper, n (% of resits)	N = 651	N = 642	N = 1293
Foundation	622 (95.5)	627 (97.7)	1249 (96.6)
Higher	7 (1.1)	15 (2.3)	22 (1.7)
Missing	22 (3.4)	0 (0.0)	22 (1.7)

Descriptive analysis—raw GCSE mark (primary outcome)

The standardised marks for each arm of the trial, and overall, are detailed in Table 13. Marks were available for 1,259 of the 1,293 students who resat (97.4%). It can be seen that for both arms of the trial, the average standardised mark was 0.0, ranging from -3.3 to 3.2 in the control arm, and from -4.0 to 2.9 in the intervention arm.

There were 34 students (2.7% of 1,293 included—28 control and 6 intervention) who resat the maths GCSE in November but could not be included in the primary analysis. Twenty-seven of these were due to the setting not providing the raw scores for the students (all from one setting in the control arm), and the remaining seven were not included due to sitting none of the papers thus having no raw score (one control and six intervention).

Table 13: Standardised raw mark by arm, and overall

	Control	Intervention	Overall
Standardised mark			
N	623	636	1259
Mean (SD)	-0.0 (0.9)	0.0 (1.1)	0.0 (1.0)
Median (min, max)	0.1 (-3.3, 3.2)	0.2 (-4.0, 2.9)	0.1 (-4.0, 3.2)

Descriptive analysis of secondary outcomes

Achieving a grade 4 or higher (that is, achieving a standard pass)

The number of students who passed in each arm of the trial, and overall is detailed in Table 14.

Overall, the percentage of students who achieved a standard pass was 24.4%. There is a slightly higher percentage who passed in the intervention arm (27.7%) than in the control arm (21.0%).

Table 14: Numbers who sat and passed the maths GCSE, by arm and overall

	Control	Intervention	Overall
Sat the exam	n = 651	n = 642	n = 1293
Passed, n (% of those who sat exam)	137 (21.0)	178 (27.7)	315 (24.4)

Attendance at exam sessions

The majority of students sat three papers (90.1%); however, when considering that one exam board (Eduqas) had only two papers, 93.7% of the students sat all applicable papers. This was similar in the control arm (91.9%) and the intervention arm (95.5%). The mean percentage of applicable papers sat by the pupils was 97.8%—noting that some should have sat two and some should have sat three: similar in the intervention arm (97.4%) and the control arm (98.3%). Further details on the number of papers sat is detailed in Table 15.

Table 15: Number of papers sat per arm, and overall

	Control (n = 651)	Intervention (n = 642)	Overall (n = 1293)
Number of students who resat: n (% of resits)			
3 papers	556 (85.4)	609 (94.9)	1165 (90.1)
2 papers*	63 (9.7)	17 (2.7)	80 (8.2)
1 paper	4 (0.6)	10 (1.6)	14 (1.1)
0 papers	1 (0.2)	6 (0.9)	34 (2.6)
Missing	27 (4.2)	0 (0.0)	27 (2.1)
Number of students who resat: n (% of resits)			
All papers	598 (91.9)	613 (95.5)	1211 (93.7)
Some papers	25 (3.8)	23 (3.6)	48 (3.7)
No papers	1 (0.2)	6 (0.9)	7 (0.5)
Missing	27 (4.2)	0 (0.0)	27 (2.1)
Average percentage of expected papers sat			
N	624	642	1266
Mean (SD)	98.3 (8.5)	97.4 (13.4)	97.8 (11.3)
Median (min, max)	100 (0, 100)	100 (0, 100)	100 (0, 100)

* Eduqas has two papers only.

Analysis in the presence of non-compliance

The number of sessions attended for the intervention was recorded both by registers at the sessions and self-reported on the teacher survey. These figures are reported in IPE Programme Compliance section. When defining compliance at the teacher level as attending the first two of the three training sessions, in person or via a live webinar, we found, from the training attendance registers, that 49 teachers were compliant—45.8% of the 107 'actively involved' intervention teachers.

Implementation and process evaluation

This section reports the findings of the IPE using the following structure:

- Context of the trial: the nature of the settings and teachers involved, teachers' attitudes to maths resits and their perceptions of students' attitudes, and motivations for being involved in the trial.
- Training: description of the three trainings days and feedback from attendees.
- Fidelity of implementation of 5Rs: dosage, delivery, lesson structure, use of lesson plans and resources, and student self-study.
- Student engagement with 5Rs.
- Enablers and barriers to adopting the 5Rs programme.
- Business-as-usual: practice in control settings.
- Comparison between intervention and control settings: perceived impact on students (knowledge and engagement), resource use, and impact on teachers (confidence and likelihood to repeat teaching approach).

The section concludes with a summary of the IPE findings mapped to the research questions.

Context

Teacher background
Most of the survey respondents were teachers in FE settings, with roughly half as many in school sixth forms and a minority in sixth form colleges (see Table 16). This reflects the distribution of settings in the trial overall.

Table 16: Survey responses by type of setting—raw numbers

	Baseline survey		Post-survey	
	Intervention*	Control	Intervention	Control
Total (N)	93	96	80	67
FE college	57	55	49	35
Sixth form college	9	13	8	9
School sixth form	27	28	23	23

* Excluding those project leads (the main contact for the evaluation team within each setting) who were not teaching 5Rs (25 total) and only answered a very limited question set.

Maths was the main subject taught by all but one of the baseline respondents. Their highest maths qualification varied from GCSE (12%) and A-level (21%) up to undergraduate (37%) and postgraduate degree or equivalent (25%).

Over two-thirds had been teaching for six years or more (69%) and most of the others (21%) had taught for three to five years with only 5% being in their first year of teaching. Teachers were a little less experienced in resit maths specifically, although almost half (49%) had taught it for four or more years. For 15%, the evaluation year was the first time they had taught resit maths. Over half of them were also teaching maths that was not post-16 GCSE resit in the evaluation year (57%). This was less frequent among the intervention (47%) than the control (67%) group; 15% (20% intervention, 9% control) had only ever taught resit maths.

Low sample sizes meant sixth form college teachers could not be compared with the other two settings. However, those in FE settings were more experienced in teaching resit maths than teachers in school sixth forms (61% vs 33% had taught it for four or more years) but they were less likely to be teaching other maths classes in the current year (26% vs 82%) and more had never done so (33% vs 0%).

In total, 11 respondents said they had followed the 5Rs approach previously (six intervention and five control teachers), mainly having picked it up in previous jobs or using the approach without it being badged '5Rs'.

Teaching post-16 GCSE maths resits

At baseline, most teachers held mixed views about delivering resit maths (Table 17), often echoing the range of attitudes they perceived in their students. The struggle to motivate students reluctant to continue studying maths was a common theme: for some, dealing with unenthusiastic students who lacked confidence was demotivating, whereas others found it inspiring. Adjectives such as 'rewarding', 'frustrating', and 'challenging' were commonly used:

> *'It is very rewarding when students that work hard achieve a grade 4, but frustrating as it is mandatory. Those who have no interest in the subject influence those around them' (Teacher, FE college, baseline survey, control).*
>
> *'It is challenging but rewarding once the students are motivated. It is also one of the most difficult and frustrating jobs I have ever done' (Project lead/teacher, FE college, baseline survey, intervention).*

Table 17: Teacher attitudes to teaching post-16 resit maths classes—baseline survey

Categories of comment	Total (n = 189)	Intervention (n = 93)	Control (n = 96)	Example quote
Positives				
Enjoy it	74	35	39	*'I really enjoy this challenge. Giving students the motivation to not give up [in general and particularly tricky looking questions]' (teacher, FE college, intervention).*
Rewarding	21	7	14	*'It can be rewarding when students engage and find that they can actually do something which they have always believed to be beyond their ability' (teacher, FE college, control).*
Enjoy making a difference to attitudes / improving skills	19	9	10	*'I like that I can make a difference and give them an altogether more positive outlook on maths' (teacher, FE college, intervention).*
(Some) students motivated to pass	16	7	9	*'The students are willing to learn and put their best effort into learning, which makes easier for learning to take place' (teacher, school sixth form, control).*
High confidence of teachers	14	5	9	*'I feel very confident and enjoy teaching and motivating students as it can be hard for them to motivate themselves during their A-level years' (teacher, school sixth form, control).*
Negatives				
Demotivated / reluctant learners	73	30	43	*'Many 16- to 18-year-old learners are often disaffected as a result of prior experience and require significant motivation' (teacher, FE college, control).*
Challenging / stretching	21	9	12	*'Challenging because of misbehaving mainly due to lack of motivation and being already failed at least once' (teacher, FE college, intervention).*
Frustrating / waste of time	18	11	7	*'Generally students will engage with the work in class but for students to do the additional work outside of class is very rare, which I find frustrating' (teacher, FE college, intervention).*
Low self-confidence of learners	16	7	9	*'Most want to pass but do not believe in themselves so consequently do not put in enough effort' (teacher, sixth form college, control).*
Find it difficult / lots of effort	14	8	6	*'Hard work trying to teach students who don't want to be there' (teacher, school sixth form, intervention).*

Students' attitudes to studying maths

The lesson observations, staff interviews, and student interviews in the setting visits revealed the diversity of students' attitudes to maths ranging from totally committed to passing to totally alienated from the subject, with most lying somewhere in between:

'Their attitude is "don't like maths, don't want to be here". I have to do it because this is what the government say, but I'd rather not be doing my maths, because I just don't like it. And it's a very mixed reaction between kids that want to try hard, want to pass it, want to be there every lesson and others that have no interest whatsoever' (teacher interview, school sixth form, control).

One key element in determining students' attitudes towards maths was their perception of its relevance. Some students acknowledged it was important to their future, perhaps because they needed the qualification to go to university or pursue a particular occupation, or because it supported their parallel studies. In these cases, they were usually more engaged with the lessons:

'We have pockets, engineering for example, the students are a lot more motivated and see the benefit of maths' (project lead interview, FE College, control).

In contrast, other students failed to recognise any practical reason why they might need to pass GCSE maths:

'I think a lot of the girls in my class have got health and social [health and social care courses]; they've got a lot of coursework, and they see that as their main priority, not necessarily to be doing maths outside their lessons, so that's a bit of a struggle for us' (project lead interview, school sixth form, control).

'I don't need it at all. It seems like a waste' (student interview, school sixth form, intervention).

Although it was generally recognised that these students were harder to engage, this was not a foregone conclusion. The student who dismissed maths as a 'waste' (above) went on to say:

'But I guess that the sooner you pass, the sooner you have more time to concentrate on other things; but if you don't pass, then you're still in that, like, routine of having to go to maths all the time' (student interview, school sixth form, intervention).

A second key element was how likely students thought they were to pass. Several teachers in the study talked about students being limited by their self-belief in terms of mathematical ability:

'They've got it into their head that they can't do something. So it's almost as if they look at a question and because they're telling themselves they can't do it, they inevitably can't do the question' (teacher interview, FE college, control).

This was confirmed in feedback from the students themselves, many of whom were influenced by their previous performance in the exam. Some questioned how they could possibly improve now, with fewer lessons per week and other subject priorities, if they had failed to achieve a grade 4 when maths had been a key part of the curriculum:

'I don't feel confident at all because I was 11 marks off in my actual one, and now I find that there's quite a few marks that I have to gain; and to having less maths lessons, it's, kind of like I'm not going to get better, am I?' (student interview, school sixth form, intervention).

The third main element determining a student's attitude to maths was how easily it fitted alongside their other work. The tension between time spent on maths and their main subject(s) was picked up by several students as a source of stress. Regardless of their perception of the relevance of maths to their future, students resented its impact on an already crowded schedule:

'If you have a big assignment, you'd rather do the assignment than maths, I know it's bad, but your like course is more important than maths, even though you're trying to pass maths' (student interview, sixth form college, control).

Students were asked how their current maths lessons compared with the ones they had done the previous year (usually the first time they had taken GCSE maths). Regardless of trial arm, several students felt they were getting more help and better explanations in their current year, with several linking this to the class size being much smaller. This was supported by the ten lesson observations, where most classes had between 6 and 13 students (the full range was 3 to 18). There were also comments from students in both intervention and control settings that they were more likely to be given exam-style questions to work on, which was something they welcomed.

Staff motivation for trial involvement—intervention arm

As Table 18 illustrates, the overwhelming reason for getting involved in the trial was a wish to boost student performance in the GCSE resits underpinned by increasing engagement and motivation, encouraging more work outside lessons, and achieving deeper understanding. Staff also welcomed the prospect of support and ideas both for lesson planning and structure, and for approaches used to deliver the content. It was evident from the interviews that several settings welcomed free training and resources in an area that was not usually prioritised. Some, who had been delivering maths lessons to GCSE resit students for several years without much success, just wanted to try something new:

> *'I'm not happy with where we're at. So, I suppose, in a sense, if you're not happy with something, of your provision, and something comes along saying, this might help you, you just say, yeah, great, we'll try that. You've kind of got nothing to lose' (project lead interview, school sixth form, intervention).*

There were some respondents (six) who had no initial expectations of 5Rs because they had been sent to the training by their setting without any prior information.

