FE Interventions in Maths

Evaluation of a scaling-up study in Centres for Excellence in Maths

Final Report
March 2023

Pye Tait Consulting
Royal House, 110 Station Parade, Harrogate
HG1 1EP
01423 509 433
info@pyetait.com
www.pyetait.com

Cert No: QEC19593371/0/Q Rev: 001

Pye Tait Consulting

Registered in England, Company No: 04001365, VAT No: 755 8312 14
Postal address: Royal House, 110 Station Parade, Harrogate, North Yorkshire, HG1 1EP
Tel: 01423 509 433

Registered office address: 5 Merus Court, Meridian Business Park, Leicester, LE19 1RJ

email (enquiries related to this report): m.pye@pyetait.com
email (general enquiries): info@pyetait.com
website: www.pyetait.com

Pye Tait Consulting is part of the EMB-Group.

Acknowledgements:

Pye Tait would like to thank all the teachers and learners who took part in the scale-up study and evaluation. Intervention Coordinators also played a crucial role in the delivery of the study and evaluation and supporting teachers.

Edexcel provided the questions used in the maths assessment and supported Pye Tait's recruitment of examiners.

Contents

List of figures

List of tables

Executive Summary

Introduction

In 2018/19, to improve maths outcomes for Level 2 maths qualifications amongst 16–19-year-old learners, the Department for Education (DfE) funded the Education and Training Foundation (ETF) to manage 21 Centres for Excellence in Maths (CfEM) across England. The intention being to form a five-year national improvement programme in teaching maths in Further Education settings.

In early 2022, DfE requested ETF conduct a new strand of research to evaluate the effectiveness of a small number of promising action research interventions which CfEM had conducted to that date. If deemed successful, these interventions could be piloted on a national level.

Following a review by ETF - and approval from DfE – four interventions were selected for this scale-up activity. The interventions had been undertaken in the previous year, were demonstrably successful and could be implemented in a 4-week period, requiring no additional teaching or other resource. They were:

i. **Bar Models** –focussing on using pictorial representations to depict fractions and ratio problems, and aiding learners in understanding key related maths concepts.

ii. **Ratio Tables** – utilising a method of solving proportional reasoning problems, which builds on learners' informal practices without relying on algorithms.

iii. **Responsive Teaching** –using diagnostic questions to identify learners' misconceptions and address them through peer discussions.

iv. **Engagement & Resilience** –addressing fixed-mindsets and negative attitudes towards maths, with the aim of creating a more positive learning environment with low-risk, goal-free activities.

To evaluate the scale-up study, ETF commissioned Pye Tait to conduct a 'distance travelled' evaluation, comparing key metrics at the beginning and the end of the intervention. This method was preferred over more experimental methods as it would reduce the burden on the sector. Learners completed a pre- and post-intervention maths assessment and an attitudinal questionnaire. The maths assessment comprised 10 GCSE questions to show their understanding of fractions, ratio and proportion. The learner attitudinal questionnaire explored their confidence and self-reported capabilities. To enable a robust assessment of the distance travelled, the pre- and post-intervention assessment and pre- and post-intervention questionnaire were identical[1]. Only those assessments and questionnaires which could be matched to the same learner in the post-intervention from the pre-intervention were included in analysis.

A total of 1,202 matched maths assessments and 866 matched learner attitudinal questionnaires were returned.

Additionally, a post-intervention survey was conducted with teachers and focus groups with Intervention Coordinators – teachers (or sometimes administrators) at each Centre who coordinated the recruitment and participation of teachers at up to 3 colleges. Intervention Coordinator was a new role for the CfEM.

[1] One additional question was included in the post-intervention attitudinal questionnaire, to explore learner perception of the period of intervention.

Results

The evaluation shows a small, but statistically significant increase in the marks achieved by learners after the intervention. The mean total mark per learner in the pre-intervention assessment was 11.2 marks, increasing to 12.5 marks in the post-intervention assessment – an increase of 1.3 marks. Learners in the Engagement & Resilience intervention group saw the highest change, with an increase in the mean mark of 2.5 marks, from 10.5 to 13. The Responsive Teaching group saw the smallest change, an increase of 0.8 marks from 11.7.

The maths assessment also explored conceptual understanding through examiners recording the use of bar models or of ratio tables in relevant questions. This also showed an increase in usage of these methods after the intervention. Perhaps unsurprisingly, the Bar Model learner group recorded the highest increase in use of bar models in their answers to the relevant questions and the Ratio Tables learner group recorded the highest increase in use of ratio tables in their answers to the relevant questions.

A third metric explored in the maths assessment was 'willingness to answer', indicated by the number of learners leaving a question blank, or nearly blank. Overall, learners answered more questions in the post-intervention assessment compared to the pre-intervention assessment. Learners in the Engagement & Resilience intervention group recorded the biggest reduction in the proportion unanswered questions, while learners in the Ratio Tables group recorded a slight increase in the proportion of unanswered questions.

The learner attitudinal questionnaire was included in the evaluation to ensure a broader impact assessment than maths capabilities, including assessing confidence in maths.

Overall, there were small, but statistically significant increases among learners for all confidence measures. Confidence was at a higher starting point regarding being in a maths classroom and asking for help. However, the change in scores was highest for confidence in the maths assessment they had just completed (an increase in 0.5 on a 1 to 10 scale) and confidence in doing an assessment (+0.4), a vital consideration for learners resitting exams. Learners in the Bar Model intervention group noted the highest belief in their ability to draw bar models and ratio tables,followed by the Engagement and Resilience intervention group for ratio tables. In summary, learners on the Ratio Tables & Responsive Teaching interventions recorded the lowest attitudinal improvements, and learners in the Engagement & Resilience and Bar Models interventions the highest.

Teachers were also asked about the impact on their learners in the teacher survey[2]. Of 60 teachers who responded to the survey (around half of the number who began the intervention):

- 70% reported the intervention had improved the maths capabilities of at least some disengaged learners
- 83% reported that the intervention improved confidence in maths of at least some disengaged learners
- 64% report the intervention improved maths capabilities amongst all learners (engaged and disengaged), suggesting the interventions had a more positive impact on disengaged learners.

[2] The number of teacher survey respondents is too low to report by intervention group.

A key objective for the CfEM is to ensure the enhancement of teaching skills across the FE sector. Encouragingly, almost three-quarters of respondents to the teacher survey (72%) reported that the intervention has increased their skills as a maths teacher.

Slightly fewer report that their skills in engaging maths resit learners has increased, though is still a high proportion at 65%.

These are positive results, likely to have a longer-term impact, for a relatively short intervention.

Also particularly encouraging is the likelihood of teachers reporting they will use the materials and techniques again (74%) and their likelihood to advocate the use to other teachers (73%).

A number of observations were made by teachers regarding the problematic timing of the intervention (after November resits and before Christmas) and the amount of time allocated overall for teaching the intervention and completing the evaluation requirements. Many teachers felt the impact may have been reduced by learner (or teacher) absence, which might be expected but was exacerbated through the study period by industrial action on the railways and in some colleges. There were also some comments made regarding how the materials could be improved and pitched more appropriately at this group of learners, although this was variable across interventions and learner groups with no consistent messages emerging through the evaluation.

Recommendations

Bespoke Randomised Control Trials for each intervention

On the whole, given the improvements observed, the evaluation would suggest there is a case for further testing the interventions subject to changes in how the interventions are delivered. For example, by not attempting to use the same study approach, e.g. timing, for all interventions. Other recommended changes include:

- conduct a more experimental approach which would allow comparisons with a control group, to eliminate the possibility that these improvements may have occurred anyway
- prepare for the study in a summer term and implement in September
- allow more time and resources for teachers to undertake administrative activities, such as maintaining attendance records
- appoint Intervention Coordinators within each participating college (rather than a 1 to 3 ratio), to ensure teachers are fully trained, materials are available on time and all evaluation activities are fully completed. Their task was frequently reported as easier where the teachers were previously known to each other, suggesting an on-site coordinator would be an important development.

Ensure resource availability, by prioritising if necessary

A risk of the above recommendation is that resources are not available to properly manage or implement all four of the interventions included in this study. In which case we would recommend prioritising the Engagement & Resilience intervention first, and Bar Models second, as these recorded high impacts on maths scores and highest improvements in attitudinal scores (which could lead to longer-term improvements in maths performance).

Roll out materials immediately

All of the interventions showed some evidence of progressing learners. We would suggest the materials are reviewed by designers in light of the evidence arising from this evaluation, perhaps in a conference or similar, and made available to FE maths teachers as soon as possible.The material should be accompanied by CPD for teachers and regular opportunities to check and clarify with designers and experts. There should be a proportionate evaluation of the roll-out, to assess whether the method is helping to improve maths engagement and achievement amongst learners in FE colleges. This would be less rigorous than an RCT and the implementation, correspondingly, more flexible, enabling teachers to adapt according to their learners' needs.

1. Introduction

1.1 Centres for Excellence in Maths

The achievement of a Level 2 qualification in Maths is a key determinant of future success[3], but attainment is challenging, particularly for those undertaking resits. On average, of GCSE maths resit learners in England (c. 200,000 students), a quarter (23%) fail to achieve grade 4. Whilst the very recent picture of resits is less clear due to the impact of COVID and the subsequent cancellation of examinations in 2020 and 2021, the results from 2018/19 through to 2021/22 show between 75 and 85% of those taking resits remain below grade 4.[4]

In 2018/19, to improve maths outcomes for Level 2 maths qualifications amongst 16–19-year-old learners, the Department for Education (DfE) funded Centres for Excellence in Maths (CfEM) to form a five-year national improvement programme, managed by the Education and Training Foundation (ETF). ETF's specific focus is to support teachers and leaders across the Further Education sector to help them achieve their professional development goals for the benefit of learners and employers across England.