Table 18: Expected impact of 5Rs project on sign-up—baseline survey, intervention only

	N = 139	Example quote
Improved results/outcomes	71	*'… enable more students to pass at grade 4 or grade 5' (project lead/teacher, school sixth form).*
Increase student engagement	21	*'I hope it helps with student engagement in lessons' (project lead, sixth form college).*
Increase student motivation	15	*'… motivation to succeed' (project lead/teacher, FE college).*
Better experience for students	7	*'… feedback from other colleges on how we can improve learner experience' (project lead, FE college).*
Improve motivation to study outside lessons	6	*'… that students would have access to resources that would encourage more revision at home' (project lead/teacher, school sixth form).*
Students have deeper knowledge / understanding	6	*'… develop areas that students make silly mistakes [in]' (teacher, FE college).*
A new approach / style	17	*'… new approaches I can use in my lessons' (teacher, school sixth form).*
Develop / improve planning, teaching and assessment	15	*'… plan and prepare lessons more effectively' (teacher, FE college).*
More / better resources	13	*'I hoped it would be designed especially for post-16 students and new resources aimed at them' (teacher, sixth form college).*
Structured lessons	9	*'I am hoping that the students would benefit from the routine and structure' (project lead/teacher, school sixth form).*
Not sure what to expect	6	*'… initially wasn't sure as just sent by my head of department' (teacher, school sixth form).*

Since the baseline survey was completed after the first training session, respondents were asked what impact they now expected from the 5Rs programme. The feedback was very similar to the original hopes, but about twice as many teachers were likely to anticipate an increase in students' confidence or self-esteem. However, some teachers expressed disappointment or concern about the likely impact (13 out of 75) and another five did not expect any improvement. Mostly this was related to early experiences using the approach with their students rather than issues with the training session itself:

'Now I have started delivering the programme I feel a bit more sceptical about the success of the programme because I can't get my students to do enough practice outside of class' (teacher, FE college, baseline survey, intervention).

Training

Training observations

There were three training days, one just before or at the beginning of each term. Each was designed to take place once per region, reducing the time and travel the teachers were required to undertake. Webinars were provided as back up. The planned third in-person day had to be substituted with a live webinar, offered on two dates, because of the COVID-19 restrictions. Two members of the evaluation team observed each session, with the exception of the final live webinar which was observed by one evaluator.

DAY 1—September 2019: two trainers, nine participants, two evaluators observing

The developer began by inviting all the teachers to contact her via email for support at any time during the year. The 5Rs project was introduced and emphasis given to the need to approach teaching GCSE maths resit differently from previous school maths lessons and ensuring students appreciated the benefit of having the GCSE maths qualification for their future. The teachers were encouraged to get students engaged in maths on a daily basis with all the resources made available through the 5Rs student Padlet. The structure of the 5Rs lessons was outlined, emphasising the need to ensure that each section was not too long and that the year is about revision and finding out where students make common mistakes. Alternative methods were discussed and demonstrated, including distributing a tea towel with different calculation approaches outlined. The many resources available on the teacher Padlet were introduced, for example, Corbettmaths, OnMaths.com, M4ths.com, but the emphasis was on using the resources that worked best for the individual teacher. A practical activity was used in the afternoon along with further emphasis on the 5Rs structure and pace of lessons to keep the students engaged. Advice was given on tailoring the timings of the lesson structure to fit a longer lesson, for instance by adding additional loops of the Revise and Repeat elements (15 minutes each) as appropriate. A discussion at the end of the day suggested teachers were looking forward to teaching 5Rs.

DAY 2—January 2020: one trainer, 11 participants, two evaluators observing

The second training day began with an example of a practical problem-solving task before an open discussion about participant's experiences of the November resits. Feedback indicated clearly that settings take different approaches to the November resits with some entering all students as a matter of course and others entering only those most likely to obtain a grade 4 or above. This was followed by the developer recapping the 5Rs lesson structure and asking for feedback on how participants were using it in their lessons. Questions were asked about adapting the timings and the large number of resources on the teacher Padlet, which some thought could be overwhelming. The developer explained that it was not necessary to try to use them all, rather pick the ones that worked for them. She also offered to tailor the teacher Padlet to fit teachers' requests by, for example, removing some of the content. New resources that had been added to the Padlet were also demonstrated. The importance of encouraging students to do some daily maths was repeated from the first training day. Some methods for encouraging students to attempt longer exam questions were shown as often students avoid these. Discussions followed about ways to help students break the questions down into individual steps. The new lesson plans for the first four weeks of the spring term were shown on the website. Participants were informed that the website would stay live until the end of the year. Teachers were mostly very engaged and enthusiastic and all were happy to share their experiences so far. Most seemed confident delivering 5Rs and thought the students were engaged in lessons; however, some found adapting it for longer lessons was a challenge.

DAY 3—webinar March 2020: one trainer, one evaluator observing

During this training webinar the developer acknowledged that COVID-19 meant that it was unclear what would happen with the 5Rs trial. She emphasised that the Padlet would remain available for all of the academic year as well as the next. The student Padlet was promoted as a great way for students to work remotely with many useful resources in one place for them to continue their daily maths. There was a discussion about the GCSE exams, which had not been cancelled at this point.

Programme compliance

Compliance with the 5Rs programme was defined in the protocol as attending the first two training sessions (either in-person or via live webinar). Of the 107 teachers involved in the trial at the intervention settings, 49 met this criterion, giving 46% compliance. The delivery team attribute some of the low attendance to staffing issues within some settings and some staff being instructed to take part in the intervention rather than choosing to do so.

Day 1 was attended by 79 teachers (74%) with a considerable drop to 60 (56%) attending Day 2. The picture was very different for the third session which took place after the schools and colleges had closed for the first national lockdown due to COVID-19. It was delivered by live webinar on a choice of two dates (20 or 24 March 2020, very shortly after schools and colleges had been closed to most students). Only 27 teachers (25%) attended. It was available online to view afterwards but no information is available on how many teachers did so. Looking at the pattern for all the teachers involved in the intervention:

- 17 (16%) attended no sessions;
- 35 (33%) attended one sessions;
- 34 (32%) attended two sessions; and
- 21 (20%) attended three sessions.

Nearly all respondents from the post-intervention survey claimed to have attended the first training session in some form (91% in total including 82% in person or live webinar). These figures dipped slightly for the second session (86% in total including 73% in person/live webinar), which does not reflect the size of decrease seen in the actual attendance figures (shown above). This could indicate that the survey was completed by more engaged teachers, or there was some level of exaggeration or mis-remembering. However, attendance at the third session live webinar was very similar to the proportion logged as attending in real life (27%, plus 9% watching a recording and 8% trained some other way, mostly dissemination by colleagues, giving 44% total). This left 56% who received no final training session (Table 19); this high figure probably partly reflected the impact of the COVID-19 pandemic.

Table 19: Mode of attendance at training sessions—post-intervention survey

Type of attendance:	Session 1 N = 80 %	Session 2 N = 80 %	Session 3* N = 80 %
In person	74	69	NA
Webinar (live)	8	4	27
Webinar (recorded)	0	1	9
Other training arrangements	10	13	8
Received no training	9	14	56

* Session 3 took place in the first week of the first national lockdown, severely affecting attendance.

Teacher feedback

Nearly all those respondents in the baseline survey who had received the first day of training felt it had prepared them well to deliver 5Rs, but more said ‘quite well’ (56%) than ‘very well ‘(34%). They found it very informative, that it communicated the programme structure and aims coherently, and presented a variety of resources (including lesson plans) that were clearly explained:

> *‘It explained the process and also gave the tools to look at all the online resource in my own time. There were plenty of examples on how the lessons could be structured’ (teacher, FE college, baseline survey, intervention).*

Forty percent of those trained had contacted the trainers since the training event and nearly all of them (94%) were ‘very satisfied’ or ‘quite satisfied’ with the response they received.

The teachers who were interviewed in the visits were generally complimentary about the training. They welcomed its face-to-face nature and the chance to meet other teachers who were delivering resit maths. The first session, with the resources, ideas, and techniques it introduced, was received more enthusiastically than the second, which focused more on reflection and feedback.

At the time, shortly after starting to implement the programme, the majority of all baseline respondents in the implementation arm (regardless of whether or not they had been trained) felt 'quite confident' using the 5Rs approach (66%). Although some were 'very confident' (18%), a similar proportion were 'not very confident' (15%).

Fidelity

Dosage

Approximately half the teachers in the intervention arm said students had two maths resit lessons timetabled per week (43 out of 80 responses). The majority of the remainder had three per week (18/80) or one or fewer (14/80). The most common length of lesson was 90 to 100 minutes (28/80) or 60 minutes (21/80). As might be expected, there was a link between the length and frequency of lesson: those with one-hour lessons tended to have two or three a week, whereas those with longer slots (between two and three hours) usually only had one or two a week (Table 20).

Three-hour lessons were unique to the FE colleges in the sample. The pattern reported by teachers in the control settings was very similar.

Table 20: Frequency and length of lessons

	One or less	Two	Three	Four	Five or more	**Total by length**
50 Mins	1	2	2	-	4	9
60 Mins	1	8	11	1	-	21
75 Mins	-	4	-	-	-	4
90-100 Mins	3	25	-	-	-	28
120 Mins	4	4	1	-	-	9
180 mins	4	-	-	-	-	4
Different lengths	-	-	3	-	-	3
Other	1	-	1	-	-	2
Total per week	**14**	**43**	**18**	**1**	**4**	**80**

Source: post-intervention survey, intervention teachers—raw numbers.

Over half the teachers in the intervention settings rated their students as having 'quite good' attendance (58%), although 28% said 'quite poor' (Table 21). Only 9% judged attendance to be 'very good'. The logic model did not predict that the 5Rs programme would have any direct influence on attendance levels so it was unsurprising that the picture was almost identical in control settings. It also emerged as an issue in the school/college visits with some absenteeism (nearing 50% in two cases) and late arrivals across both trial arms, which was also mentioned in the interviews:

> *'Our target attendance is about 85% for all programmes, and for maths at the minute it's about 70%' (project lead interview, FE college, intervention).*
>
> *R2: 'Well some people just don't turn up.'*
>
> *I: 'Right. Is that because they just don't turn up to anything?'*
>
> *R1: 'No, I think that's just because they've given up' (student interview, sixth form college, intervention).*

Table 21: Student attendance—post-survey

On average, how would you rate your GSCE maths resit students on attendance at lessons?			
	Intervention (n = 80) %	**Control (n = 65) %**	**Total (n = 145) %**
Very good	9	8	8
Quite good	58	57	57

Quite poor	28	28	28
Very poor	3	6	4
Don't know	4	2	3

Delivery

The lessons observed in all six intervention settings had been well prepared, as might be expected when the teacher is aware that someone will be watching. When interviewed, most students as well as teachers confirmed that the lesson was a typical one and in all except one lesson, students seemed very familiar with the 5Rs lesson structure. Good teaching practice, such as modelling skills by taking the class through an exam question and checking students' understanding, was widespread.

Only one of the lessons was given the highest rating for implementing 5Rs routines and materials faithfully and consistently, but all the remainder received the next best rating—that the 5Rs lesson structure was followed and some resources used but not consistently. The 5Rs programme recognises that contexts vary, so surface adaptations to suit learner needs, or adjustments to the structure to fit a time slot that was not one hour, were acceptable. Most of the observed adaptations were timing adjustments: either extending a section to ensure adequate understanding or making sure the structure fitted the timetabled slot. It was common for teachers to report that they were deviating from 5Rs because they adapted the scheme of work or lesson plan to meet student needs:

> *'I'm at the point now that I know what their needs are, and so if I feel they don't need to be taught area, I'm not going to do that lesson, and I'm not showing the videos; I'm teaching the topic myself, and then they're doing exam practice on it' (teacher interview, school sixth form, intervention).*

> *'I think, in an ideal world, the structure would be fantastic […] just getting to the last Repeat and Ready, it can be quite a push' (teacher interview, FE college, intervention).*

The alternative methods of calculation that were a feature of 5Rs were only mentioned at a low level, and then in relation to resistance to them. For instance, this teacher was not confident in her own ability to perform the method and was also concerned that students would misremember it:

> *'There was something about putting on a pair of gloves and numbering the fingers in order to learn the times tables […] I'm not brave enough to try and remember to show the students. Some students would love that, but some would then be like … oh, they'd get it wrong' (teacher interview, school sixth form, intervention).*

A second teacher had adopted the different approaches but found the students reluctant to use them:

> *'I am showcasing all methods. We are giving them the opportunity. I have opened up to that, but I think, my lot are still … this is new; this is, kind of, unfamiliar. So, they're still going back to … sticking to what they know' (teacher interview, school sixth form, intervention).*

5Rs lesson structure

Nearly all the teachers in the post-intervention survey claimed to have followed the 5Rs structure either very (33%) or quite (59%) closely. This was confirmed in the setting visits, where all the sections usually featured. However, there was some flexibility, particularly in the way teachers approached Recall and Routine: in one school sixth form, the teacher swapped the sections round while in another they were combined into one.

In the interviews, teachers were shown the suggested 5Rs lesson structure and asked which section(s) they found useful and why (Appendix 19). Routine (practising different maths topics) and Ready (exam techniques and common mistakes) both featured strongly:

> *'Just because, every topic that we do they've seen it before. But we're spending more time with some of [the topics], they probably have never spent time going through the techniques and common mistakes' (teacher interview, school sixth form, intervention).*

Other teachers struggled to fit in the full 5Rs sequence because they judged that their students needed more time to go over the key topic and consequently the Ready section on exam techniques and common mistakes was sacrificed.

> *'Fifteen minutes for one key topic, it's not 15 minutes for us. I mean, we end up spending 45 minutes doing one topic, because of our levels' (teacher interview, FE college, intervention).*

One teacher acknowledged that 5Rs had improved their practice by emphasising the importance of using the type of questions students were likely to find in exams:

> *'[Before 5Rs] I did a table for them. I added two more columns. But in the exam they don't necessarily add a column for them. They need to think of the columns. So it's important that they may see how a question comes in the exam' (teacher interview, FE college, intervention).*

The students, as the developers expected, were not familiar with the names of the different lesson sections, but they recognised the descriptions from the prompt card (Appendix 19). Recall and Routine were seen as particularly useful:

> *'Because they're topics from the past that we didn't really understand but now we do because we go over the topic' (student interview, school sixth form, intervention).*

Several students appreciated the structure, culminating in practice with exam questions. One eloquently described the Revise and Repeat elements:

> *'[At college], it gets explained in more depth until you understand it and you actually get work and you get helped through it. And then once you understand it, you go and do like an exam question on it […] it's alright doing it in the lesson, but you want to have it in the exam situation, in like an exam question, because it's how it's going to be in the actual GCSE exam' (student interview, FE college, intervention).*

Lesson plans

Adherence to the 5Rs lesson plans (examples in Appendix 20) was lower than adherence to the overall structure. According to the post-intervention survey, one in ten teachers had never used them (predominantly those who had never accessed the website or already had other plans in place). Most, however, used them always (19%) or usually (43%) with a third using them sometimes (18%) or occasionally (11%). Just 8% said they followed the plans 'very' closely, with most opting for 'quite closely' (67%) and one in four (25%) saying 'not very closely':

> *'More than anything I use it as a skeleton, and to try and find some of these new resource' (teacher interview, FE college, intervention).*

Several teachers said they deviated from the lesson plans by amending the recommended timings. This happened for two main reasons. One reason was to fit in with the timetabling requirements of the setting where there might, for example, be only two hours for resit maths a week and as a result not all topics could be covered. In one case study visit, a two-hour slot was observed. The teacher covered two key topics, although the 5Rs structure became less coherent after moving to the second. There was an additional challenge for those whose maths lessons were not multiples of the 60 minutes 5Rs lesson plans were designed for. This teacher, for example, had a 90-minute slot:

> *'So I'll do revise, repeat and then revise, repeat for a different learning outcome and then Ready will be some exam questions at the end' (teacher interview, FE college, intervention).*

The other main reason for not following the recommended 5Rs section timings was to adjust to students' needs. This could happen at any section of the lesson as questions were raised or when the teacher picked up issues but was most evident in the Revise and, to some extent, Repeat sections where the key topic was being dealt with:

> *'I found it difficult with my cohort to stick to timings as the scheme was fast and furious and I needed more time in certain topics than was recommended' (project lead/teacher, FE College, post-intervention survey, intervention).*

In the observations, one teacher in particular showed a lot of flexibility in the latter part of the lesson, with students moving on from Revise into Repeat and Ready as their ability and understanding allowed.

Across all the observations, Ready was the section most likely to keep to length, possibly because it fell at the end of the lesson so could not overrun.

Resources

Teachers were using a range of resources (see Table 24 for detail). Corbettmaths 5-a-Day was easily the most popular resource used in the lesson (chosen by 84% as one of the main three they used), whereas past exam papers were most commonly given for homework (64%). Some differences were evident between types of setting: past papers, Corbett 5-a-Day, and Hegarty Maths were more popular at school sixth forms than at FE colleges; the reverse was true of MathsWatch.

Resources were used fairly frequently in the observed lessons. In half of them, Corbettmaths 5-a-Day featured in the Routine section. Later in the lessons, old exam papers or exam-style questions on worksheets were used. Only one teacher played a full-length instructive video (from Corbettmaths); another two used short videos of songs about a topic, for instance how to calculate the area of a trapezium. There was some evidence of resistance to playing the longer instructional videos since teachers felt it was usurping their role:

> *I personally am not going to show videos when I'm teaching. I believe it's a useful resource for [students] as part of their independent study, and I flag it up to them on a regular basis that you can go away and watch the video. But in my lessons I'm not going to be showing the videos, because I believe I'm paid to teach' (teacher interview, school sixth form, intervention).*

Self study

One of the aspects of the 5Rs logic model is to encourage independent learning among students by improving their study skills and engaging them with online resources (particularly via the student Padlet) to revise outside the classroom.

In the post-intervention survey, nearly three-quarters of teachers (74%) claimed to be encouraging their students at least once every two to three weeks to use the Padlet (Table 22). However, few believed that students were using it very frequently, with 38% estimating it would be less often than once a week and 28% saying rarely or never.

Table 22: Usage of Padlet

How frequently did you encourage your students to use the Padlet to do extra maths?	Teachers N = 80 %
Every week	44
Every two to three weeks	30
Less often	19
Rarely or never	8
To the best of your knowledge, how often did they use the Padlet to do additional work?	
At least one a day	-
Two or three times a week	1
About once a week	18
Less often	38
Rarely or never	28
Don't know / can't say	16

In the six lesson observations there was little explicit encouragement to revise outside the lesson and no mention at all of the Padlet. Most teachers asked their students to finish off the worksheet or exam questions they had been working on for homework.

Students estimated that they spent from no time at all to up to three hours a week on maths self study:

> *R2: 'If we're going to be honest, not much [time] at all, because all of our other subjects are quite…'*
>
> *[…]*
>
> *R1: 'Yeah. Now the exam is creeping up, I think we would do a bit' (student interview, school sixth form, intervention).*

The most common resources used were past exam papers and online materials and there was some evidence that teachers supported them in this:

> *I prefer to do, like, exam style questions for test papers. I think they really help me, because I just try and shoot to the back where you have all the harder questions, and then I'll do them, and if I have anything wrong … I don't know anything, or I have anything wrong, I'll ask the teacher next lesson to go through it with me' (student interview, school sixth form, intervention).*

> *'And the teacher always comes round, and if we need any questions, or she may go through how she would have worked it out. And then she could give us some more stuff, or we can go onto Corbettmaths and help us. And say like, this is how to do it, and like do some more practice on it at home' (student interview, FE college, intervention).*

The Padlet was explored specifically in the student and teacher interviews. In one case, the students were unaware of it and while their teacher felt her students found it helpful, she suggested that, having identified the resources they liked best, they might be accessing them directly rather than through the Padlet. It also meant nothing to students in a second setting where the teacher admitted to repeatedly forgetting to remind students about it.

In a further two settings, the students were aware of the Padlet but did not use it. One pair of students preferred working through past exam questions on paper and both the other students claimed to have lost their log-in details (although there were, in fact, no log-in details needed). The teacher in the second instance claimed to be proactive about the Padlet, giving students opportunities to use it in class when there was time and sending out reminder emails about using it outside the class. However, the teacher's enthusiasm was muted and they criticised it as difficult to navigate:

> *'The students did [use the Padlet], to begin with, and we have used them in the class, but there's honestly so much on the Padlet, they don't even know where to start' (teacher interview, FE college, intervention).*

In a fifth setting, the project lead raised similar concerns about the Padlet being crowded while recognising the upside was that students had everything in one place. This college had created a QR code to avoid students forgetting how to access the Padlet.

The teacher in the final setting was a keen advocate of the Padlet and said they sometimes had students use it for ten minutes in the lesson to encourage those who were failing to use it outside the class. In their interview, her students mentioned the Padlet spontaneously and enthusiastically as a change from how they had been taught maths previously:

> *'Well Padlet is a maths resit website for students to go on to look at different maths website that you can use to revise for maths and I've been using it and it's really helpful' (student interview, school sixth form, intervention).*

Student engagement with the 5Rs programme

Behaviour in most of the 5Rs lessons observed was generally good with the majority of students engaged and working quietly. But in two instances, both 90-minute sessions in FE colleges, there was a considerable number of disruptive students. Behaviour included non-maths-related mobile phone use, throwing pens, and off-task talking along with complaints such as 'I hate maths', 'I give up with this maths class', and 'too many tasks, it's blown my head!'.

All six settings had a pattern of student engagement being highest for the first three sections of the lesson—Recall, Routine, and Revise—but falling for Repeat and Ready. This was particularly noticeable in the FE colleges where the lessons lasted 90 minutes or two hours, suggesting the issue might lie with students' attention span rather than the nature of the individual sections.

There was one setting that received consistently low scores on all the ratings of lesson features. The lesson was slow and students became increasingly bored and disengaged resulting in a substantial number of them failing to follow the key topic in the Revise section and going completely off-task. In four of the other lessons there were no major issues with the pace and classroom management was very good. The remaining lesson was very slow, although classroom management was reasonable.

Many of the students interviewed said their confidence in maths had increased compared with the previous year. For some, this was because there were smaller class sizes, more opportunity to work at your own pace, and improved access to exam questions. Others welcomed the greater scaffolding:

> *'At college, like they break it right the way down, and then literally, they put in stages for you to work it out, and then that helps you a bit more' (student interview, FE college, intervention).*

However, some felt less prepared. At one setting, the students were uneasy with their teacher's emphasis on picking up marks on easy questions rather than grappling with the more complex ones. Other students recognised that they had failed to achieve a grade 4 when their school gave a great deal of emphasis to maths and felt they had a much reduced chance now there were less favourable conditions:

> *'I was more confident last year […] because I've also seen some of my friends: they did their retake in November, and I've seen that they've come out and got a worse grade than they did before […] having less maths lessons, it's, kind of like I'm not going to get better, am I?' (student interview, school sixth form, intervention).*

> *'I mean, we try to [do work outside lessons] but I'm also doing other A-level and BTEC options; it's really hard. And having to fit it in as well as maths is just stressful; it's just a pain' (student interview, school sixth form, intervention).*

Although the 5Rs approach was to replace traditional homework with daily maths practice using the Padlet, the majority of teachers claimed to have set homework either every lesson (29%) or every two or three lessons (50%). However, teacher feedback confirmed the programme's assumption that student participation in traditional homework was low (81% saying completion was quite or very poor).

Enablers and barriers to adopting the 5Rs programme

Enablers

Structure

The structure of 5Rs was generally welcomed by teachers and students alike as offering a variety of activities that helped maintain engagement:

> *'I think actually [the students] really enjoy that they're doing something different rather than just sat, doing a worksheet for 40 minutes and I'm getting bored. It's constantly chopping and changing and you're getting a real mix of things in the lesson and every lesson you're thinking back to the exams as well' (teacher interview, sixth form college, intervention).*

> *'It's just much more structured. I like the fact that, you know, you've got ten minutes, ten minutes, fifteen… So, the chunking really works well' (project lead interview, FE college, intervention).*

Exam technique

Students often referred to teaching approaches that emphasised exam craft to improve their chances of passing the GCSE:

> *'Because there are some bits we've got told at school, but now, we've actually been told how to do the whole, step by step to get the full marks. It works so much better' (student interview, FE college, intervention).*

> *'Well I like doing two topics in a day because it's really useful because these are eventually easy topics that will come up in the exam paper, easy marks to miss' (student interview, school sixth form, intervention).*

Explanation

Some also talked about an increased depth of explanation, and occasionally that teachers offered alternative explanations if the initial approach had not helped the student:

'When she goes through stuff, she explains it well, and she goes … if you still don't understand it, she'll explain it a different way, and like, until you get it. And she'll help you, give you examples and stuff like that' (student interview, FE college, intervention).

Revisiting previous learning

Teachers and students were also positive about the repeated threading of different topics through the sections of the lessons outside the key topic. They appreciated the chance to practise what they had learnt previously, be it in rapid fire recall, practising basic maths, or short questions that appear at the beginning of exams:

'As much as it can be boring it does actually work out, like even the five minutes at the beginning, it refreshes you. So like at the beginning of the lesson she'll ask us questions that aren't about this lesson, so she'll do like five random questions' (student interview, sixth form college, intervention).

Resources

The 5Rs curriculum and resources could prove to be enablers or barriers depending on the circumstances of the individual teacher and setting. For instance, although two project leads agreed that the 5Rs programme was more suitable for less experienced teachers, one welcomed this as providing their team with much-needed support, but the other felt it ignored their teachers' existing skills. A teacher in a setting with little other support for resit maths explained its benefits to them:

'It's just taking that little bit of pressure off, because I know I've got a scheme of work. I know all the resources are there, and there's more than enough for me to just go in, print off, use or direct my kids and that's what I had never had before. And as a school, for resits we don't have a scheme of work in place' (teacher interview, school sixth form, intervention).

Barriers

Pacing

One major challenge for teachers trying to follow the 5Rs lesson structure was to keep to the timings of the five elements of the lesson while catering for a range of ability. Often they were teaching groups that included students who had switched from Functional Skills as well as those looking to convert a grade 3 to a grade 4. This made pacing and content problematic:

> *'Sometimes the pace has to be slowed down or some extra work has to be provided, just to differentiate that you've got some learners who may have come up through functional skills Level 1, and therefore it can be a bit too fast-paced for them' (teacher interview, FE college, intervention).*

More than one teacher felt that the key assumption of the 5Rs programme—that the topics are being revised rather than learnt for the first time—was inappropriate for their cohort:

> *'I don't think for us, it hasn't been working this quick, you know, one hour lessons. We haven't been able to get everything that we're supposed to be getting done in them, because of the different levels. It's just we have to spend more time teaching than revising' (teacher interview, FE college, intervention).*

This exchange between a pair of students following a lesson on calculations relating to circles is just one example of how students had different prior knowledge:

> *I: 'Did you learn anything new about [the topic]?'*
>
> *R2: 'I was alright with it but still good to keep on top.'*
>
> *R1: 'I didn't know how to do it at the beginning of the lesson and I do now' (student interview, sixth form college, intervention).*

Adjustments for ability and prior knowledge were often seen in the lesson observations. For example, the speed of going over answers was varied to match students' level of understanding and students were expected to self-select appropriate exam questions to work on.

Status of resit maths

A second major challenge was the status of GCSE maths resits in general. Not only are many students being forced to study maths by legislation but it also has low priority compared with the course(s) they have chosen to follow. This not only impacts on their attitudes but can also create timetable clashes. One school sixth form had issues with students having to chop and change between two sets of classes, or even miss some slots altogether:

> *'So then Miss can't fully concentrate on one topic every lesson, because different people are there different days, which is quite hard, because then sometimes you're doing things you've done before, or sometimes you're missing things […] I only do four a fortnight now, because I've got a clash with art, so I can't go to one' (student interview, school sixth form, intervention).*

Timetabling

The preponderance of lessons that were longer than the 60 minutes the 5Rs plans were designed for also caused challenges, as in this example of two 90-minute timeslots a week:

> *'We've got to try and cut one of those lessons in half and try and teach half a lesson and then carry on teaching it the following… carry on from the following lesson, doesn't work like that for us' (teacher interview, FE college, intervention).*

The lesson observations suggested that students grew more restless as time went on. While this would affect all lessons, in the 5Rs structure this meant that the Repeat and Ready sections were particularly likely to suffer from disruption and poor concentration:

> *'My lessons were three-hour lessons and it's a long time to do maths and they get tired and lose the concentration after one [hour]' (teacher, FE College, post-intervention survey, intervention).*

Other comments

Teachers at two of the six intervention settings visited said the 5Rs programme was disappointingly similar to their existing approach to teaching resit maths, although one acknowledged that their approach was now more revision-based than teaching a topic from fresh.