The main aim of CfEM is to build teachers' skills and spread good practice across the country through networks of maths professionals in colleges. To achieve this, the CfEM programme comprises a number of distinct but related strands:

- The establishment of 21 Centres for Excellence in Maths. A Centre is one Further Education (FE) college, and each Centre leads a local network of local FE provider partners.
- Teacher-led or -consulted development of resources and handbooks to inform maths teaching practices.
- Random Control Trial of mastery-based maths lessons.
- Various forms of Training and Development.
- Collaborative Action Research by groups of FE maths teachers, coordinated by action research leads in each Centre and further supported with training in research methods provided by ETF and delivery partners.
- A Whole College Approach strand, based on implementing organisational change to improve maths outcomes.

1.2 Scaling-up success

In spring of 2022, DfE requested ETF conduct a new strand of research to evaluate the effectiveness of a small number of the action research projects. If deemed successful through this strand, these interventions could be piloted on a wider national level.

Following a review by ETF - and approval from DfE – four interventions were selected for this scale-up activity. The interventions had been researched in the previous year and were demonstrably successful.

[3] For example, see Returns to maths and English learning (at Level 2 and below) in Further Education (publishing.service.gov.uk)
[4] https://www.gov.uk/government/statistics/a-Level-and-other-16-to-18-results-2022-revised

1.3 Evaluating the effectiveness of the scale-up

In August 2022 ETF commissioned Pye Tait Consulting to carry out the evaluation of the scale-up study with specific objectives of:

- Identifying which, if any, of the selected interventions are successful in improving learner progress towards a Level 2 maths qualification when implemented by many more teachers
- Identifying which, if any, of the selected interventions are successful in improving learner attitude toward maths and willingness to take part
- Describing how the selected interventions were implemented, what works well in which context and identify characteristics of success
- Explaining why colleges found an intervention effective, or not
- Informing what CPD is most effective for any national trials or roll out by DfE and inform the resource bank of materials that will be published online as part of the CfEM legacy for the FE sector.

1.4 Report structure and reporting convention

Chapter 2 of the report describes the methodology of delivery of the scale-up study and its evaluation, as the delivery and evaluation are, necessarily, closely entwined.

Chapter 3 presents impact on learner progress in maths and in attitudes toward maths as measured through the study. The Appendices provide more detail about each of the four interventions.

Chapter 4 presents findings from research with teachers.

Chapter 5 draws together conclusions and Chapter 6 presents recommendations for consideration in any wider roll-out of these maths interventions.

Additional tables from the maths assessment and learner attitudinal questionnaire analysis are presented in the Appendices.

Throughout, we refer to the implementation of the four interventions as the ‘scale-up study’ or ‘study’ as distinct to the ‘evaluation’ of the scale-up study.

In narrative and tables/graphs, the terms pre-intervention or Week 1 are used to refer to the baseline assessment, and post-intervention or Week 6 are used to refer to the final assessment.

A negative impact, or no change, in tables is recorded in red font.

2. Methodology

2.1 Introduction

This chapter describes the methodology of the scale-up study and the evaluation and the roles of those involved. It records the rationale behind the initial design and how and why the design changed during implementation, to maximise robustness and enable practical implementation. The chapter also introduces challenges which arose during implementation.

2.2 Implementing the scale-up study

As stated above, ETF were asked to deliver this new strand of research in spring 2022 by the DfE and then spent a number of months setting up the scale-up study prior to its evaluation.

Timings

Given the time needed to organise the scale-up study, and the need to report on the evaluation of the study by the end of March 2023, ETF allocated a 7-week window between the November GCSE resits and Christmas for the implementation of the interventions in the classroom. The four-week period of the intervention itself was expanded to six weeks to allow for the completion of a pre-intervention maths assessment and attitudinal questionnaire by learners in Week 1 and a post-intervention maths assessment and attitudinal questionnaire by learners in Week 6. The maths assessments and attitudinal questionnaires are the cornerstone of the evaluation of the scale-up study (see Evaluation Methodology below).

Selecting the interventions

A key decision at the start was the choice of four interventions to be rolled out across the 21 CfEMs. Based on criteria such as their success in making progress toward a level 2 maths qualification when tested as an action research project; ability to be delivered without any additional staffing or equipment and deliverability in a four-week period in any college setting, the four selected interventions are:

i. **Bar Models** – The Bar Model intervention focuses on using pictorial representations to depict fraction and ratio problems, and aids learners in understanding key related maths concepts.

ii. **Ratio Tables** – The Ratio Tables intervention utilises a method of solving proportional reasoning problems, which builds on learners' informal practices without relying on algorithms.

iii. **Responsive Teaching** – Centred on different elements than the Bar Models and Ratio Tables interventions, Responsive Teaching uses diagnostic questions to identify learners' misconceptions and address them through group peer discussions.

iv. **Engagement & Resilience** – Focusing on learner participation and self-efficacy, the Engagement & Resilience intervention addresses fixed-mindsets and negative attitudes towards maths, with the aim of creating a more positive learning environment with low-risk, goal-free activities.

Intervention allocation across Centres

Interventions were allocated to centres, as far as possible, on the basis of their expressed preferences. Three of the four interventions were taken up by five CfEMs each, with the fourth (Engagement & Resilience) being taken up by six CfEMs.

Intended scale of the interventions

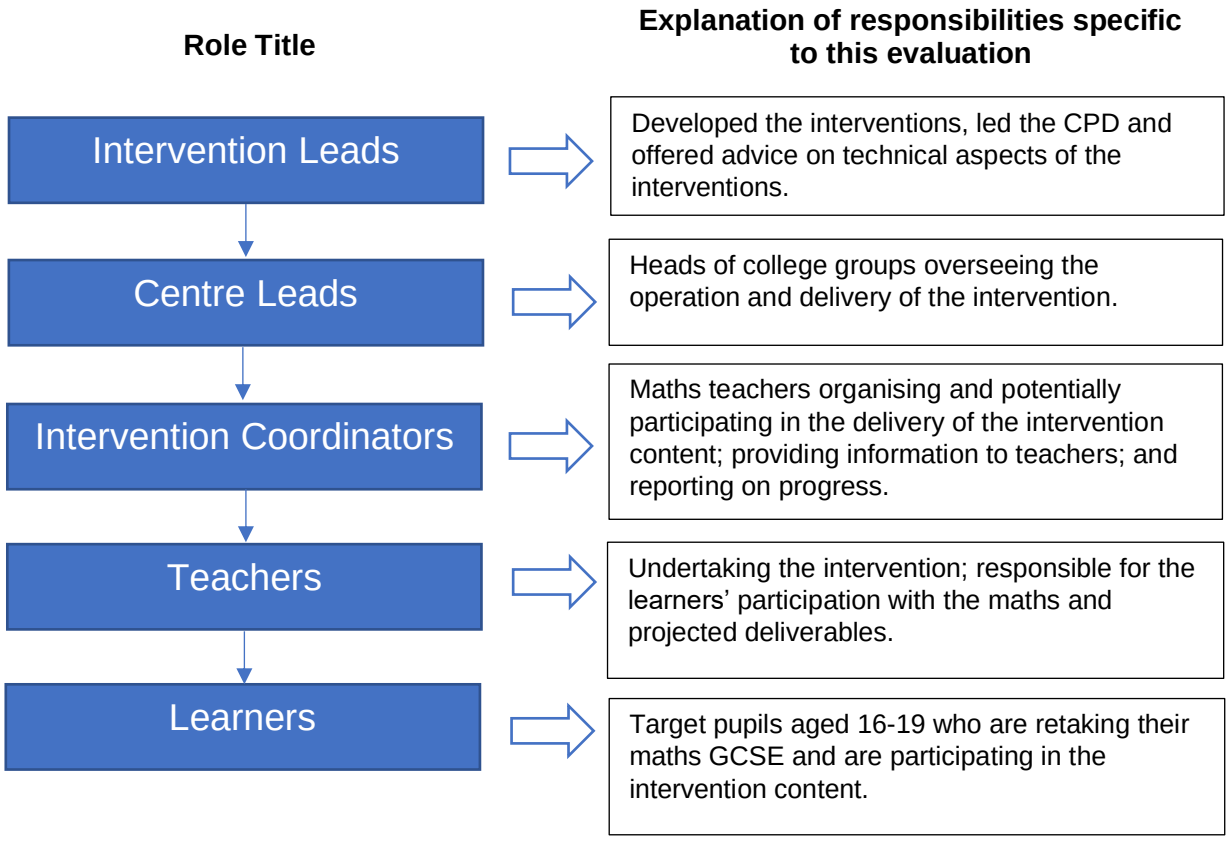
Initially, Centres were to recruit six teachers each, ideally from three independently managed sites totalling 126 teachers across up to 63 sites.

The 126 teachers would deliver the intervention to 50 GSCE resit learners each. The original target number of learners to be reached by the intervention was 6,000 and it was anticipated this would allow for around 1,500 learners per intervention.

Roles and responsibilities

The scale-up study required the involvement of a range of people, as summarised in Figure 2.1 below and described in this section.

Figure 2.1: Roles and responsibilities of the Centres, Teachers and Learners



The interventions were devised by **Intervention Leads**. They pulled together the materials, led the CPD sessions and offered advice on technical aspects of the interventions.