> *'I wouldn't say I'm rigidly following 5Rs at all, if I'm quite honest, because, like I've already said, it tends to be in the format of what we're already doing' (teacher interview, school sixth form, intervention).*

Another felt it had failed to live up to its promise and did not deliver the lesson-ready package they were expecting:

> *'I think when I went to the training day, and it was, we've got specific resources on each topic; we've got a lesson plan for every lesson, I was like: amazing; I'm going to be able to just click on something, and today's lesson will be there ready for me; and that is not the case. It is a link to a website, and then I have to find the resources I want to use on that website' (teacher interview, school sixth form, intervention).*

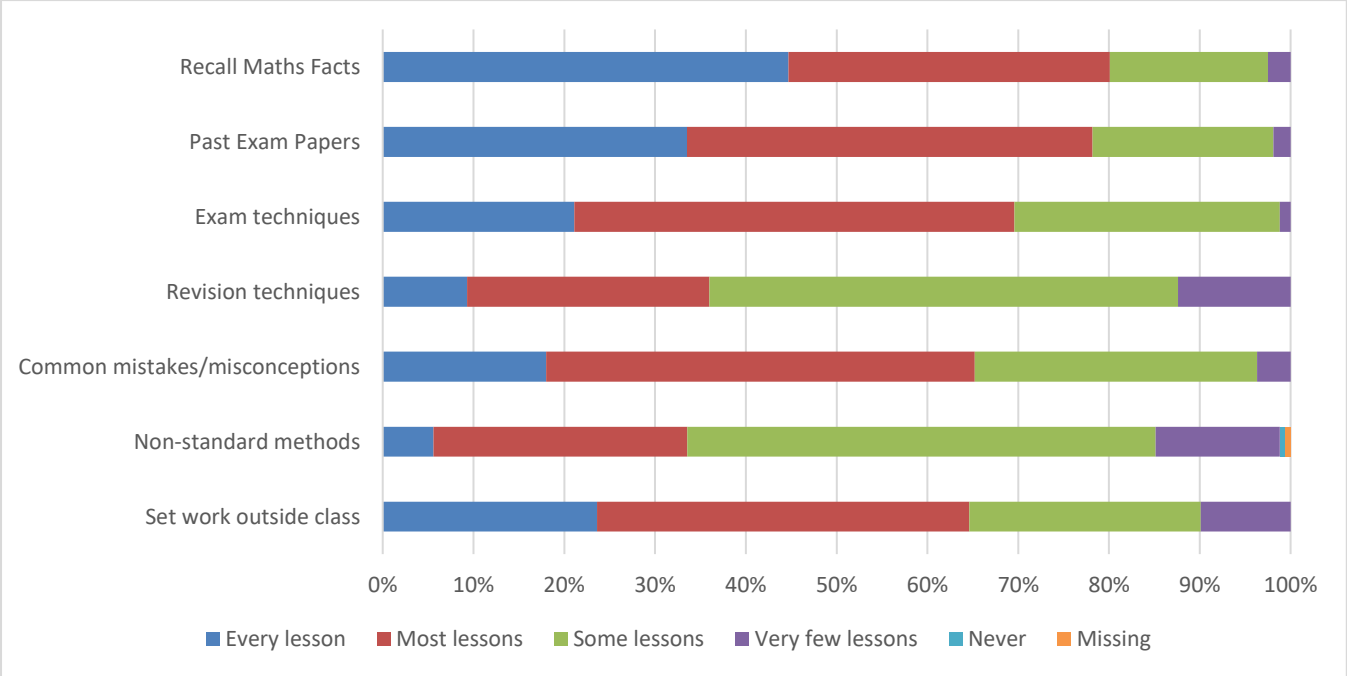
Several teachers were unhappy that they did not receive all the resources, including the scheme of work, at the beginning of the academic year so they could tweak and re-organise it as they wished. They felt constrained by only getting termly releases of material. Outside the trial conditions, it was anticipated that the package would be available as one full year package divided into three ten-week blocks.

Practice in control settings

To establish the nature of business-as-usual practice, teachers in the baseline survey were asked about approaches they had used in the most recent post-16 GCSE maths resit classes they had taken before the current academic year (Figure 4). The list of possible approaches in the survey matched those characteristic of 5Rs. The vast majority of teachers were asking students to recall maths facts (80% in every/most lessons) and do questions from past papers (78%). To a lesser degree, it was also common to explore exam technique (70%) and look at common mistakes and misconceptions (65%). Revision techniques and non-standard methods of doing calculations were much less likely to feature (36% and 34% respectively in every/most lessons). In 65% of cases, teachers were encouraging students to do homework or other work outside the classroom in every/most lessons. This was higher in school sixth forms (90%) than in FE colleges (57%).

Figure 4: Frequency of using different approaches

Q: How often do you do the following in your lessons?

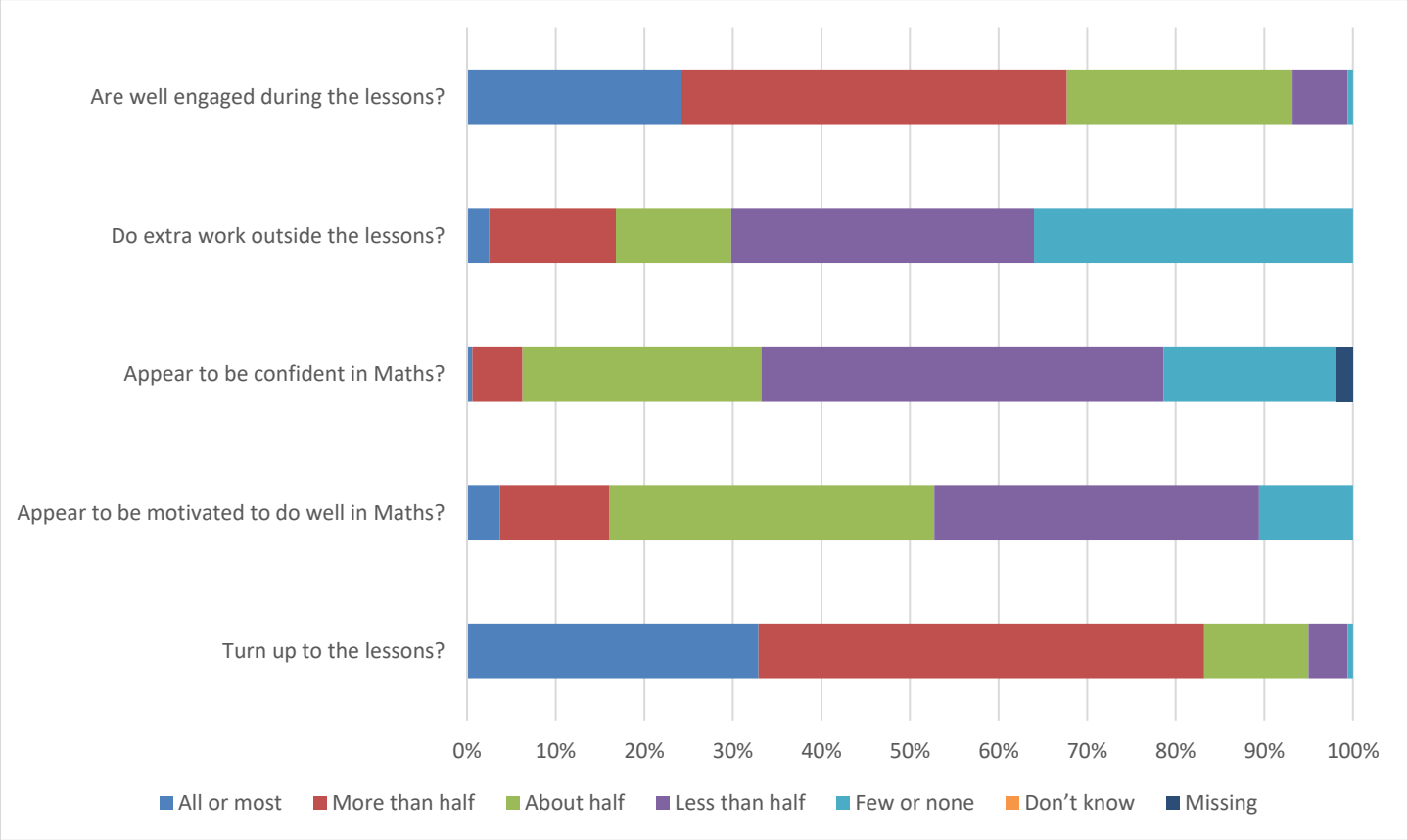


Also at baseline, all teachers were asked about the attitudes and behaviour of the most recent resit cohort they had taught.

Figure 5 shows that 93% of the teachers considered that at least half their students were engaged during lessons and 53% of teachers thought that at least half the students were motivated to do well in maths. However, student confidence in maths was judged to be low (64% thought that fewer than half their students appeared confident). Doing extra work outside the lessons was thought to be rare (just 30% saying half or more of their students did any). This was lower in FE settings (17%) than school sixth forms (51%). This needs to be set in the context of only 33% of teachers saying that all or most of their students turned up to lessons. Attendance seemed to be even more problematic at FE colleges (26% turning up to all or most lessons) than school sixth forms (46%).

Figure 5: Teacher perceptions of student attitude and behaviour

Q: How many students usually…



In the post-survey, three-quarters of teachers in the control arm (74%) said they used a set structure for their lessons, with most others (22%) using one sometimes. They tended to stick to it very (39%) or quite (56%) closely. The most common structure was a three-part (43%) or four-part (25%) lesson, including a starter and main section:

> *'Corbettmaths 5-a-day starter, RAG worksheets after scaffolding the work and finish with exam questions from past papers' (teacher, sixth form college, post-intervention survey, control).*

(Note: 'RAG' is the red, amber, green assessment for learning traffic light system.)

> *'Starter (Beat the Exam), topic introduction, discussion and examples, independent work' (teacher, FE college, post-intervention survey, control).*

Three of the four lessons observed in the control arm had some similarities with the structure and materials of the 5Rs approach. All three started with a short recap section before moving on to a key topic including, in two cases, relevant exam questions. In the third case, students were given worksheet questions on the key topic before having a final section of self-directed learning using exam questions in areas where they judged themselves to be weak. The fourth lesson was completely focused on one key topic with no exam questions.

From the interviews, it was evident that elements of the underpinning philosophy of the 5Rs approach was present in some of the control settings, such as recognising the year was about revising and focusing on exam technique:

> *'Why it's called a resit is because they've seen it once before, and so when is it exactly that they did not understand, what are the misconceptions pinpointing them' (teacher interview, sixth form college, control).*

> *'So, I try and pick what I call quick fixes, but I think, "Well if you can get that, you've now boosted your marks by 12, 13 marks." For some of them that would have been a pass, because they were just short' (teacher interview, school sixth form, control).*

Some of the same challenges apply across both trial arms, such as dealing with a range of ability in one class and enabling students to concentrate throughout long sessions:

> *'We try to vary up, sometimes we do interactive […] We have cubes, we make them up so they've got visual stimulation for that. If we are doing area, volume of shapes again, we have shapes to show them area and surface area and volume. So, worksheets as well, and obviously teacher-led examples' (teacher interview, school sixth form, control).*

All the control settings visited were subscribing to software packages that gave them access to GCSE maths resources. In two cases this was MathsWatch and in one it was MyMaths. The fourth setting subscribed to PiXL, giving them access to the maths app, but the teacher was also keen to subscribe to Mathsbox and for most lessons students had access to other resources via Microsoft Teams:

> *'I use something called Maths Genie and Corbettmaths, that's like my own time revision, there's basically it's same as MathsWatch but it's videos, can answer exam questions' (student interview, FE college, control).*

Most teachers anticipated only a very small proportion of the students did much outside the lesson (Figure 5) and this was confirmed in the student interviews where half the students said they never did any work outside the lessons and for most of the others, maths homework or even self-directed revision might be undertaken, but only if other coursework allowed.

> *R1: 'It's not like in our other lessons we know we have to get essays done or assignments done, otherwise it's going to go downhill from there.'*

> *R2: 'See, even with the homework though, he says, I understand if you don't hand it in because, what is it he said the other week, because I know you've got other A-levels, and I'm like, yeah' (student interview, school sixth form, control).*

One college had changed the way it packaged homework to encourage better completion rates:

> *'We kind of badge it as, if you would like to try and improve your grade and improve this skill, here's some additional work' (teacher interview, FE college, control).*

Students were aware of the various online maths resources that were available to them and some claimed to do as much as two or three hours maths a week outside their lessons (including homework). One teacher admitted it was not always possible to predict which students would do extra work:

> *'I've got some students I know full well are doing absolutely nothing outside the classroom, and then others would surprise you, so others have set the MathsWatch, because we can see who's done their homework on MathsWatch, and you can actually see some of those students you wouldn't have expected to go on, go on on a weekly basis and do everything' (teacher interview, FE college, control).*

In a manner reminiscent of the 5Rs student Padlet, one teacher reported encouraging students to use PiXL Maths, which, like MathsWatch, had the advantage that teachers could use the software to monitor students' take-up and performance:

> *'So we're trying to give them the idea that if they're always on their phone, maybe they might want to stay about five/ten minutes and, you know, jump on to PiXL Maths app and do a question or two. We're trying to promote that' (teacher interview, sixth form college, control).*

Another similarity with the 5Rs approach was the sense of offering an alternative to the previous school approach if appropriate:

> *'[I] often show it the same [way as feeder schools] again, because sometimes that is all you need to do is bring it, sort of, back to mind. But always offer them another explanation as well so that they don't feel, sort of, trapped in the, right, this is the same loop that I've been round over and over again' (project lead interview, FE college, control).*

When teachers in the implementation arm were asked if the observed lessons were typical of their approach to 5Rs lessons, they tended to say 'yes', with perhaps a slight timing tweak or different resource usage. However, the teachers in control settings were much more likely to say their approach varied to suit the students, and it seemed more easily adaptable in terms of timing and coverage:

> *'The group that you went into, a lot of them are quite capable and are ready for the exam-based questions […] other groups you might find that there's a lot of them that don't know the skills, so it's more the textbook questions with everyone working with me on the board' (teacher interview, FE college, control).*

> *'It's never always structured the same because some topics, say transformations—sometimes they can be top on, and others they have struggled with and I have to go right back to basics to find out what they can and can't do' (teacher interview, school sixth form, control).*

The differences between the 5Rs programme and business-as-usual approaches will be discussed in the next section.

Comparison between intervention and control settings

This section looks at the similarities and differences between intervention and control settings to enable conclusions to be drawn about the possible impact of the 5Rs programme. Unless otherwise specified, the data cited comes from the post-survey. However, the forced early conclusion to the trial meant it was not possible to collect the student survey data, which would have helped corroborate or counter some of these findings.

Impact on teachers

Intervention teachers were asked whether delivering the 5Rs programme had made them more confident about teaching maths resit lessons in the future. Half (50%) said it had had no effect with most of the remainder feeling 'a lot' (13%) or 'a little' (36%) more confident. There was a similar pattern of response when teachers in the control arm were asked the equivalent question suggesting that the 5Rs programme had not increased teacher confidence more than expected from delivering resit maths for a year using any other approach.

The vast majority of teachers said they would be 'very' (40%) or 'quite' (44%) likely to use the 5Rs programme in the future, with 16% 'not very/not at all likely' to. In comparison, teachers in the control arm were slightly less likely to teach their resit class the same way again: 31% were 'very likely', 43% were 'quite likely' and 25% 'not very/not at all likely' to do so. Reasons for wanting to continue with 5Rs included the consistent, repetitive structure; increased student engagement because of it being split into different parts; and having several topics rather than just one in each lesson. The minority who said they were unlikely to deliver using 5Rs again wanted it to be more individualised, slower, and more in-depth.

Perceived impact on students

Teachers were asked to rate their GCSE maths resit students on nine items using a four-point Likert scale ('very good', 'quite good', 'quite poor', and 'very poor'). The items were: mathematical knowledge, independent learning strategies, exam technique, confidence in maths, motivation to learn, attendance at lessons, engagement in lessons, behaviour in lessons, and completion of homework. The responses to these questions were recoded to a binary response: positive (very good and quite good) or negative (very poor and quite poor). The percentages were then compared between the intervention and control settings using a chi-squared test and are detailed in Table 23.

When taking a p-value of 0.05 to indicate a significant difference, teachers in the intervention settings have a significantly higher proportion of positive responses for four dimensions: mathematical knowledge (63.8% vs 32.8%, $p < 0.001$), independent learning strategies (30.0% vs 12.5%, $p = 0.011$), exam technique (45.6% vs 21.9%, $p = 0.003$), and confidence in maths (35.0% vs 10.9%, $p = 0.001$). There was no evidence of significant difference between the

intervention and control arms for the other five dimensions, although directionally the response for motivation to learn and engagement in lessons was more favourable for the intervention arm. There was no discernible difference on attendance, behaviour, or completion of homework.

These findings broadly support the logic model but it is important to note that they are based solely on teacher perception, with a further bias possible because those in the intervention arm who responded to the survey may have been more positive about it. It was predicted that 5Rs would improve study skills, engagement, work outside the class (not homework), understanding of basic skills, exam technique, confidence, attitudes, and motivation. Enhanced behaviour and attendance did not feature in the model and the completion of homework was not relevant since the programme does not encourage teachers to set traditional homework.

Table 23: Comparison of positive and negative responses to the post-intervention teacher survey between teachers in control and intervention settings

	Control (n = 65)	**Intervention (n = 80)**	**Total (n = 145)**	**p-value**
On average, how would you rate your GCSE maths resit students on:				
Mathematical knowledge?	N = 64	N = 80	N = 144	
Positive	21 (32.8)	51 (63.8)	72 (50.0)	<0.001
Negative	43 (67.2)	29 (36.3)	72 (50.0)	
Independent learning strategies?	N = 64	N = 80	N = 144	
Positive	8 (12.5)	24 (30.0)	32 (22.2)	0.012
Negative	56 (87.5)	56 (70.0)	112 (77.8)	
Exam technique?	N = 64	N = 79	N = 143	
Positive	14 (21.9)	36 (45.6)	50 (35.0)	0.003
Negative	50 (78.1)	43 (54.4)	93 (65.0)	
Confidence in maths?	N = 64	N = 80	N = 144	
Positive	7 (10.9)	25 (35.0)	35 (24.3)	0.001
Negative	57 (89.1)	52 (65.0)	109 (75.7)	
Motivation to learn?	N = 64	N = 80	N = 144	
Positive	17 (26.6)	33 (41.3)	50 (34.7)	0.066
Negative	47 (73.4)	47 (58.8)	94 (65.3)	
Attendance at lessons?	N = 64	N = 77	N = 141	
Positive	42 (65.6)	53 (68.8)	95 (67.4)	0.686
Negative	22 (34.4)	24 (31.2)	46 (32.6)	
Engagement in lessons?	N = 64	N = 80	N = 144	
Positive	42 (65.6)	64 (80.0)	106 (73.6)	0.052
Negative	22 (34.4)	16 (20.0)	38 (26.4)	
Behaviour in lessons?	N = 64	N = 79	N = 143	
Positive	56 (87.5)	68 (86.1)	124 (86.7)	0.803
Negative	8 (12.5)	11 (13.9)	19 (31.3)	
Completion of homework?	N = 63	N = 76	N = 139	
Positive	12 (19.1)	17 (22.4)	29 (20.9)	0.631
Negative	51 (81.0)	59 (77.6)	110 (79.1)	

Approaches and resources

There were several parallels between the control and implementation arms in terms of classroom practice. Most teachers in control settings said they followed a set lesson structure during the majority of their lessons. The lessons were usually divided into three or four parts rather than the five parts specified by the 5Rs programme. The majority of business-as-usual lessons (as reported at baseline by all respondents) included the equivalent of the Recall (of maths facts), Repeat (exam questions), and Ready elements of the 5Rs approach (see Practice in control settings).

Like teachers in 5Rs settings, those in the control arm were using a wide range of resources but the detail varied (Table 24).

In lessons, Corbettmaths 5-a-day was much more common in 5Rs (84% choosing it as a main resource) than in control (46%) settings, and this difference persisted when giving homework and general recommendations. The other main difference was that teachers in control settings were more likely to use past exam papers (85% vs 65%) in lessons.

Table 24: Main resources used*

	Intervention (n = 80) %	**Control (n = 65) %**	**Total (n = 145) %**
To support lessons			
Past exam papers	65	85	74
Corbettmaths 5 a day	84	46	67
Maths Genie	34	43	38
MathsWatch	34	34	34
Other	25	39	31
Hegarty Maths	11	20	15
Mr Bartons Maths	19	9	15
MyMaths	10	6	8
BBC Bitesize	1	0	1
None	0	0	0
When giving homework			
Past exam papers	64	68	66
Corbettmaths 5 a day	36	20	29
Maths Genie	23	32	27
MathsWatch	41	34	38
Other	33	37	35
Hegarty Maths	14	28	20
Mr Bartons Maths	9	6	8
MyMaths	11	9	10
BBC Bitesize	3	0	1
None	4	3	4
As a general recommendation to students			
Past exam papers	56	52	55
Corbettmaths 5 a day	63	46	55
Maths Genie	36	49	42
MathsWatch	34	35	35
Other	30	28	29
Hegarty Maths	15	29	21
Mr Bartons Maths	16	9	13
MyMaths	13	9	11
BBC Bitesize	16	22	19
None	0	0	0

*Teachers could select up to three resources per section.

Costs: time and consumables

Data from the post-intervention survey suggested that teachers in 5Rs settings were spending slightly less time planning, on average, than those in the control arm: 63% of 5Rs teachers said they spent 30 minutes or under planning each lesson compared with 47% in control settings, whereas only 10% said they spent over an hour compared with 22% in the control arm.

Teachers in the intervention arm were asked how their use of exercise books, paper, and other consumables in 5Rs lessons compared with usage in other GCSE maths resit lessons. Just over half (54%) said it was about the same with the remainder slightly more likely to say they used a little/lot more (32%) rather than a little/lot less (22%). Nearly all the teachers who participated in the interviews reported that they were using more paper, although one had begun to use tablets as a solution.

Summary of IPE findings

RQ1 How closely does the 5Rs as implemented follow the intended model, for instance in structure, content, and frequency of delivery? How well is it being delivered?

Implementation and delivery of 5Rs was generally good with the five-part lesson structure followed fairly closely. Most adaptations related to timing adjustments, either to ensure student understanding or to fit the timetabled slot. The lesson plans were not always used and when they were, often not followed very closely.

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?

Timetabling of maths resit lessons varied considerably across settings and few had the pattern of three 60-minute sessions a week that the 5Rs template was based on. Although the curtailment of the trial meant student registers were not collected, teacher report suggested that low attendance was a concern in a substantial minority of settings.

RQ3 Is there any variability between different types of setting in fidelity, delivery, or attitudes towards the programme (for example, between FE colleges and school sixth forms)?

The cancellation of the student survey limited the exploration of this research question to data collected from staff. FE colleges tended to timetable longer, less frequent maths lessons. Since the lesson observations showed that students became less engaged as time wore on, this might have negative implications for the later elements of 5Rs (Repeat and Ready) depending on how the structure is adapted to fit the longer slot. Although teachers reported similar attitudes (engagement, confidence, and motivation) of students in FE and school sixth form settings, FE students were judged less likely to undertake work outside the lessons (or to be encouraged to do so by their teachers) or to turn up to class at all.

RQ4 What are the barriers and enablers to adopting the programme? Has 5Rs been adapted during the trial? How and why (including whether it has been adapted for delivery to functional maths classes)?

Most teachers and students found the five-part structure of the lessons engaging and helpful. Students were appreciative of the opportunities to revisit content repeatedly and to develop their exam technique. Many teachers struggled to maintain the recommended pace while assuring adequate understanding in classes where not all students had been taught the content before. There was also a challenge if lesson slots did not match the 60-minute ideal of the 5Rs model. There was a feeling amongst some project leads and teachers that the programme was more suitable for less experienced teachers and therefore could be perceived as either supportive or condescending depending on the context.

The cancellation of the student survey and shortening of the teacher post-survey as a result of COVID-19 has limited the data that addresses this question, including its adaptation for functional maths classes.

RQ5 What is the level of compliance with the programme (measured as attendance at training)?

Compliance (attendance at both of the first two training days) was 46%.

RQ6 How are students engaging with 5Rs and what impact does it have on their attitudes to maths (those elements not covered in the ATMI questionnaire)? How much work do they complete on their own, outside lessons?

The cancellation of the student survey seriously limited the data collected directly from the students' perspective. Comparing teacher perceptions of students in intervention and control settings suggests the 5Rs programme may have boosted their mathematical knowledge, independent learning strategies, exam technique, and confidence in maths. The case study visits showed most students were engaged and well-behaved, but a minority in FE settings were very disruptive. There was no evidence that 5Rs students were completing more work outside the classroom than those in control settings. A fundamental assumption of the programme was that it would encourage daily revision using online resources accessed via the Padlet but several of the limited number of students interviewed were unaware of the Padlet and teachers presumed it was being used infrequently, if at all.

RQ7 How are teachers engaging with 5Rs? What are their opinions about the training provision and subsequent support?

A large majority of teachers in the intervention settings said they would like to continue using the 5Rs programme to teach resit maths. They were positive about the training they received, finding the first day particularly valuable, and were satisfied with any subsequent support they requested.

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

It was common practice before the trial for most or all lessons to feature the recall of maths facts and questions from past papers. Exam technique and common mistakes and misconceptions were addressed slightly less frequently. Revision techniques and non-standard methods of doing calculations were present in only a minority of lessons. Most teachers in control settings followed a set lesson structure, usually three- or four-part. In the observations of business-as-usual practice, it was common to start with a recap section before exploring a main topic and then introducing exam questions on that topic or wider topics. In a few intervention settings, the 5Rs programme was not considered very different from usual practice.

RQ9 What can be learned from the IPE to inform a larger trial in terms of possible changes to the intervention and trial design?

The IPE findings, incomplete as they are, suggest that two underlying premises of the 5Rs model need to be revisited.

One is that all students have encountered the maths topics before and only need to revise them rather than be taught them for the first time. This was not always the case, particularly when teachers were faced with a wide range of learners. Some guidance and support needs to be given for situations where this prior knowledge does not exist.

The second is the assumption that students will engage in maths revision outside their lessons, specifically using the Padlet. Although this happened in some instances, the available evidence indicated that such self-study was not prevalent. Teachers need guidance as to how they can encourage this practice or the 5Rs programme needs to incorporate a mechanism to prompt the student directly.

Furthermore, the lukewarm response to the training suggests that it would benefit from being revisited.

Conclusion

Figure 6: Key conclusions

Key conclusions
1. The 5Rs programme was well-received by teachers and was implemented as intended up until the disruption caused by the COVID-19 pandemic. One exception was that the programme intended to increase student revision outside the classroom but this evaluation did not find evidence that the 5Rs programme had successfully encouraged this.
2. Less than half of teachers attended both of the first two training sessions. However, most teachers seemed to understand the 5Rs approach and its underlying philosophy well, and to have applied the five-part structure to their lessons. They were less likely to follow the detailed lesson plans.
3. Teachers perceived the 5Rs programme to have improved students' mathematical knowledge, independent learning strategies, exam technique, and confidence in maths.
4. Some teachers felt that the 5Rs programme assumed lessons could focus on revision when in fact time often had to be diverted to teaching maths concepts instead of revising them. Additionally, engagement tended to wane over the course of longer lessons, which affected the last two elements of the lesson structure (Repeat and Ready). All teachers of GCSE maths resits face challenges such as these in motivating pupils who have previously failed to achieve a standard pass in GCSE maths and so are often unwilling to engage with compulsory maths lessons.