CfEMs had a **Centre Lead** who co-ordinated CfEM activity within the College. To assist in the delivery of the intervention and to facilitate communication across the scaled-up range of colleges and teachers involved, each of the 21 Centre Lead identified and recruited a teacher (or administrator) to take on the new role of **Intervention Coordinators** (ICs).

The Intervention Coordinators facilitated the recruitment of the teachers taking part in the delivery of the intervention and aided in the organisation of the evaluation. The ICs were given a half or full day per week to fulfil this role.

In making ready for the intervention roll-out, the ETF required **teachers** to:

- Attend live, online 1.5 to 2.5 hour CPD sessions which covered intervention content, delivery plans, and research requirements (or viewing afterwards if they could not attend live)
- Administer the learner baseline ('pre-intervention') maths assessment and questionnaire (see Evaluation Methodology below)
- Implement the intervention in parts of their lessons over a 4-week period (fitting into existing planning) and to do so consistent with the training and guidance. This was vital to ensure the intervention was implemented in the same way by all teachers and minimise the risk of teachers adapting the intervention in the classroom and potentially impact on results
- Administer the learner post-intervention maths assessment and questionnaire.

The material provided to all teachers included handbooks which outlined the content and purpose of the four interventions and offered greater detail on expected tasks over the course of the six weeks. Additionally, resources for the interventions were made available online as individual Padlets[5], which contained recordings of the CPD sessions, content for the lesson plans and access to the evaluation material – links to the learner questionnaires and pdf copies of the maths assessments.

Only **learners** who were undertaking GCSE resits (not Functional Skills) and were aged 16-19 were eligible for inclusion in the study. However, it was recognised that this may prove difficult for teachers with mixed classes and so the target of 50 learners per teacher was removed. While all learners in the class may have undertaken assessment and evaluation activities (see below), only those in scope were included in the evaluation.

Other than this, selection and involvement of learners in the interventions was made entirely by the teachers and organised according to the teachers' current and own set-up of maths classes.

Role of Pye Tait Consulting

Section 2.3 goes on to describe the evaluation methodology, but as evaluators, Pye Tait performed a number of activities to support implementation of the scale-up study.

ETF delivered the training to the teachers, but from that point, teachers raised queries with Intervention Coordinators and Pye Tait became the first port of call for Intervention Coordinators themselves. A dedicated member of staff within Pye Tait acted as the primary contact point for the coordinators via email, to deal with all queries, gather data and send reminders about all stages of the evaluation (i.e., learner and teacher questionnaire deadlines, assessment deadlines, and focus group organisation).

Communication with the Intervention Coordinators via Pye Tait was consistent throughout the length of the intervention, including preparation and post-intervention stages, from October 2022 through to February 2023. Pye Tait received numerous queries, some of which were beyond the remit of the evaluation. These queries were dealt with by Pye Tait where possible (e.g., the location of intervention materials), however frequently, issues were raised which were beyond the scope of the evaluation role, and these were forwarded to ETF for consideration.

[5] A cloud-based software offering real time platform.

Additionally, and in response to ETF being unable to recruit any organisation to administer the collection and distribution of maths assessments to examiners and the recruitment of examiners themselves, Pye Tait stepped in to allow the scale-up study to stay on track by:

- Recruiting, coordinating and overseeing the work of Examiners marking the assessments.
- Arranging the collection and distribution of assessments from colleges to Examiners.

This process resulted in additional administrative duties for Pye Tait and a considerable increase in engagement with ICs to arrange the collection of assessments.

2.3 Evaluation Method

The evaluation of the scale-up study was proposed as a small efficacy trial in order to assess the impacts produced by the interventions on learner Level 2 mathematics capabilities and attitudes towards maths over the period of the intervention.

There were four primary research strands for this evaluation:

- Learner maths assessments conducted pre-intervention (in Week 1) and post intervention (Week 6)
- Learner attitudinal questionnaires conducted pre-intervention (in Week 1) and post intervention (Week 6)
- Post-intervention survey of participating teachers, and
- Two focus groups with intervention coordinators.

Due to the size of the study and the time allocated, ETF decided against commissioning an evaluation with control groups, therefore the overall approach was to measure changes between pre-intervention and post-intervention for the same individuals. The learner maths assessments and questionnaires provide data on 'distance travelled' by learners on maths capability and attitude towards. The focus groups and teacher survey provided an additional element to offer greater, explanatory information regarding how the interventions were implemented and what worked well. The method enabled Pye Tait to address the aims of the research within the parameters given (section 1.3).

The timeframe of these elements is given in the following table.

Table 2.1: Timetable of evaluation events

<table>
<tr><td>07/11/2022</td><td colspan="2" rowspan="4">Week 1 questionnaire and assessment available</td></tr>
<tr><td>14/11/2022</td></tr>
<tr><td>21/11/2022</td></tr>
<tr><td>28/11/2022</td></tr>
<tr><td>05/12/2022</td><td colspan="2" rowspan="3">Week 6 questionnaire and assessment available</td></tr>
<tr><td>12/12/2022</td></tr>
<tr><td>19/12/2022</td></tr>
<tr><td>26/12/2022</td><td colspan="2">Christmas Break</td></tr>
<tr><td>02/01/2023</td><td rowspan="3">Teacher questionnaire live (January 3rd – 20th 2023)</td><td></td></tr>
<tr><td>09/01/2023</td><td rowspan="2">Intervention Coordinator focus groups (17th – 18th)</td></tr>
<tr><td>16/01/2023</td></tr>
</table>

Each learner who participated in both week one and week six had their attitudinal questionnaire and maths assessment submissions matched by using their unique learner code (see Appendix for a description of the learner code allocation and matching process). This was a vital task in the evaluation process, as without the matched data we would be unable to assess the continuation, intervention effectiveness or improvement of learners throughout the course of the intervention.

During analysis, assessments and questionnaires received from those aged over 19 and not undertaking maths resits were removed.

It is of note that not all learners attending the first session will have attended the final session and vice versa, therefore the analysis conducted for this impact evaluation has ONLY involved learners who have either:

i. completed a set (the pre- and post-intervention) of maths assessments AND completed a set of (pre- and post-intervention) attitudinal questionnaires, or

ii. completed a set of maths assessments but, for some reason, did not complete both attitudinal questionnaires, or

iii. those who completed a set of learner attitudinal questionnaires but, for some reason, did not complete a set of maths assessments.

Statistically it is of no value reviewing learner's results if they only completed the pre- *or* post-intervention maths assessment or the pre- *or* post-intervention attitudinal questionnaire. The measure has to involve the analysis of outcomes from the pre- and post-intervention tools of both – or at least one – set, as described above.

The data is assessed and presented as the average distance travelled scores of all those who submitted both pre- and post-intervention maths assessments and/or attitudinal questionnaires.

Learner maths assessments

Critical to the evaluation of the scale-up study is the assessment of maths capabilities amongst participating learners before and after the intervention and assessing the distance travelled. For this, ETF produced a 10-question assessment for administration in Week 1 and Week 6, based on existing Edexcel maths GCSE exams (see Appendix 3).

The assessment questions asked learners to show their understanding of three maths concepts: fractions, ratio and proportion. Each question was worth between one and five marks and details are listed below for context. A higher number of marks denotes a more complex question, as shown in Appendix 3.

Teachers administered the assessments and completed papers were sent to a number of examiners recruited for this project[6] to mark. Each examiner was assigned the same institution's pre- and post-intervention papers for consistency.

Marking instructions asked for two types of marking to be considered:

- **Standard marking:** each question was marked in line with the original Edexcel mark scheme with the total mark awarded recorded.

[6] Pearsons signposted ETF and Pye Tait to a pool of approved examiners for Pye Tait to use for recruitment purposes

- **Non-standard marking:** additionally, each question was marked according to two other criteria, 'question not attempted' and the 'use of bar models or ratio tables'.

The pre- and post-intervention assessments were matched together for analysis as described above. Those papers that were unable to be matched were not included in the analysis, any entries undertaken twice by the same learner were also discarded. This resulted in a total of 1,202 learners whose data could be analysed.

After cleaning and checking, a total of 1202 sets of matched pre- and post-intervention learner maths assessments were ready for analysis.

Learner attitudinal questionnaires

Pye Tait supported ETF in designing both the pre- and post-intervention learner attitudinal questionnaires. These were hosted online by Pye Tait on Microsoft Forms to be accessible by direct links and by QR codes via the learners' mobile phones.

The surveys included a mix of demographic questions ascertaining the learners' current grade and age, and Likert scale questions regarding current perceptions of mathematics. The questions remained the same from week one to six, with the exception of two additional reflection questions added to the final survey to assess the opinion from the learner of the intervention's effectiveness in improving maths capability.

After cleaning and checking, a total of 866 sets of matched pre- and post-intervention learner attitudinal questionnaires were ready for analysis prior to removal of those outside scope.

Teacher questionnaire

All participating teachers were invited to take part in an online questionnaire post-intervention (Appendix 3). This included any teacher who completed the intervention delivery – fully or partially - and those unable to start for any reason. This assessed their overall opinion of the impact and effectiveness of the intervention delivery and content.

A total of 60 responses – 50% of all participating teachers– were received for this survey.

Intervention coordinator's focus groups

The Intervention Coordinators took part in one of two focus groups. These assessed their overall opinion of the role they were given, what improvements they would make to the intervention process, and their perception of the impact the intervention has had.