Impact evaluation and IPE integration

The COVID-19 pandemic affected both the impact evaluation and the IPE. Most of the programme delivery and the IPE fieldwork had been completed before the setting closures in March 2020, however, the primary outcome measure could not be collected due to the cancellation of the summer 2020 exams. Overall, about one third of the students took the November 2019 exam but this was an unrepresentative sample due to the differing entry policies adopted by settings. The evidence supporting the logic model and the interpretation below are based on this incomplete data collection.

Though there was no notable difference in standardised fine grade November resit GSCE maths score between the two groups, a higher percentage of students in the intervention group than in the control group passed, out of those that sat it. This is based on descriptive analysis only. A higher proportion of students were entered for the exam in the control group than in the intervention group and we cannot be sure of the comparability of these subgroups across the two groups. Analysis adjusting for factors that may be associated with outcome, such as KS2 performance and FSM status, was not possible.

Evidence to support the logic model

In general, the mechanisms of the logic model were supported by the evidence collected, with the exception of one element—student revision outside the classroom.

The development team provided most of the input as planned. The first two sets of in-person training events took place with alternative support offered to some of those unable to attend. The third day of training was switched online because of COVID-19 restrictions. However, compliance (defined as attending both the first two training days) was low at 46%.

As intended, teachers were provided with the curriculum and resources via a dedicated website, and the majority claimed to have accessed it. Lesson plans were made available on this platform at the start of each term. Nearly all teachers claimed to be closely following the 5Rs lesson structure; this was supported by the observations. Adherence to the lesson plans was less widespread both in terms of frequency of use and how strictly they were followed.

Limited independent evidence from the lesson observations indicates that the fidelity of implementation of 5Rs was reasonably good. However, the original intention had been to include questions in the teacher and student post-surveys to explore how frequently different teaching approaches were used (similar to the baseline survey). These questions were omitted from the post-intervention teacher survey because responses could not be triangulated with student data and the measure needed to be shortened as a result of the COVID-19 situation.

It was predicted that 5Rs would improve student study skills, engagement, work outside the class (not homework), understanding of basic skills, exam technique, confidence, attitudes, and motivation. Unfortunately, it was not possible to complete the student survey so only indirect evidence based on teachers' perceptions could be collected. Based on this, students' mathematical knowledge, independent learning strategies, exam technique, and confidence in maths

were all rated significantly more highly in intervention settings than control settings. There was weaker (non-statistically significant) evidence that motivation to learn and engagement in lessons were also better.

Teacher feedback, therefore, supported most of the mechanisms by which 5Rs influenced students as outlined in the logic model. However, no evidence was found to support the element relating to the engagement of students with online resources to revise outside the classroom, which the developers had identified as a key principle of the 5Rs programme. These resources, and the student Padlet (a digital noticeboard designed to facilitate their access), were seldom mentioned spontaneously by students or teachers. Teachers estimated that only a minority of students were using the Padlet weekly, although the programme encouraged daily practice.

Data from student surveys would be needed to confirm these findings.

Interpretation

There are issues around GCSE maths resits that, regardless of the teaching approach being used, have a substantial influence on student outcomes. Legislation demands that all students who have not achieved a standard pass in GCSE maths continue to study the subject. Consequently, many were on the course under sufferance and had poor motivation. Others were keen to pass because they needed the qualification to progress in their chosen studies or career but—recognising that they had already failed at least once when receiving more teaching time and support—often lacked confidence about their chances.

The findings from the evaluation made it clear that many teachers were teaching classes with a range of student ability. Some had most recently been studying functional maths so much of the GCSE content was not so fresh in their minds. This meant teachers found themselves having to teach some content for the first time, undermining the assumptions of the programme and threatening the integrity of the lesson, which is designed to refresh different maths topics at pace before revising a key topic. As a result, the exam practice elements of the lesson were sometimes reached later than expected, or not at all.

The 5Rs programme drew heavily on revision approaches shown by previous research to be of moderate or high utility (Dunlosky et al., 2003; Donoghue and Hattie, 2021) including practice tests, distributed practice, and interleaved practice. Teacher and student feedback suggested that, insofar as these were incorporated in the lesson structure, they were well received. However, there was little or no evidence that students following the 5Rs approach were any more likely to engage with study activities outside lessons compared with those following business as usual practices. Such self-directed student revision, however, is a central principle of the 5Rs approach—using the online resources available through the Padlet. It was not apparent that this was happening: there was low awareness of the Padlet and the limited evidence available indicated that few students were engaging with maths outside lessons. However, this is an area where more evidence is needed.

There is insufficient evidence to make robust claims about the success or otherwise of the 5Rs programme. The findings suggest that the lesson structure does support a revision approach to maths teaching. However, this can be problematic in some cases where teachers are having to teach content for the first time rather than revise it. There was no evidence that 5Rs students were spending more time revising outside the classroom and mention of the Padlet was low. Teachers did not seem to be promoting its use on a frequent or consistent basis, and the training could perhaps include more guidance on how to persuade students to engage with it.

Implications for 5Rs programme design

Some key assumptions of the programme (particularly that the GCSE maths resit year is revision-only and that the Padlet would encourage students to revise outside the classroom) were not borne out by this study. As a result of this and other findings, certain elements of the programme could usefully be redesigned to increase its likely impact.

There were issues with both teacher attendance at, and content of, the training sessions. It might be worth considering retaining the initial face-to-face event but putting subsequent sessions online. This would reduce the time and cost involved in teachers' attendance and hopefully increase participation. Although attendance at the third sessions, which were delivered online, was low, this was most likely due to the time pressures the teachers were facing as a result of the COVID-19 pandemic rather than it being delivered online. Small group reflection on, and sharing of, problems and practice would still be possible using breakout rooms. Preparedness to teach 5Rs was relatively low after the training and the post-survey showed teacher confidence in teaching maths resit lessons was no different from that of control

teachers, despite support from 5Rs and the website being available, suggesting a re-examination of the content might be beneficial. Areas that might profit from more attention include clarifying how the approach works with students who are encountering the content for the first time and how to increase student motivation and improve their disposition to learn.

The challenging context for resit GCSE maths must not be under-estimated. Many students have neither the time nor interest to engage with the subject inside or outside the classroom. Although the format of 5Rs lessons seemed to be popular with students, there was little evidence that they were motivated to revise outside the classroom. This formed a key assumption within the logic model but the findings show it was over-optimistic—many students were not even tempted to try the Padlet. This issue of encouraging student participation outside the lessons needs to be addressed explicitly in any re-design by integrating student attitudinal and motivational support into the 5Rs approach.

Limitations and lessons learned

The main limitation of this study was that, because of the COVID-19 pandemic, it was not possible to conduct most of the impact evaluation or to carry out two intended elements of the IPE: the student survey and analysis of lesson attendance. Moreover, the post-intervention survey for teachers was much shorter than originally anticipated to minimise burden and maximise response rate at a challenging time and, as a result, some of the research questions could not be explored as thoroughly as intended. Although the November GCSE maths resit results were collected as anticipated, they are not generalisable to the summer data and consequently have not been analysed to the extent originally planned in the SAP. None of the primary or secondary research questions could be addressed.

The IPE research measures worked well. Without the constraints of COVID-19, the post-intervention survey would have repeated more of the teaching approach questions in the baseline survey. These questions, along with those referring to student knowledge and behaviour, would have been replicated in the student survey. This would have allowed comparison between pre- and post-intervention, intervention and control arms, and teacher and student.

Although we randomised the settings in July 2019, a combination of students still confirming course choices and the complexity of selecting the appropriate classes in large settings contributed to delays in finalising the student sample. It was anticipated that classes would be settled by the end of September, however, this was not the case. This led to some teachers being informed at the last minute of training sessions, which may have contributed to low attendance and some students missing the beginning of the intervention because they joined classes after the start of the course.

Finally, the value of obtaining the results from the November resits is questionable given the differing policies towards entry for the exams and the low number of students entered across the sample. It created an additional burden on settings early in the spring term.

Future research and publications

The limited findings reported here suggest that, if funding were available, it would be appropriate to conduct more research into a revised version of the 5Rs approach in post-16 settings. Another trial, even over a shorter period, where the primary outcome was collected—which could not be collected in this evaluation—would allow a fuller assessment of the 5Rs programme.

Future work in post-16 settings should take account of the fact that data collection early in the autumn term can be very difficult and communication with teachers challenging. Although the evaluation team were successful in obtaining the required data, it was very time consuming. Especially in large settings, it may be beneficial to contact teachers directly rather than just through a project lead so they are more aware of what is happening and what is required.

More work needs to be undertaken with students to ascertain their motivation and the barriers to engagement with GCSE maths resits generally and their views on the 5Rs approach specifically. The student survey and Attitudes Toward Maths Inventory would have provided more information in these important areas.

It would be useful to be able to measure, in some way, the amount of work done independently by students outside lessons as this is a central part of the 5Rs philosophy. We were not able to do this as the student Padlet, the online resources portal, could not identify the user and, therefore, could not provide any student-level data. It was unclear from the IPE how much guidance and encouragement teachers gave students around independent work and how motivated

students were given that maths was not their main course and as such not their chief priority. The available Padlet data can give a rough indication of those settings that are more or less successful at engaging students with the technology and perhaps guide sample selection for more in-depth qualitative work in any future evaluation.

Although it has been mooted that 5Rs has a short-term impact (six-week courses have been done in the past), it would be advisable to concentrate on the summer GCSE to avoid any additional burden on settings.

To address concerns about low attendance at training and some relatively low ratings of it, it would be useful to obtain more teacher feedback including reasons for non-attendance and, for those who do attend, more detailed opinion about the content. Administering the full teacher post-survey as originally conceived would provide more information about the differences in teaching approaches and practices between the 5Rs and control settings. By triangulating data from the teacher survey with data from the student survey, much firmer conclusions could be drawn about the efficacy of the logic model and the particular strengths and weaknesses of the 5Rs programme in comparison with business as usual practices.

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Appendix 1: Memorandum of Understanding

Evaluation of 5Rs post-16 GCSE Resit Maths

MEMORANDUM OF UNDERSTANDING

The aim of this project is to evaluate the impact of the 5Rs post-16 GCSE Resit maths programme (5Rs), delivered by members of staff who have received specialist CPD training, on students' attainment at their subsequent maths GCSE re-sits. The programme is a revision-focused curriculum approach with structured lessons and an emphasis on students revising key topics outside classroom hours. The evaluation is being funded by the Education Endowment Foundation (EEF), an independent charity dedicated to breaking the link between family income and educational achievement. The results of the research will contribute to our understanding of the potential value of using 5Rs to improve success rates in GCSE maths re-sits and will be widely disseminated to schools and colleges across England.

This memorandum of understanding (MoU) explains what your setting's participation in the study will entail. If you agree to take part and accept the terms and conditions outlined, please sign a copy of this form and return by email or postal mail to the contact provided at the end of this letter.

The project

5Rs is intended as a whole class intervention (non-targeted) for students aged 16-19 re-sitting GCSE maths after previously gaining Grade 3 or below. The impact of 5Rs will be evaluated and compared with "business as usual", i.e. usual teaching, using a randomised controlled trial (RCT). It is a manualised intervention which follows a curriculum model tailored to the specific needs of GCSE maths resits students.

The curriculum model draws upon: the work of Awarding Body Chief Examiners; Ofsted commentary of maths resit classes; the Department for Education's assessment objectives; and a wealth of advice and guidance from a range of post-16 resit practitioners. It has been designed to look and feel different to students' previous learning experiences, including alternative methods that they will not have encountered in school.

Best practice in maths revision from National Centre for Excellence in the Teaching of Mathematics (NCETM) and common exam pitfalls have been mapped and built into the scheme of work. Staff will receive an initial day's training which outlines the method and the theory behind the approach and followed by one catch up day in each of the two following terms (See Setting Information Sheet for more details). Students also have access to a suite of online resources and are encouraged to practice outside of lesson time. Training is facilitated by Julia Smith Ltd and managed by AoC (Association of Colleges).

During this project, you will be contacted by both the 5Rs support team, hereafter referred to as the 'Project Team', who are responsible for overseeing the CPD training model for staff and providing ongoing support and by researchers from York Trials Unit (YTU) at the University of York, hereafter referred to as the 'Evaluation Team', who are carrying out an independent evaluation of the project.

Structure of the evaluation

The evaluation will involve 80 settings in England. Half of the settings will be randomly assigned to deliver the 5Rs approach, with the other half continuing with "business as usual" for the whole academic year (2019/2020):

- *5Rs:* Delivery is on a whole class basis. Teachers, lecturers and trainers (hereafter referred to as teachers) will be asked to use 5Rs in every lesson for the full academic year. Students should be encouraged to study independently outside lessons and to take responsibility for their own revision. For the purposes of the project, there is no cost to settings allocated to this approach, and to thank you for providing the necessary data you will receive a thank you payment of £300.

- *'Business as usual' Approach:* Settings in the control group will be asked to continue with usual teaching of GCSE maths resit students in 2019/2020. As a token of our appreciation for your setting's participation, your setting will receive a thank you payment of £750.

Random allocation is essential to the evaluation as it is the best way of investigating what effect 5Rs has on students' attainment. It is important that settings understand and consent to this process.

In order to find out how the intervention is working we will visit a sample of settings to observe some lessons and conduct some interviews with both staff and students. Informed consent will be sought from staff and students before we conduct these interviews. Staff and students will also be asked to complete an online survey.

The Evaluation Team will use setting and student information provided by settings, including GCSE scores, and information from the National Pupil Database (KS2), to assess any impact of the intervention on attainment.

Eligibility criteria for participation

Post-16 education and training providers in England are eligible to take part in the trial. This includes Colleges, Sixth Form Colleges, School sixth forms, University Technical Colleges and Independent Training Providers.

Settings are eligible to apply if the following criteria are met:

- They have a minimum of 15 students aged 16-19 re-taking GCSE maths in the year 2018-2019 and expect these numbers to stay constant or rise in 2019-2020.
- GCSE students are enrolled by September 2019 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 are involved in the Maths for Life trial funded by EEF.
- They or their staff have previously been trained in or used the 5Rs programme, including accessing the 5Rs materials available on the AQA website.
- They have been selected as a Maths Centre of Excellence.

Please note:

- Settings with more than one campus are eligible to apply as separate settings if they have completely independent, non-collaborative maths departments. Campuses that fulfil this requirement will then be randomised individually.
- A maximum of five teachers can be trained per setting.
- An upper limit of approximately 80 students can participate in the evaluation per setting. Settings with more than 80 students can still deliver the intervention (if they are randomly allocated to the intervention group) to the whole cohort if they wish. However, in such cases the evaluation team will randomly select the

teachers/classes to be involved in the evaluation (i.e. those that will be asked to provide data to the evaluation team.

- Where a setting chooses not to deliver the intervention to their whole cohort the evaluation team will randomly select the teachers/classes to be involved in the evaluation.
- Only students aged 16-19 will be included in the trial.

Use of Data

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).

The University of York will be deemed a Data Controller (as defined by the data protection legislation) with regard to the personal data used for this project. Information sheets, with the option of withdrawal from the research, will be provided to potential participants as appropriate.

This 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. 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.

For the purpose of research, the student data will be linked with information about the students from the National Pupil Database (NPD) 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.

A data sharing agreement will be put in place between the University of York and each setting which 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. All data held by the Evaluation Team will be retained for three years after publication of the final report and then securely destroyed. All results will be anonymised so that no setting or individual student will be identifiable in the report or dissemination of any results.

Responsibilities of the Project Team:

- Provide CPD training for staff members. Training will consist of one day of hands-on training per term delivered at a local venue
- Provide top-up training if a new staff member has to start delivering 5Rs, because of staff absence, leaving etc
- Provide support to the setting as appropriate
- Provide termly schemes of work and lesson plans to intervention settings
- Provide an online 5Rs presence for guidance and support.

Responsibilities of the Evaluation Team:

- Act as the first point of contact for any questions about the evaluation
- Organise a data sharing agreement to be put in place with settings
- Conduct the random allocation of settings to 5Rs and control (teaching as usual)
- Provide information about the trial for participants
- Conduct baseline and end of trial surveys with teaching staff
- Conduct case study visits to a selection of settings during the trial
- Conduct a student survey towards the end of the trial
- Collect class and student level data (including name, date of birth, UPN) from settings
- Obtain previous and subsequent re-sit GCSE marks from settings

- Request NPD (KS2) data using student details
- Analyse the data from the project
- Disseminate the research findings through the EEF report and at conferences and through academic papers.

Requirements for Settings:

- Complete the setting baseline information form (attached to this MOU) including:
  - nominating a project lead who will agree to take responsibility for the project within their setting and act as a point of contact for the Evaluation and Project teams.
  - nominating up to five appropriate members of staff (teachers of maths GCSE resits) who will take part in the CPD training and deliver the intervention if allocated to the intervention group
- Provide the Evaluation Team with the raw scores from the GCSE maths exams as soon as possible after the re-sits (in January for November 2019 exams and August/September 2020 for June 2020 exams).
- Facilitate researchers from the Evaluation and Project Teams in collecting evaluation data. This covers: online teacher surveys at the beginning of the academic year 2019/2020; online teacher and student surveys in March/April 2020; case study visits between November 2019 and April 2020 to 10 selected settings, which will include lesson observations, interviews with staff and paired interviews with students.
- Deliver letters to students giving them information about the study and the possibility of withdrawing from data processing. They will inform the Evaluation Team of any such requests to withdraw.
- Permit the publication of anonymised data collected.
- Provide the relevant pupil names, UPNs and date of birth to enable the Evaluation Team to obtain data from the National Pupil Database (NPD). (A data sharing agreement will be put in place detailing the specifics of this).
- Notify, at the earliest opportunity, the Project Team and Evaluation Team if there are any issues which could prevent the effective implementation of the intervention.
- Notify the Project Team and Evaluation Team immediately if the setting has to withdraw from the project for operational or other unavoidable reasons and wherever possible still allow assessment data to be collected for the evaluation.
- Members of staff involved in the project will provide valid email addresses and telephone contact numbers to the Evaluation and Project Teams and agree to check communications regularly during the period of the research.

Key Dates

Activity	Date
Setting recruitment	March – July 2019
Randomisation of settings to the intervention or control group	July 2019
Pre-evaluation teacher survey	September 2019
Teacher training session 1	September 2019
Provide student data to the evaluation team – name, UPN, date of birth, gender etc	September 2019
Intervention delivery	October 2019 to May/June 2020
Visits by the evaluation team to selected settings	Nov 2019 – April 2020
Provide November GCSE raw mark and grade to the evaluation team	January 2020
Teacher training session 2	January 2020
Student survey/ attitude to maths questionnaire	March/April 2020
Post-evaluation teacher survey	March/April 2020
Teacher training session 2	April 2020
Provide student attendance data to the evaluation team	August/September 2020
Provide GCSE raw mark and grade to the evaluation team	August/September 2020
Evaluation report published	July 2021

Head Teacher/Principal agreement

I agree for my setting _____to take part in the Evaluation of a 5Rs post-16 GCSE maths resit programme and accept the terms and conditions outlined in the Memorandum of Understanding.

Setting Name: _____

Setting Telephone Number: _____

Setting Address: _____

_____

_____

_____

Head/Principal Name: _____

Head/Principal Signature: _____ Date: ____/____/_____

Head/Principal Email Address: _____

Project Lead Name: _____

Project Lead Email Address: _____

Project Lead Job Title:_____

Setting baseline information

Type of setting:

Further Education College	☐
Sixth Form College	☐
School sixth form	☐
University Technical Colleges	☐
Independent Training Providers	☐

Number of students on roll: ☐

Exam Board: AQA/Edexcel/OCR/Other Please specify: _____

Student and teacher information

	2018-19 Actual	2019-20 Expected
Number of students aged 16-19 resitting GCSE Maths		
Number of students you intend to take part in the evaluation		
Number of classes		
Number of classes you intend to take part in the evaluation		
Number of teachers		
Number of teachers you intend to take part in the evaluation		

Details of teachers involved in the 5Rs evaluation (up to 5)

Teacher name	Email Address

If teacher names are not yet known please indicate below when you expect to have this information:

_____

Thank you for agreeing to take part in this research. Please return this form to:

[Project Team Contact details]

Appendix 2: Data Sharing Agreement

Data Sharing Agreement

Between

UNIVERSITY OF YORK

and

[Setting Name]

DATED 27 August 2019 (the "Effective Date")

1

1. Parties

1.1. **UNIVERSITY OF YORK**, whose registered office is at University of York, Heslington, York, YO10 5DD (the University); and

1.2. [Setting name and address] (the Setting).

Each known as a 'Party' and together as the 'Parties'.

2. Background

2.1. The University is conducting a research project entitled, 'Evaluation of 5Rs post-16 Maths' (the "Project") on behalf of the Educational Endowment Fund (EEF) who have funded the Project.

2.2. The Parties have entered into a memorandum of understanding which sets out the role of the University and the Setting in relation to the Project.

2.3. The Project requires that data is shared by the Parties including Personal Data and this Agreement will set out the arrangements between the Parties for the sharing of that data for the purposes of the Project.

3. Definitions and interpretation

3.1. For the purposes of this Agreement:

- 'Agreement' means, this data sharing agreement, its attachments, and any agreed amendments.
- 'Data Protection Laws' means, the General Data Protection Regulation (EU) 2016/679 and Data Protection Act 2018 and all applicable laws and regulations relating to the processing of the personal data and privacy, including where applicable the guidance and codes of practice issued by the Information Commissioner .
- 'Data Controller', 'data processor', 'data subject' 'personal data', 'processing', 'special category data' have the meanings as defined by the General Data Protection Regulation (EU) 2016/679.

3.2. The headings of the articles and clauses in this Agreement are for convenience only and have no legal effect.

3.3. References in this Agreement to any statute or statutory provision include reference to the same as amended, re-enacted, or replaced from time to time.

4. Nature and purpose of the sharing

4.1. The parties agree to share data for the following purposes only:

The purpose of sharing student data (for selected students who will be re-sitting their maths GCSE in 2019-2020) is to assist the evaluation team (researchers at the University) to independently evaluate the effectiveness of the 5Rs resit maths programme on behalf of the Education Endowment Foundation (EEF).

The EEF is an independent charity founded in 2011 with funding from the Department of Education. Its aim is to build the evidence for what works in raising children's attainment. Consequently, evaluations are conducted to demonstrate the impact of its projects on attainment. All EEF evaluations require data on the background characteristics of pupils/students (including free school meals eligibility) and their attainment – from schools and from the National Pupil Database (NPD).

Ultimately, the EEF aims to track all its pupils/students longitudinally using the NPD and link with data collected directly from its evaluations. This data will be stored in an EEF data archive (currently held by FFT Education with the intention of handing over to ONS), with the aim to eventually make it publicly available in an anonymised form for further research for the benefit of the wider education and research communities.

5. Data items to be shared

5.1. The Setting has agreed to provide to the University the personal data set out in Appendix 1.

5.2. The parties will share the minimum amount of data necessary for the purpose specified in this Agreement. For a breakdown of data categories being shared see Appendix 1.

5.3. An anonymised version of the data may be retained by the University upon expiration of this Agreement and used for future research purposes.

6. Data protection

6.1. Each Party shall in relation to the processing of the personal data comply with its respective obligations under the Data Protection Laws.

6.2. Each Party shall act as a Data Controller in respect of the processing of the personal data that is the subject of this Agreement on its own behalf and in particular each shall be a Data Controller of the personal data acting individually and in common, as follows:

6.2.1. The Setting shall be a Data Controller where it is Processing the Personal Data in relation to its usual business as a provider of education; and

6.2.2. The University shall be a Data Controller where it is processing the personal data in relation to the research Project.

6.3. Each Party shall assist the other Party in complying with all applicable requirements of the Data Protection Laws in relation to the processing of the personal data.

6.4. A Party sharing information under this Agreement will ensure it is not subject to any prohibition or restriction which would:

6.4.1. prevent or restrict it from disclosing or transferring the personal data to the other Party as required under this Agreement;

6.4.2. prevent or restrict it from granting the other Party access to the personal data as required under this Agreement; or

6.4.3. prevent or restrict the Party from processing the personal data, as envisaged under this Agreement.

7. Legal basis for processing personal data

7.1. In line with the University's charter which states that the University advances learning and knowledge by teaching and research, the University processes personal data for research purposes including this Project under Article 6 (1) (e) of the GDPR:

- Processing is necessary for the performance of a task carried out in the public interest

If special category data is being shared under this Agreement, it will be processed by the University under Article 9 (2) (j):

- Processing is necessary for archiving purposes in the public interest, or scientific and historical research purposes or statistical purposes

7.2. Research will only be undertaken by the University where ethical approval has been obtained, where there is a clear public interest and where appropriate safeguards have been put in place to protect data.

7.3. At the end of the evaluation, the University, as evaluators, are expected to submit data directly to the EEF data archive, currently held by the Fisher Family Trust (FFT) but expected to be held by the Office for National Statistics (ONS) by the end of this Project. When the data is transferred to ONS, the EEF becomes the Data

Controller and is responsible for determining the purpose and means of the data processing. The evaluation data may be shared by the EEF with the Department for Education and, in an anonymised form, the UK Data Archive and potentially other research teams. The EEF processes personal data from evaluations on the basis of legitimate interests, according to the General Data Protection Regulation (GDPR), Article 6, paragraph 1(f), Further information about how the data is processed by the EEF can be found in their privacy notice: https://educationendowmentfoundation.org.uk/public/files/Grantee_guide_and_EEF_policies/Evaluation/Data_protection/Privacy_notice_-_EEF_evaluations.pdf.

8. Access and individuals' rights

8.1. The parties recognise that data subjects have the following general rights under data protection law:

- a right to be informed
- a right of access
- a right to rectification
- a right to erasure
- a right to restrict processing
- a right to data portability
- a right to object
- rights in relation to automated decision making and profiling

8.2. Where a request is received by a data subject to exercise any of these rights set out in 8.1, the receiving party will promptly (and in any event within 48 hours), notify the other Party. The parties will take necessary steps, as required by the Data Protection Laws, to comply with such requests.

8.3. In the event that a Freedom of Information Request is submitted for the shared data, the receiving party will notify and consult the other Party. The decision to disclose (in full or in part) or not will rest with the receiving party.

9. Governance and security

9.1. The Parties agree to ensure that all personal data disclosed or transferred to, or accessed by, the other Party is accurate and up-to-date, as well as adequate, relevant and not excessive to enable a party to process the personal data as envisaged under this Agreement;

9.2. Notwithstanding 9.1, the Parties agree to take the following steps to ensure data accuracy: the pupil data provided by the Setting at the start of the study will be imported into a University database and cross-checked with the original to ensure consistency. A dedicated member of the University's team will ensure that all research data collected during the study is correctly completed, assigned and input.

9.3. Electronic data sent by the Setting to the University's evaluation team will be encrypted and transferred via the University of York's DropOff service. Paper questionnaires for the surveys completed by students in Spring Term 2020 will be delivered and returned by courier service.

9.4. The parties agree to maintain appropriate technical and organisational measures to safeguard data from unauthorised or unlawful processing, accidental loss, destruction or damage. The agreed technical and organisational security measures are set out in Appendix 2.

9.5. All personal data will be destroyed at the end of June 2024.

9.6. Each party agrees to provide the other with all information necessary to demonstrate compliance with the terms of this Agreement. This includes a general right to audit, inspect or otherwise verify the steps taken.

9.7. The Party receiving personal data will not share that data with a third party without the other Party(s) prior consent, save in relation to disclosures to recipients as set out in this Agreement as having permitted access including those set out in clause 7.3 and Appendix 2.