In the event, nine of the 21 Intervention Coordinators attended one of these sessions, and two provided responses later via email.

2.4 Data Sets and Limitations

This section describes some of the limitation of the study and evaluation with further details in the Appendices.

Final numbers in the scale-up study and evaluation

The number of matched maths assessments and attitudinal questionnaires, presented above, was somewhat below the initial target of 6000. This was expected given: the removal of the target of 50 per teacher (as described in 2.2); the likelihood of absence and attrition from the study (by both teachers and learners) over the 6-week period and the fact that the study took place immediately after November resits. This section introduces some of the factors involved.

A total of 119 teachers were recruited in the initial stages for this scale-up study, very close to the initial target of 126. Almost nine out of ten of the teachers who signed up (98)

completed the full six weeks of the intervention. Those who finished the full study were spread over 51 FE colleges – which is fewer than the estimated sample size of 63 (3 per CfEM). The colleges which submitted matched assessment and/or survey data are shown in Appendix 1.

In terms of the number of learners, this is more difficult to assess. ETF and Pye Tait considered asking teachers to record the numbers in each selected class and attendance at each session to estimate overall numbers and provide a response rate but decided that this would be an additional burden on the teachers. Instead, teachers could volunteer attendance records indicating numbers of participating learners, but in the event, this was not completed comprehensively and could not be used to count numbers of learners involved or to support the analysis.

A total of 4534 pre- and post-intervention assessment papers were marked by examiners and 3006 learners took part in the pre-intervention and at least partially engaged in the evaluation material. However, for reasons explained in Appendix 2 regarding errors with codes resulting in unmatched data sets, not all their results can be included in the final analysis for the evaluation. The number of learners involved at some stage is probably higher, but there were instances where teachers noted learners were not actively engaging in content, for the assessment or the questionnaire. Learners may also have been present for some of weeks 2 to 5 of the intervention, if not weeks 1 and 6.

While the final usable numbers of maths assessments and attitudinal questionnaires are lower than the anticipated numbers of participating learners (see section 2 above), this is not particularly surprising given the nature of the study. The evaluation data collected does allow an assessment of the efficacy of the interventions and some analysis of differences between the four interventions (see Chapter 4 and see also Appendices 4 to 7 for further Invention data).

2.5 Conclusions

The scale-up study involved the delivery of a maths intervention over a 4-week period, supplemented by classroom time in delivering pre-and post-intervention assessments and questionnaires to assess ‘distance travelled’. This evaluation methodology was adopted to minimise the burden on the sector.

A number of expected and unexpected challenges arose (see Appendix 2 for further detail), including the recruitment of examiners, practical delivery of the intervention which was aimed at 16-19 year old resit learners but who attended mixed learner classes (e.g. with older learners and those taking Functional Skills), labour disputes and learner and teacher attendance.

However, the commitment of Intervention Coordinators, teachers and other parties ensured the interventions were delivered as intended and a reasonable amount of data collected to assess the effectiveness of the maths interventions and to make recommendations on further roll out.

3. Impact for Learners

3.1 Introduction

This chapter sets out the findings from the pre-and post-intervention matched data sets. It firstly described the results of the maths assessments, followed by the findings from the attitudinal questionnaires. Appendix 3 presents the maths assessment and the learner questionnaire in full.

3.2 Maths Assessment

The results of the examiners' marks awarded per learner were recorded in Excel. They have been analysed and presented in terms of a *change in marks* between the mean of all answers for all learner respondents submitting BOTH a pre- and post- intervention assessment. Table 3.1 shows the numbers received and matched. Appendix 1 details which colleges returned matched assessments.

Table 3.1: Numbers of learners completing pre- and post-intervention maths assessments and number of matched assessments, by intervention group

Intervention	Pre-intervention	Post-intervention	Matched data sets
Totals	3006	1538	1202
Bar Models	669	246	197
Engagement & Resilience	604	250	180
Ratio Tables	666	356	287
Responsive Teaching	1067	686	538

The findings indicate if, as a result of the four-week intervention, there was an improvement in:

- **Performance:** pre-and post-intervention marks compared using Mean and changes.
- **Use of models and representations:** Alongside the marks awarded to a learner on the ten questions, examiners were also asked to note, separately, whether a learner had made use of either bar models[7] or ratio tables[8] in each of the ten questions.
- **Willingness to answer**: indicated by any change between the number of questions 'Not Answered' recorded by the examiner pre-and post-intervention. If a question was not attempted by a learner, the examiner was to enter a code of "not answered" rather than 0 on the mark book. Indications of no attempt by the learner, are if it had been left blank, or if there was a minimal response with no mathematical information or process included. Analysis of the question not attempted was to provide an indicator of the change in willingness to answer a maths question pre- and post-intervention.

[7] Bar Models were most relevant to Qs 1,3,4,5,6,9 and 10
[8] Ratio Tables were most relevant to Qs 2,7 and 8

Statistical Significance

In order to provide an indication of statistical significance for these results t-tests have been conducted on the mean difference of all responses per question, and the mean difference of responses per intervention method per question.

The tests are a statistical procedure used to evaluate the mean differences between data gathered in the pre- and then post-intervention, and whether these differences (if any) are statistically significant.

The statistical significance of each mean change (or no change) indicates whether or not the difference could have arisen by chance. There is no other implication or inference. It is important to recognise that a non-statistically significant change returned by the single tailed, paired t-test does not imply that there has been no change at all. This can be for a number of reasons, specifically sample size and random variation within the dataset. To account for this, statistical testing has not been conducted on Age and GCSE grade cross-tabulations due to the variance in their sample sizes.

Performance

The mean total mark per learner in the pre-intervention assessment was 11.2 marks, increasing to 12.5 marks in the post-intervention assessment – an increase of 1.3 marks.

All questions (Table 3.2) saw an overall increase or no change in total marks per candidate between Week 1 and Week 2 assessments.

Table 3.2: Performance – pre- and post-intervention mean mark and change per question, all learners

	Max. mark that could be awarded	Pre-intervention Mean Mark	Post-intervention Mean Mark	Change in marks	Statistically significant*
All Qs	29	11.2	12.5	+1.3	
Q1	1	0.9	0.9	0	Yes
Q2	2	0.9	1.0	+0.1	Yes
Q3	3	0.9	1.1	+0.2	Yes
Q4	2	1.3	1.4	+0.1	Yes
Q5	3	1.8	2.0	+0.2	Yes
Q6	4	2.3	2.5	+0.2	Yes
Q7	2	1.6	1.6	0	Yes
Q8	4	2.6	2.7	+0.1	Yes
Q9	3	0.8	1.1	+0.3	Yes
Q10	5	2.2	2.5	+0.3	Yes

Base: 1,202 learners

***** if yes this means there is sufficient evidence to conclude that the result is statistically significant (i.e., a p-value is less than 0.05).

- In general, there are minor changes in the mean between pre- and post-intervention.

- Q10, theoretically the most complex question (5 marks could be awarded) saw the biggest change in mean mark, with a +0.3 change in average mark. This might be expected given the bigger scope for change (from 1 to 5 marks)
- Q9 (3 marks could be awarded) was the most challenging question of the assessment for learners with the lowest aggregate marks, and with *no answer* being the most common answer. However, it also sees an increase of 0.3 from 0.8 to 1.1.

In terms of performance in the assessment by intervention, all groups reported a positive change. Learners in the Engagement & Resilience intervention group increased their mark the most, by 2.5 marks (Table 3.3). The Responsive Teaching group saw the smallest change, an increase of 0.8 marks from 11.7 to 12.5.

Table 3.3: Performance – pre- and post-intervention mean and change, by intervention group

Intervention group	Pre-intervention average mark	Post-intervention average mark	Change in marks	Statistically significant
Bar Models	11.7	13.2	+1.5	Yes
Engagement & Resilience	10.5	13.0	+2.5	Yes
Ratio Tables	10.2	11.8	+1.6	Yes
Responsive Teaching	11.7	12.5	+0.8	Yes

Base: 1,202 learners; Bar Models: 197 learners; Engagement & Resilience: 180 learners; Ratio Tables: 287 learners; Responsive Teaching: 538 learners.

Finally, to assess whether the interventions worked better with higher abilities in pre-intervention, we undertook an analysis of the changes by quartile. Table 3.4 below shows that those with higher marks in pre-intervention achieved a greater increase in their post-intervention marks, although, overall, each quartile saw a positive change in the mean mark. There are no notable differences in mean marks per quartile by intervention (see Tables in Appendices A4.2, A5.2, A6.2 and A7.2), suggesting that the differences between the interventions reported in Table 3.3 are more likely to be associated with the intervention rather than the pre-existing capabilities of the learners.

Table 3.4: Performance – pre- and post-intervention mean and change, by quartile

All learners	Lower Quartile (Q1)	Median (Q2)	Upper Quartile (Q3)	Maximum (Q4)
Learners	301	301	300	300
Week 1 mean mark	3.1	8.4	13.3	20.1
Week 6 mean mark	3.7	9.6	15.1	21.8
Change in mean mark	+0.6	+1.2	+1.8	+1.8

Base: 1,202 learners

Use of models and representations: ratio tables

For both pre- and post-intervention assessments, examiners checked whether learners used specific mathematical representations in their working out. The first technique, ratio tables, could be used in three questions: Q2, Q7, and Q8.

Table 3.5 shows that there was an increase in the proportion of learners using ratio tables in all three questions, albeit from apparently low bases. Learners were most likely to use ratio tables for Q7, and the increase in the proportion of learners using ratio tables in answering this question also increased the most (a 3.4 percentage point increase from 16.5% of learners using ratio tables in answering the question to 19.9% in the post-intervention assessment).

Q8 saw the smallest number of learners utilise ratio tables, and the smallest change in pre- and post-intervention assessment numbers, at +1.2 percentage points.

Table 3.5: Use of models and representations – use of ratio tables pre- and post-intervention, all learners

	Pre-Intervention		Post-Intervention		Change
Question	Count	% of learners	Count	% of learners	Percentage point change
Q2	33	2.8%	51	4.3%	+1.5 pp
Q7	194	16.5%	232	19.9%	+3.4 pp
Q8	17	1.5%	30	2.6%	+1.2 pp

Base: overall 1,202 learners with variable base per question (once blank answers removed).

Appendices 4-7 detail the responses for the interventions and Table 3.6 shows the percentage point change across the three questions.

This shows that the learners in the Responsive Teaching intervention had the lowest percentage point increases in use of ratio tables and the greatest changes were recorded in the Ratio Tables or Engagement & Resilience groups, depending on the question.

Table 3.6: Use of models and representations – percentage point change in use of ratio tables, by intervention

Question	Bar Models	Engagement & Resilience	Ratio Tables	Responsive Teaching
	Percentage point change			
Q2	+2.5 pp	+3.9 pp	+1.7 pp	+0.1 pp
Q7	+3.6 pp	+5.6 pp	+5.9 pp	+1.4 pp
Q8	-1.0 pp	0.0 pp	+2.5 pp	+1.7 pp

Base: 1,202 learners; Bar Models: 197 learners; Engagement & Resilience: 180 learners; Ratio Tables: 287 learners; Responsive Teaching: 538 learners. NB: variable base per question (once blank answers removed).

Use of models and representations: bar models

As above, examiners noted how often learners used bar models in their working out in each assessment for all remaining questions (other than Q2, Q7 and Q8) as listed in Table 3.7 below.

The table shows that there was a positive change in the use of bar models between each assessment, though the total proportion of learners using the technique are apparently low.

The highest improvement occurs with Q9, where 47 or 4.3% of learners use bar models in their response pre-intervention, rising to 102 (9.2%) of learners after their intervention.

There were no negative changes, indicating that bar models were positively impressed upon the learners.

Table 3.7: Use of models and representations – use of bar models pre- and post-intervention, all learners

	Pre-Intervention		Post-Intervention		Change
	Count	%	Count	%	Percentage point change
Q1	3	0.3%	13	1.1%	+0.8 pp
Q3	12	1.0%	59	5.1%	+4.1 pp
Q4	43	3.7%	79	6.7%	+3.0 pp
Q5	9	0.8%	29	2.5%	+1.7 pp
Q6	10	0.9%	28	2.4%	+1.5 pp
Q9	47	4.3%	102	9.2%	+4.9 pp
Q10	30	2.7%	51	4.6%	+1.9 pp

Base: overall 1,202 learners - NB: variable base per question (once blank answers removed).

Appendices 4-7 detail the responses for the interventions. Table 3.8 shows the percentage point change across the questions and shows that the learners on the Bar Models consistently recorded the greatest increase in the use of bar models across the relevant questions.

Table 3.8: Use of models and representations – percentage point change in use of bar models, by intervention

Question	Bar Models	Engagement & Resilience	Ratio Tables	Responsive Teaching
	Percentage points			
Q1	+3.6 pp	-1.1 pp	0.0 pp	+0.1 pp
Q3	+10.2 pp	+3.4 pp	+0.7 pp	+3.6 pp
Q4	+3.6 pp	+2.8 pp	+6.0 pp	+2.8 pp
Q5	+8.1 pp	0.0 pp	-0.4 pp	+1.0 pp
Q6	+9.6 pp	0.0 pp	0.0 pp	-0.2 pp
Q9	+12.2 pp	+7.3 pp	+1.4 pp	+2.9 pp
Q10	+5.6 pp	+1.7 pp	+0.7 pp	+1.1 pp

Base: 1,202 learners; Bar Models: 197 learners; Engagement & Resilience: 180 learners; Ratio Tables: 287 learners; Responsive Teaching: 538 learners. NB: variable base per question (once blank answers removed).

Willingness to answer

Examiners recorded the question was attempted or not to indicate willingness to answer. The numbers and proportions of students not answering each question, alongside the change in numbers and percentage point change, is shown in Table 3.9 below.

Table 3.9: Willingness to answer – demonstrated by the number of *not answered* questions, all learners

	Pre-intervention Not Answered		Post-intervention Not Answered		Change	
	Count	%	Count	%	Count	Percentage point
Q1	63	5%	50	4%	-13	-1 pp
Q2	196	16%	145	12%	-51	-4 pp
Q3	427	36%	371	31%	-56	-5 pp
Q4	253	21%	187	16%	-66	-5 pp
Q5	252	21%	213	18%	-39	-3 pp
Q6	297	25%	280	23%	-17	-1 pp
Q7	156	13%	159	13%	3	0 pp
Q8	244	20%	288	24%	44	+4 pp
Q9	671	56%	604	50%	-67	-6 pp
Q10	617	51%	580	48%	-37	-3 pp
Total	3,176	-	2,877	-	-299	-

Base: 1,202 learners NB: variable base per question (once blank answers removed).

Table 3.9 shows:

- Pre-intervention had collectively 299 more instances of learners not answering than post-intervention, suggesting improved willingness to answer overall.
- Q9 and Q4 showed the most improvements, with 67 fewer learners not answering Q9 (671 pre-intervention, 604 post-intervention, a decrease of 6 percentage points) and 66 fewer Q4 (253 pre-intervention, 187 post-intervention, a decrease of 5 percentage points).
- More than half of learners did not answer Q9 and Q10 in week one, 56% and 51% respectively, but these dropped slightly to 50% and 48% respectively in week six.
- Although a relatively low proportion (20%) of learners did not answer Q8 pre-intervention, this was the only question to see an increase in the proportion not answering in the post-intervention assessment (up to 24%), indicating a worsening willingness to answer.

Table 3.10 below shows the number changes in questions not answered by intervention group. Willingness to answer remained the same or improved across all questions for those on the Engagement & Resilience intervention. For half of the assessment (5 questions), fewer of the matched learners on the Ratio Tables intervention answered questions in the post-intervention assessment.

Table 3.10: Willingness to answer – demonstrated by the percentage of not answered questions and percentage point (pp) change, by intervention group

	Bar Models Questions not answered			Engagement & Resilience Questions not answered			Ratio Tables Questions not answered			Responsive Teaching Questions not answered		
	Week 1	Week 6	+/-	Week 1	Week 6	+/-	Week 1	Week 6	+/-	Week 1	Week 6	+/-
Q1	6%	5%	-1 pp	6%	3%	-3 pp	4%	5%	+1 pp	5%	4%	-1 pp
Q2	17%	14%	-3 pp	17%	12%	-5 pp	15%	11%	-4 pp	17%	12%	-5 pp
Q3	39%	32%	-7 pp	46%	37%	-9 pp	33%	30%	-3 pp	33%	29%	-4 pp
Q4	21%	20%	-1 pp	26%	14%	-12 pp	19%	16%	-3 pp	21%	14%	-7 pp
Q5	19%	14%	- 5 pp	21%	20%	-1 pp	20%	20%	+/-0	22%	17%	-5 pp
Q6	23%	18%	-5 pp	31%	28%	-3 pp	24%	25%	+1 pp	24%	23%	-1 pp
Q7	8%	11%	+3 pp	14%	10%	-4 pp	16%	15%	-1 pp	13%	14%	+1 pp
Q8	17%	21%	+4 pp	27%	27%	+/- 0	22%	25%	+3 pp	19%	23%	+4 pp
Q9	57%	38%	-19 pp	62%	47%	-15 pp	49%	52%	+3 pp	57%	55%	-2 pp
Q10	50%	41%	-9 pp	57%	49%	-8 pp	47%	54%	+7 pp	52%	47%	-5 pp

Base: 1,202 learners; Bar Models 197 learners; Engagement & Resilience 180 learners; Ratio Table: 287 learners; Responsive Teaching 538 learners.

3.3 Learner Attitudinal Questionnaire

In order to understand the broader impact of the maths intervention upon learners, an attitudinal survey was conducted with learners, via an online questionnaire, to evaluate holistic improvements beyond their mathematical scores in the assessment. Learners were asked to complete the questionnaire pre-intervention in week 1, and the same questionnaire (plus one question) post-intervention in week 6.

We received responses from **866 learners** who had completed the survey for both iterations.

Although a total of 866 learners provided matched responses, not all answered every question for each week, thereby creating variances in the number of responses per question.

The overall volume of learners participating in each activity is shown in Table 3.11. Appendix 1 details which colleges returned matched assessments.

Table 3.11: Numbers of learners completing pre-and post-intervention learner attitudinal questionnaires and number of matched questionnaires, by intervention group

Intervention Group	Week 1 numbers	Week 6 numbers	Matched data sets
Total	2624	1137	866
Bar Models	501	343	211
Engagement & Resilience	808	170	165
Ratio Tables	550	244	236
Responsive Teaching	765	259	254

This section reports on the demographic data collected through the questionnaire about the participating learners, their confidence with regard to maths and their perceptions of maths teaching during the intervention. Analysis is also presented by intervention group, where data allow.