10. Data breach management

10.1. Each Party shall within 24 hours notify the other Party on discovery of accidental or unlawful destruction, loss, alteration, unauthorised disclosure or access to personal data or (where applicable) special category data which is the personal data of the other Party as set out in this Agreement.

10.2. The Parties will within such timescale to be agreed between the Parties (acting reasonably) implement any measures necessary to restore the security of compromised personal data and support the other Party to make any required notifications to the ICO and/or other equivalent relevant regulator and affected data subjects.

10.3. Notwithstanding 10.2, on discovery of a data breach, the University will follow its Information Security Incident Management Policy as set out in Appendix 2.

10.4. Each Party will, where relevant, support the other Party with such investigations.

11. Term and termination

11.1. In the event of a breach of this Agreement and a decision to terminate the sharing arrangement, the University will discuss retention of the data with the Setting and if necessary will securely delete the data.

11.2. This Agreement will commence on the Effective Data remain in force until the data has been destroyed (June 2024) unless terminated earlier as provided in 11.1 or extended with Agreement of the Parties.

11.3. Termination or expiry of this Agreement shall not affect the survival of any clauses or provisions herein which are stated, or which by their nature are intended, to continue after termination or expiry.

12. General provisions

12.1. No one who is not a party to this Agreement is intended to or may benefit from its terms.

12.2. This Agreement and the attached appendix constitutes the entire agreement between the Parties with respect to the subject matter of this Agreement and supersedes all prior and contemporaneous agreements or communications.

12.3. The Parties may not amend this Agreement, except by a written agreement of authorised representatives of the Parties.

12.4. This Agreement (and all non-contractual liability arising from it) is governed by, and is to be construed in accordance with, the laws of England and Wales. The English Courts will have exclusive jurisdiction to deal with any dispute which arises out of, or in connection with, this Agreement and the Parties irrevocably submit to such jurisdiction.

12.5. This Agreement may be executed in any number of counterparts, each of which shall be an original, but all of which together shall constitute one legal document. Signatures transmitted in an Adobe Portable Document Format (PDF) file attached to an email shall be acceptable to bind each Party and shall not affect the validity of the Agreement in any way.

The Parties have signed this Agreement by their respective duly authorised representatives.

SIGNED FOR AND ON BEHALF OF **The University of York**	**SIGNED FOR AND ON BEHALF OF** [Setting name]
Signed: _____	Signed: _____
Name: Michael Barber	Name: _____
Title: Contracts and Sponsorship Manager	Title: _____
Date: 27 August 2019	Date: _____

Signatories should be members of the senior leadership/management team or other individual authorised to sign documentation of this nature on behalf of the organisation.

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Appendix 1

Description of Data

Item	Purpose/Use	Source	When collected	Format
Student details (Name, DOB, UPN, gender)	To allow the University's evaluation team to coordinate the study and access the National Pupil Database (NPD)	Setting	At the beginning of the 2019/2020 academic year	Encrypted Excel spreadsheet
GCSE Maths grades: last attempt prior to September 2019; November 2019; Summer 2020 KS2 maths result Free school meals (FMS) status (ever been eligible for FSM)	One of the measures to be used in the statistical analysis	National Pupil Database (NPD)	Autumn 2020	Accessed via a secure portal hosted by the Office for National Statistics (ONS) Secure Research Service (SRS)
GCSE Maths grade and raw scores, student attendance at exam sessions	One of the measures to be used in the statistical analysis	Setting	January 2020 (November 2019 result) August 2020 (Summer 2020 result)	Encrypted Excel spreadsheet
Student attitudes towards maths using an adapted version of the Attitudes Toward Mathematics Inventory (ATMI)	One of the measures to be used in the statistical analysis	Setting	March/April 2020	Paper record forms
Student attendance data	To measure dosage and engagement with the programme	Setting	June 2020	Encrypted Excel spreadsheet
Teacher survey (pre & post)	To establish usual practice; teacher background and experience; motivation and engagement which feed into the process evaluation (examining how the programme has been put into practice); use of resources	Collected from teachers by the University's evaluation team through online surveys	September 2019 and March/April 2020	Online (Qualtrics survey software)
Teacher training attendance	Attendance at training will be used as a proxy for compliance in the statistical analysis and will be measured as attending days 1 and 2 of three (or equivalent if teacher joins partway through trial)	Development Team	April 2020, after final day of training	Encrypted Excel spreadsheet or Word document

Item	Purpose/Use	Source	When collected	Format
Teacher training observation	To establish the expected model and fidelity in terms of different trainers' approaches	Collected at training sessions by the University's evaluation team	At the beginning of each term 2019/2020	Paper forms
Teacher download data	Teacher downloads of schemes of work and lesson plans would be used as proxy for their engagement with 5Rs, and triangulated with self-report of frequency of use.	Development Team	Collected throughout year but shared with evaluation team May 2020	Encrypted Excel spreadsheet
Lesson observation and teacher/departmental head interview	To explore what 5Rs looks like in the classroom – fidelity to lesson plan including timings; use of resources; how different elements are received; adaptations and barriers; student engagement. To check the approaches used in control settings, including any overlap with 5Rs.	Collected by the University's evaluation team researchers at the setting	November 2019 to April 2020	Paper & audio voice recording
Student interviews	To establish their reaction to the lessons and their different elements, especially in relation to previous GCSE maths teaching; activity outside lessons e.g. interaction with online resources.	Collected by the University's evaluation team researchers at the setting	November 2019 to April 2020	Audio voice recording
Student survey - post-intervention	To investigate teaching approaches and resources used; opinion of different elements; confidence in maths; frequency of class attendance and time spent in self-study.	Setting	March/April 2020	Paper forms

Item	Transfer to/from evaluation team	Storage	Access	Destruction of personal data
Student attendance data	Encrypted and sent by the University of York's DropOff service	In a password-protected database on university servers.	Restricted to members of the University's evaluation team	End of June 2024, three years after report publication
Teacher survey (pre & post)	Downloaded from Qualtrics	Stored in Excel/NVivo/SPSS files on the university servers	Restricted to members of the University's evaluation team	End of June 2024, three years after report publication
Teacher training attendance	Encrypted and sent by the University of York's DropOff service	In a password-protected database on university servers.	Restricted to members of the University's evaluation team	End of June 2024, three years after report publication
Teacher training observation	With the researcher	Paper forms will be held in locked filing cabinets stored in a room with restricted access. Digital data will be stored in a password-protected database on the university servers.	Restricted to members of the University's evaluation team	End of June 2024, three years after report publication
Teacher download data	Encrypted and sent by the University of York's DropOff service	In a password-protected database on university servers.	Restricted to members of the University's evaluation team	End of June 2024, three years after report publication
Lesson observation and teacher/departmental head interview	With the researcher on paper and password-protected voice recorder. Observation sheets will not include names of staff. Audio files will be securely transferred to and from an approved transcription service via the University of York's DropOff service	Paper interview notes will be held in locked filing cabinets stored in a room with restricted access. The notes will be transcribed by the researcher and stored on university servers. The audio files will be uploaded to university servers and deleted from the voice recorder.	Restricted to members of the University's evaluation team and the transcription service. The transcription service will not have information about the settings or teachers.	End of June 2024, three years after report publication
Student interviews	With the researcher on encrypted voice recorder. Audio files will be securely transferred to and from an approved transcription service via the University of York's DropOff service	Uploaded to university servers and deleted from voice recorder	Restricted to members of the University's evaluation team and the transcription service. The transcription service will have no information about the settings or students.	End of June 2024, three years after report publication
Student survey - post-intervention	By courier (no identifying details will be on the record form, labelled with the student ID only)	Paper forms will be held in locked filing cabinets stored in a room with restricted access. Digital data will be stored in a password protected database on the university servers.	Restricted to members of the University's evaluation team	End of June 2024, three years after report publication

Appendix 3: Participant Information Sheet

Evaluation of 5Rs post-16 GCSE Resit Maths Programme (5Rs)

Participant Information Sheet

24th October 2019

Dear Participant,

Your school/college is taking part in the *5Rs post-16 GCSE Resit Maths Programme* evaluation. The research is being funded by the Education Endowment Foundation (EEF), an organisation that funds research into education. The University of York has been asked by the EEF to independently evaluate this programme.

This research project is fully supported by your school/college and will be carried out under strict ethical and data protection guidelines.

All students in participating classes, selected by the school/college, will receive this information. It tells you about the study and the ways in which we (the University of York) will collect, use, store and share your data. It also sets out how long we will keep your data and what rights you have in relation to that data under current data protection legislation.

What is 5Rs?

5Rs is a programme specifically designed for students aged 16-19 resitting GCSE maths and aims to improve pass rates. It has been developed by Julia Smith Ltd, working in partnership with the Association of Colleges.

How is the 5Rs programme being evaluated?

To find out how well the programme works, some participating schools/colleges will use the 5Rs programme for resit maths lessons this year and some schools/colleges will not. This selection is made randomly using a computer programme; the schools/colleges have not been selected for any particular reason.

In schools/colleges using the programme, teachers who take GCSE re-sit classes will be trained to teach maths in accordance with the 5Rs programme. Teaching will continue as normal for schools/colleges who do not use the programme.

Researchers will compare results from students in schools/colleges that have used the programme with results from those in schools/colleges that have not.

What information will be collected?

We would like to collect information about you from your school/college, including your full name, date of birth, unique pupil number, gender, your GCSE marks and grade for resit exams taken this academic year and your attendance at maths lessons). We will also ask you to complete a questionnaire about your attitudes towards maths and a survey about your resit maths lessons. A small number of you may also be asked if you're willing to take part in an interview with researchers from the University of York.

For the purpose of research, the information provided by your school/college will be linked with information about you from the National Pupil Database (including free school meal eligibility, gender, your KS2 SATS maths result and the grade you got the last time you took maths GCSE) and shared by the University of York with the Department for Education, the EEF, Fischer Family Trust (FFT) (EEF's data processor for their research archive) and, in an anonymised form, with other research teams and potentially the UK Data Archive. Further matching to National Pupil Database data may take place during subsequent research.

Your data will be treated with the strictest confidence and safeguards are in place to protect your data, in line with current data protection legislation. We will not use your name or the name of your school/college in any report arising from the research. The *Frequently Asked Questions* section below will tell you more about how we will use and store the information collected in the project.

What do I need to do now?

If you are happy for your school/college to share your data with us, as described above, then you do not need to do anything.

If you do NOT want to share your data as described above, please complete the attached Participant Withdrawal from Research Form and hand it to your teacher.

You are free to withdraw your information for use in this evaluation at any time after this date by contacting your school/college in writing, who will then communicate this with the research team, or contact the research team directly using the contact details below.

If you would like more information about the evaluation, please contact the Evaluation team:

Email: ytu-5rs@york.ac.uk
Tel: 01904 321809

Frequently Asked Questions

What is the Education Endowment Foundation (EEF)? The EEF is an independent charity founded in 2011 with funding from the Department of Education. Its aim is to build the evidence for what works in raising attainment. Ultimately, this means demonstrating the impact of its projects on student attainment in schools and colleges.

Who is the Data Controller? For the purposes of this project, the University of York is the data controller as defined in the General Data Protection Regulation. Once the data has been submitted to the EEF's research data archive (managed by FFT) and has passed quality checks, the EEF will have data controller responsibility for the archived data.

How do we keep your data secure? The University takes information security extremely seriously and has implemented appropriate technical and organisational measures to protect data. Access to information is restricted on a need-to-know basis and security arrangements are regularly reviewed to ensure their continued suitability. Further information about how we will use the information provided about you can be found at: www.york.ac.uk/healthsciences/research/trials/trials-gdpr/

Under what legal basis do we process your personal data? 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). 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 (2018).

How long will we keep your data? All individually identifiable data held by the evaluation team will be destroyed 3 years after the end of the study (June 2024). Data submitted to the EEF's research data archive will include individually identifiable data.

What rights do you have in relation to your data? Under the GDPR, you have a right of access to your data, a right to rectification, erasure (in certain circumstances), restriction, objection or portability (in certain circumstances). Further information can be found at: https://www.york.ac.uk/healthsciences/research/trials/trials-gdpr/research-partcipants/

Right to complain: If you are unhappy with the way in which the University has handled your personal data, you have a right to complain to the Information Commissioner's Office. For information on reporting a concern to the Information Commissioner's Office, see www.ico.org.uk/concerns.

Questions or concerns: If you have any questions about this information sheet or concerns about how your data is being processed, please contact the evaluation team at ytu-5rs@york.ac.uk in the first instance. You may also contact the University or York's Data Protection Officer at dataprotection@york.ac.uk.

Has the evaluation of the 5Rs maths Programme received ethical approval? The project has received ethical approval from the Department of Health Sciences at the University of York.

Is my participation in the research confidential? All participant data will be treated with the strictest confidence and will be stored in accordance with current data protection legislation.

Where can I find out the results of the evaluation? The evaluation team will produce a final report, due at the end of June 2021, which will be published by the EEF on their website (https://educationendowmentfoundation.org.uk)

I have another question. If you would like more information about the evaluation of the 5Rs Programme or have any questions, please contact the evaluation team at Email: ytu-5rs@york.ac.uk Tel: 01904 321809

Evaluation of 5Rs post-16 GCSE Resit Maths Programme

Participant Withdrawal from Research Form

If you are happy for your school/college to share your data with us, as described in the information sheet v1.1 20191024, then you do not need to complete this form.

If you do NOT want to share your data, as described in the information sheet v1.1 20191024, please complete and return this form to your teacher.

If you do not return a completed form, we will assume you are happy for your school/college to share information for use in this evaluation, and we will approach your school/college to ask them to share that information.

☐ I do NOT want my information to be shared for use in the evaluation of the 5Rs post-16 GCSE Resit Maths Programme

Name (Please print clearly)..... Date.....

School/College .....

Signature .....

Further appendices:

Appendices 4-20 are available as a separate document (Technical Notes).

This document is available for download at https://educationendowmentfoundation.org.uk

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