Learner Demographics

Almost half of those completing the survey were 16 years old (Table 3.12). This question was asked, in part, to act as a proxy for how many times learners may have entered a maths GCSE. As they were not eligible for the study, those aged under 15 and over 19 (a total of 11) were removed from the remainder of the analysis, leaving a total of **855** matched survey responses in scope.

Table 3.12: Age of learners completing the Learner Attitudinal Questionnaire

Age	Number	%
15 or below	3	0.4%
16	404	46.8%
17	273	31.6%
18	141	16.3%
19 or above	35	4.1%
Over 19	8	0.5%

Base: 866

The table below illustrates the distribution of learners according to their previous GCSE grade (provided by the learner). The majority of learners who completed the questionnaire were awarded a grade 3 in their previous maths GCSE exam.

Table 3.13: Previous GCSE grades of learners completing the Learner Attitudinal Questionnaire

Previous GCSE Grade	Number	%
Don't know	79	9.3%
1 or lower	77	9.1%
2	197	23.1%
3	498	58.5%

Base: 851, 4 provided no answer.

Attitudes to maths -all learners

The survey included a number of questions to assess learner confidence in doing maths and self-reported ability.

Table 3.14 shows the pre- and post-intervention scores on how happy learners are to be doing maths again, as an overall assessment of potential engagement in the class. Respondents were asked to rank on a scale of 1 to 10 where 1 is not at all happy and 10 is very happy. Overall, learners do not appear to be particularly enthusiastic about resitting maths, but this does see a statistically significant improvement, after the intervention, of 0.2.

Table 3.14: Learner happiness in doing maths pre-and post-intervention, all learners

Where 1 is not at all happy and 10 is completely happy	Pre-intervention (Mean)	Post-intervention (Mean)	Change	Statistically significant mean change*
Q.5 How happy are you to be doing maths again this year?	4.6	4.8	+0.2	Yes

***** if yes this means there is sufficient evidence to conclude that the mean change is statistically significant (i.e., a p-value is less than 0.05). Base:855

Table 3.15 shows the results of a series of questions on learner confidence recorded in the pre-and post-intervention questionnaires. The same 10-point scale as above is used, where 1 is not at all confident and 10 is very confident. All questions show a small increase in confidence between pre-and post-intervention questionnaires (except Q6 walking into a math classroom), and most are statistically significant differences. Confidence was at a higher starting point regarding being in a maths classroom and asking for help. The change in scores is highest for confidence in the maths assessment they had just completed (an increase in 0.5 on the 1 to 10 scale) and confidence in doing an assessment (0.4), a vital consideration for learners resitting exams.

Table 3.15: Learner confidence in maths pre-and post-intervention, all learners

Where 1 is not at all confident and 10 is completely confident	Pre-intervention (Mean)	Post-intervention (Mean)	Change	Statistically significant mean change*
Q.6 How confident do you feel walking into your maths classroom?	6.1	6.1	+/- 0	No
Q.7 How confident do you feel being asked a maths question in front of the rest of your class?	5.0	5.3	+0.3	Yes
Q.8 How confident do you feel asking your maths teacher for help?	6.7	6.8	+0.1	No
Q.9 When a new topic is introduced in maths, how confident do you feel that you will understand it?	5.5	5.7	+0.2	Yes
Q10 When you were told you were doing a Maths assessment today, how confident did you feel about doing it?	5.2	5.6	+0.4	Yes
Q11 How confident are you that you got most of the answers right in the Maths assessment you have just done?	5.0	5.5	+0.5	Yes

***** if yes this means there is sufficient evidence to conclude that the mean change is statistically significant (i.e., a p-value is less than 0.05). Base: variable base per question once blank answers removed (from 829 to 842).

Finally in this section, Table 3.16 records elements of self-reported ability – learners' own perception of maths understanding, belief that their maths capability in general and ability to use bar models and ratio tables has improved. All of those show statistically significant increases in the mean score.

Table 3.16: Learner self-reported ability and improvement pre-and post-intervention, all learners

Where 1 is no understanding [Q12] or no improvement [Q13-15] and 10 is complete understanding [Q12] or lot of improvement [Q13-15]	Pre-intervention (Mean)	Post-intervention (Mean)	Change	Statistically significant mean change*
Q 12 How well do you usually understand the maths you have been taught?	6.0	6.1	+0.1	Yes
Q 13 Has your belief that you can do maths improved?	5.8	6.0	+0.2	Yes
Q 14 Drawing bar models	5.7	6.0	+0.3	Yes
Q 15 Drawing ratio tables	4.7	5.5	+0.8	Yes

***** if yes this means there is sufficient evidence to conclude that the mean change is statistically significant (i.e., a p-value is less than 0.05). Base: variable base per question once blank answers removed (from 716 to 844)

The following tables present attitudes to maths via the mean change on the 1 to 10 scales, in confidence and self-reported ability by intervention (Table 3.17, Table 3.18), by age (Table 3.19 and 3.20) and by previous GCSE maths grade (Table 3.21 and 3.22).

Attitudes to maths -by intervention method

Learners on the Responsive Teaching intervention tended to record the lowest increases and for almost all questions, the change in mean was below the change in mean for all learners. Learners on the Bar Models and Engagement & Resilience interventions tended to record the highest changes in mean score between pre- and post-intervention (Table 3.17).

Table 3.17: Changes in ratings by learner on their levels of happiness, confidence and ability, by intervention method

Where 1 is “not at all happy/confident/well” and 10 is “completely happy/confident/well”.	Bar Models (mean change)	Engagement & Resilience (mean change)	Ratio Tables (mean change)	Responsive Teaching (mean change)	All learners (mean change)
Q.5 How happy are you to be doing maths again this year?	+0.5	+0.5	+/- 0	+/- 0	+0.2
Q.6 How confident do you feel walking into your maths classroom?	+0.3	+0.2	+0.2	-0.2	+/- 0
Q.7 How confident do you feel being asked a maths question in front of the rest of your class?	+0.7	+0.3	+0.3	+0.2	+0.3
Q.8 How confident do you feel asking your maths teacher for help?	+0.2	+0.3	-0.1	+/- 0	+0.1
Q.9 When a new topic is introduced in maths, how confident do you feel that you will understand it?	+0.3	+0.3	+0.2	+0.2	+0.2
Q10 When you were told you were doing a Maths assessment today, how confident did you feel about doing it?	+0.4	+0.8	+0.2	+0.2	+0.4
Q11 How confident are you that you got most of the answers right in the Maths assessment you have just done?	+0.6	+0.9	+/- 0	+0.5	+0.5
Q 12 How well do you usually understand the maths you have been taught?	+0.4	+0.3	-0.1	-0.1	+0.1
Q 13 Has your belief that you can do maths improved?	+0.1	+0.5	+0.4	-0.1	+0.2
Q 14 Improvement in ability to draw bar models (from 1 to 10)	+0.9	+0.8	+-/ 0	-0.1	+0.3
Q 15 Improvement in ability to draw ratio tables (from 1 to 10)	+1.2	+1.1	+0.6	+0.3	+0.8

Base: Bar Models: 197 learners; Engagement & Resilience: 163 learners; Ratio Tables: 221 learners; Responsive Teaching: 240 learners. NB: variable base per question (once blank answers removed).

Table 3.18 summarises the changes across all attitudinal questions and confirms that learners on the Ratio Tables & Responsive Teaching interventions recorded the lowest attitudinal improvements and Engagement & Resilience and Bar Models the highest.

Table 3.18: Average mean change in attitudinal response by intervention method

Intervention	Bar Models (mean change)	Engagement & Resilience (mean change)	Ratio Tables (mean change)	Responsive Teaching (mean change)	All learners (mean change)
Mean attitudinal change	+0.5	+0.5	+0.1	+0.1	+0.3

Base: Bar Models: 197 learners; Engagement & Resilience: 163 learners; Ratio Tables: 221 learners; Responsive Teaching: 240 learners. NB: variable base per question (once blank answers removed).

Attitudes to maths -by age group

Table 3.19 presents the data across four age groups. Age is being used as a proxy for number of times learners have been entered into maths exams. There are no clearly discernible patterns here with some age groups recording higher increases on some questions and lower on others.

Table 3.19: Changes in ratings by learner on their levels of happiness, confidence and ability across each age group

Where 1 is "not at all happy/confident/well" and 10 is "completely happy/confident/well".	16 (mean change)	17 (mean change)	18 (mean change)	19 (mean change)	All learners (mean change)
Q.5 How happy are you to be doing maths again this year?	+0.1	+0.3	+0.4	-0.3	+0.2
Q.6 How confident do you feel walking into your maths classroom?	+0.1	+0.1	+0.2	-0.1	+/- 0
Q.7 How confident do you feel being asked a maths question in front of the rest of your class?	+0.3	+0.3	+0.4	+0.7	+0.3
Q.8 How confident do you feel asking your maths teacher for help?	+/- 0	+0.4	-0.3	+/- 0	+0.1
Q.9 When a new topic is introduced in maths, how confident do you feel that you will understand it?	+0.2	+0.3	+/- 0	-0.2	+0.2
Q10 When you were told you were doing a Maths assessment today, how confident did you feel about doing it?	+0.3	+0.6	+0.2	+0.1	+0.4
Q11 How confident are you that you got most of the answers right in the Maths assessment you have just done?	+0.5	+0.5	+0.5	+0.4	+0.5
Q 12 How well do you usually understand the maths you have been taught?	+0.2	+0.3	-0.3	+0.2	+0.1
Q 13 Has your belief that you can do maths improved?	+0.4	-0.1	-0.1	-0.1	+0.2
Q 14 No improvement (1) to improvement (10) in drawing bar models	+0.3	+0.6	-0.1	+0.9	+0.3
Q 15 No improvement (1) to improvement (10) in drawing ratio tables	+0.6	+0.9	+0.8	+0.7	+0.7

Base: Age 16: 404 learners; Age 17: 273 learners; Age 18: 141 learners; Age 19: 38 learners. NB: variable base per question (once blank answers removed).

To support this analysis, we explored the mean change across all questions. Table 3.20 showsthat the intervention has had the greatest impact on learners' who were 17 years of age, with an average mean attitudinal response increase of 0.2. This implies that the intervention had the greatest impact on learners who are likely to have sat their GCSEs in Summer 2022 and are therefore likely to be resitting GCSE maths for the first time. Learners

who were 15 years or below also had high average mean increases of 1, this is likely higher due to the smaller cohort of learners.

Table 3.20: Average mean change in attitudinal response across each age group

Student Age	16	17	18	19
Mean attitudinal change	+0.3	+0.4	+0.2	+0.2

Base: Age 16: 404 learners; Age 17: 273 learners; Age 18: 141 learners; Age 19: 38 learners. NB: variable base per question (once blank answers removed).

Attitudes to maths -by prior GCSE maths grade

Table 3.21 below shows that generally, the changes in confidence are lowest amongst those who did not know their prior maths grade. This group also recorded the greatest number of decreases in confidence or self-reported ability over the intervention period. They also recorded a 1.3 decline in their happiness in being in a classroom between pre- and post-intervention.

Table 3.21: Changes in ratings by learner on their levels of happiness, confidence and ability by previous GCSE maths grade

Where 1 is "not at all happy/confident/well" and 10 is "completely happy/confident/well".	Don't know (mean change)	1 or lower (mean change)	2 (mean change)	3 (mean change)	All learners (mean change)
Q.5 How happy are you to be doing maths again this year?	-1.2	+0.2	+0.3	+0.2	+0.2
Q.6 How confident do you feel walking into your maths classroom?	-0.7	+1.0	+0.6	-0.1	+/- 0
Q.7 How confident do you feel being asked a maths question in front of the rest of your class?	+0.3	+0.3	+0.4	+0.4	+0.3
Q.8 How confident do you feel asking your maths teacher for help?	-0.2	-0.3	-0.1	+0.2	+0.1
Q.9 When a new topic is introduced in maths, how confident do you feel that you will understand it?	+/- 0	+/- 0	+0.2	+0.2	+0.2
Q10 When you were told you were doing a Maths assessment today, how confident did you feel about doing it?	+0.4	-0.2	0.5	+0.4	+0.4
Q11 How confident are you that you got most of the answers right in the Maths assessment you have just done?	+0.3	+0.4	+0.8	+0.4	+0.5
Q 12 How well do you usually understand the maths you have been taught?	+/- 0	-0.1	+0.2	+0.2	+0.1
Q 13 Has your belief that you can do maths improved?	+0.3	-0.8	-0.4	+0.6	+0.2
Q 14 Improvement in ability to draw bar models (from 1 to 10)	+0.1	+0.2	+0.3	+0.5	+0.3
Q 15 Improvement in ability to draw ratio tables (from 1 to 10)	+0.6	+0.8	+0.8	+0.8	+0.8

Base: Don't know: 83 learners; 1 or lower: 74 learners; 2:187 learners; 3:473 learners. NB: variable base per question (once blank answers removed).

The intervention had the greatest impact on learners who had achieved a grade 2 or 3 within their previous maths GCSE, with a mean increase of 0.3 and 0.4 respectively (Table 3.22). This suggests that the intervention had the greatest positive impact upon learners who had previously scored higher in their GCSE maths.

Table 3.22: Average mean change in attitudinal response per previous GCSE maths grade

GCSE Maths Grade	Don't know	1 or lower	2	3
Mean attitudinal change	+/- 0	+0.2	+0.3	+0.4

Base: Don't know: 83 learners; 1 or lower: 74 learners; 2:187 learners; 3:473 learners. NB: variable base per question (once blank answers removed).

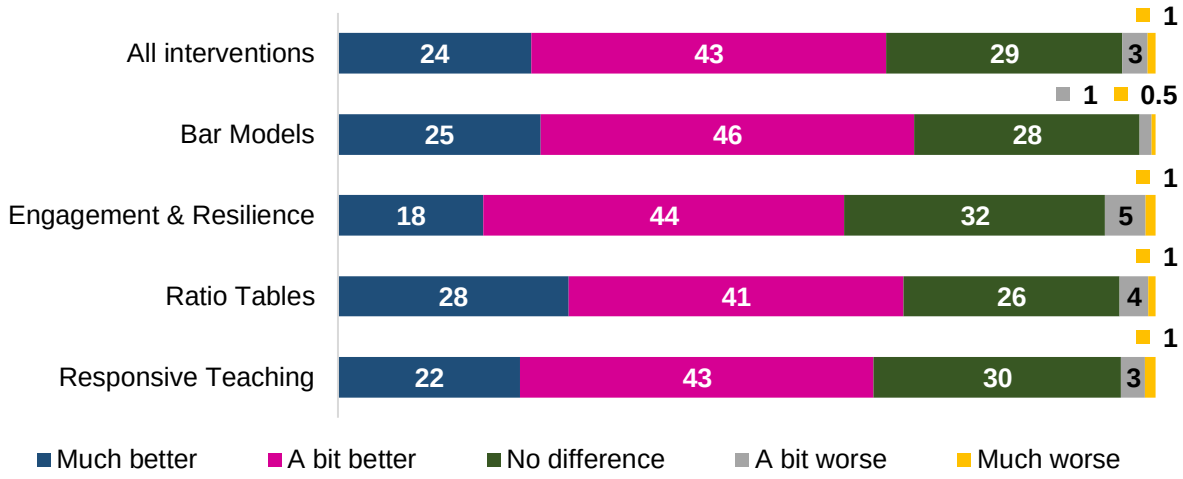
Perception of Intervention on reflection

In the post-intervention questionnaire only, learners were asked whether they had found the last 4 weeks of maths classes better or worse than previously.

Almost seven in ten (68%) reported that the new way of teaching maths was much better or a bit better than beforehand. The intervention proved better (much or a little) for those taking part in the Bar Models intervention (71%) and Ratio Tables (69%) but less well for those in the Engagement & Resilience intervention (62%).

Almost a third of learner respondents across all interventions did not think the intervention made any difference.

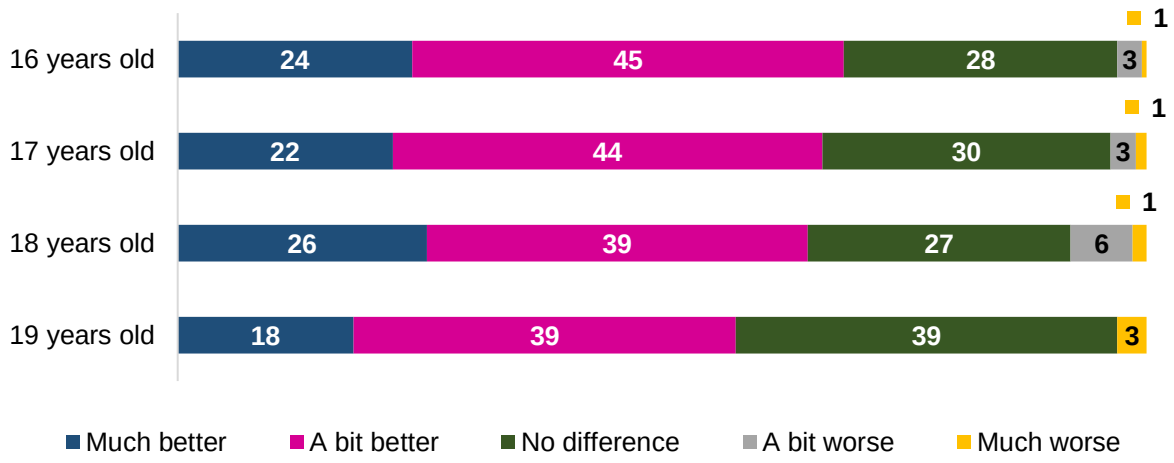
Figure 3.1: How have you found the last 4 weeks of maths classes, by intervention group, %



Base: 838

The younger age groups tend to be more positive – rating the last 4 weeks of teaching as 'much better'. The older age group are more likely to report that they noticed no difference, perhaps unsurprising if they have sat their GCSE maths exam on numerous occasions.

Figure 3.2: How have you found the last 4 weeks of maths classes, by age, %



Base: 836

3.4 Conclusions

Across almost all the evaluation data there has been a small (and sometimes statistically significant) increase in maths confidence and capability over the period of the intervention, whether this is for the sample as a whole or for specific sub-groups. This is the 'distance travelled' under investigation in the evaluation. While we cannot report whether these differences would have happened over any 4–6-week period, this does seem to be convincing evidence that the interventions have had at least some impact.

The evidence from the maths assessment suggest that the Engagement & Resilience intervention increases marks the most and the learner attitudinal questionnaire suggests that learners on the Bar Models and Engagement & Resilience interventions tended to record the highest changes in mean confidence scores between pre- and post-intervention.

The next chapter considers the teacher perspectives on the interventions.

4. Teacher Perspectives and Outcomes

4.1 Introduction

To fully address the research aims of the evaluation - including how the intervention was implemented, what colleges found effective and lessons for any national roll-out – it is necessary to obtain the views of teachers. As described in section 2 (methodology) all participating teachers were surveyed and focus groups held with Intervention Coordinators. The findings of both are presented in this chapter.

Overall, 119 teachers started teaching the four interventions and there were 60 teachers who responded to the online survey, a response rate of 50%. Table 4.1 shows how the recruited teachers and survey respondents were distributed across the four interventions.

Table 4.1: Number of teachers starting intervention and responses to survey, by intervention

Intervention	Number starting intervention	Number of survey responses
Bar Models	30	20
Engagement & Resilience	31	8
Ratio Tables	28	19
Responsive Teaching	30	12

Respondents and analysis

Of the 60 teachers responding to the survey, a third apiece were teaching Bar Models (20) and Ratio Tables (19), 12 taught the Responsive Teaching and 8 Engagement & Resilience interventions. Whilst we present data for all intervention types, the results for Responsive Teaching and Engagement & Resilience interventions in particular should be treated with caution which limits our ability to draw definitive comparisons across the interventions from the teacher perspective.

The vast majority of survey respondents (89%) have been teaching maths for more than three years. This means we cannot provide analysis based on years of teaching experience in this evaluation.

A slight majority (60%) have taken part in other aspects of the CfEM programme, most commonly in Engagement & Resilience (100% of the 8 respondents on this intervention) and Responsive Teaching (75% of the 12), followed by Bar Models (50% of the 20) and Ratio Tables (42% of the 19). Where data suggests differences between those who have participated in other CfEM activities and those who have not, this is noted in this chapter.

The large majority of teachers (92%) were able to complete the activities for all six weeks of the intervention with at least some learners. The five who did not, explained this was down to changes in priorities, absence or changes to timetabling. No disaggregated analysis is possible on this basis.

None of the Intervention Coordinators engaged in the Engagement & Resilience attended the Focus Groups, however, one provided written feedback.

4.2 Preparation and Delivery

Preparation for teachers

Teachers were very positive about the level of preparation and their understanding of the intervention based on the information and support they received, as shown in Table 4.2.

Where teachers were asked to rate levels of preparation or understanding on a scale of 1 to 10 (where 1 is not at all well and 10 is very well), overall, understanding the target audience for the intervention was rated most highly (9.2), followed by their own role in the intervention (9.0). Understanding of the underpinning theory and understanding the method behind the intervention (both 8.2) were rated lower.

The table also shows some differences by intervention. Although based on a very small sample size for the Engagement & Resilience intervention, teachers indicated a lower understanding of the theory and the method, but broadly the ratings for these elements are very similar. It is unclear why there should be variation in the other four aspects of preparation measured across the interventions as all teachers were given the same information regarding the purpose of the study as a whole, their role, target audience and timing.

Table 4.2: Teachers' level of preparation and understanding

Level of preparation/understanding in relation to …	Average / All	Bar Models	Engagement & Resilience	Ratio Tables	Responsive Teaching
the underpinning theory behind the design of the intervention, i.e. what was being taught	8.2	8.7	6.6	8.1	8.7
the maths teaching method for their intervention, i.e. Responsive Teaching, Engagement and Resilience, Bar Models, Ratio Tables	8.2	8.5	7.0	8.2	8.7
the intervention being part of a research project to explore how well the intervention would work in different FE colleges and settings in preparation for a wider, national roll-out	8.6	8.6	7.9	8.6	9.1
their role in the intervention – i.e. to complete all the assigned tasks as described, including the maths assessment and to encourage learners to complete their survey	9.0	8.9	7.9	9.3	9.3
the target audience for the intervention being mainly 16- to 19-year-old GCSE maths resit learners	9.2	9.1	8.5	9.1	9.8
the intervention needing to be delivered between the November GCSE resits and completed by Christmas	8.8	7.8	8.0	9.6	9.7

Base: Bar Models: 20; Engagement & Resilience: 8; Ratio Tables: 19; Responsive Teaching:12

Teachers used all the sources available to them in slightly differing amounts when preparing for the teaching of the interventions, but the padlets (77%) and intervention booklets (75%) were the most popular sources. Half (52%) reported drawing on the CPD sessions delivered in September/October, followed by support from the Intervention Coordinator (43%).

Delivering the intervention

The survey explored teacher perspectives of the intervention delivery, and the results are shown in Table 4.3.

On average, on a scale of 1 to 10 where 1 is not at all similar and 10 is very similar, teachers ranked the interventions at 5.9. This perhaps represents a level of similarity which strikes a balance between innovation and familiarity which would seem appropriate for this four-week intervention. Bar Model teachers tended to report that the intervention was more similar (6.8), and Engagement & Resilience teachers ranked it less similar (4.6, albeit on a low base size).

The survey explored how well the interventions matched to learners' existing skill levels. Too challenging might disengage and learners may stagnate or worse, too easy and they would not progress. Overall, when asked how well the intervention matched their learners' skill levels on a scale of 1 to 10, where 1 is not at all well and 10 is very well, the score is 6.1, which again seems a reasonable rating. This was highest for Responsive Teaching (7.7) and lowest for Engagement & Resilience (4.8), although, again, both of these are based on the smaller base numbers of teacher respondents.

Finally in this section, the survey explored how well the learners engaged with the materials from the teacher perspective. On the same 1 to 10 scale as above, overall, this was rated as 6.2, very similar to the perception of the match to skill level, but perhaps lower than what would be hoped for. This was again ranked highest for the Responsive Teaching intervention at 6.7 and lowest for Ratio Tables at 5.7, but note the low sample size of teachers on the Responsive Teaching intervention.

Table 4.3: Teachers' views on the delivery of the intervention

Aspects whilst delivering the intervention	Average / All	Bar Models	Ratio Tables	Engagement & Resilience	Responsive Teaching
How similar was the intervention to how they usually teach maths	5.9	6.8	5.6	4.6	5.9
How well did the intervention activities match their learners' skill level	6.1	6.2	5.8	4.8	7.7
How well did learners engage with the teaching material	6.2	6.5	5.7	6.0	6.7

Base: Bar Models: 20; Engagement & Resilience: 8; Ratio Tables: 19; Responsive Teaching:12

Learner engagement with the material was also explored in the focus groups with Intervention Coordinators (ICs). Reactions were variable with some noting there was not enough repetition for learners (noted by a Ratio Table IC) and another commenting that learners had become tired of the format (noted by a Responsive Teaching IC).

4.3 Impact

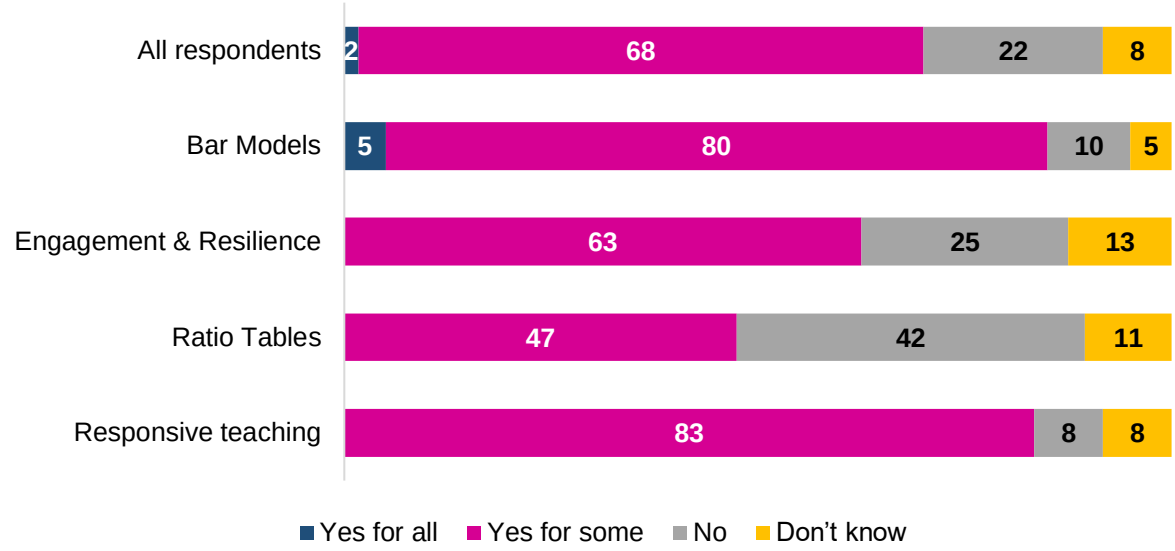
The survey explored teachers' perspectives of the impact on learners (disengaged and all learners) and on their own teaching abilities. This section begins with perspectives on impact on learners.

Learner impact -disengaged learners

Approximately seven in ten (70%) teachers felt that the intervention helped improve the maths **capabilities** of all or some disengaged maths resit learners. While subject to the same caveats on the numbers of respondents by intervention, the proportion was highest amongst teachers on the Responsive Teaching and Bar Models interventions.

Around one fifth (22%) are of the opinion that the intervention did not help. This proportion was highest amongst those on the Ratio Tables intervention (42%).

Figure 4.1: Did the intervention help improve the maths capabilities of disengaged learners, by intervention group, %



Base: Bar Models: 20; Engagement & Resilience: 8; Ratio Tables: 19; Responsive Teaching:12

Table 4.4 shows that the proportion of teachers who had taken part in some other CfEM activity are less likely to report an impact on the capability of maths learners. This may relate to expectations of the programme for those with prior experience – in other words they were already accustomed to the effect of the approach.

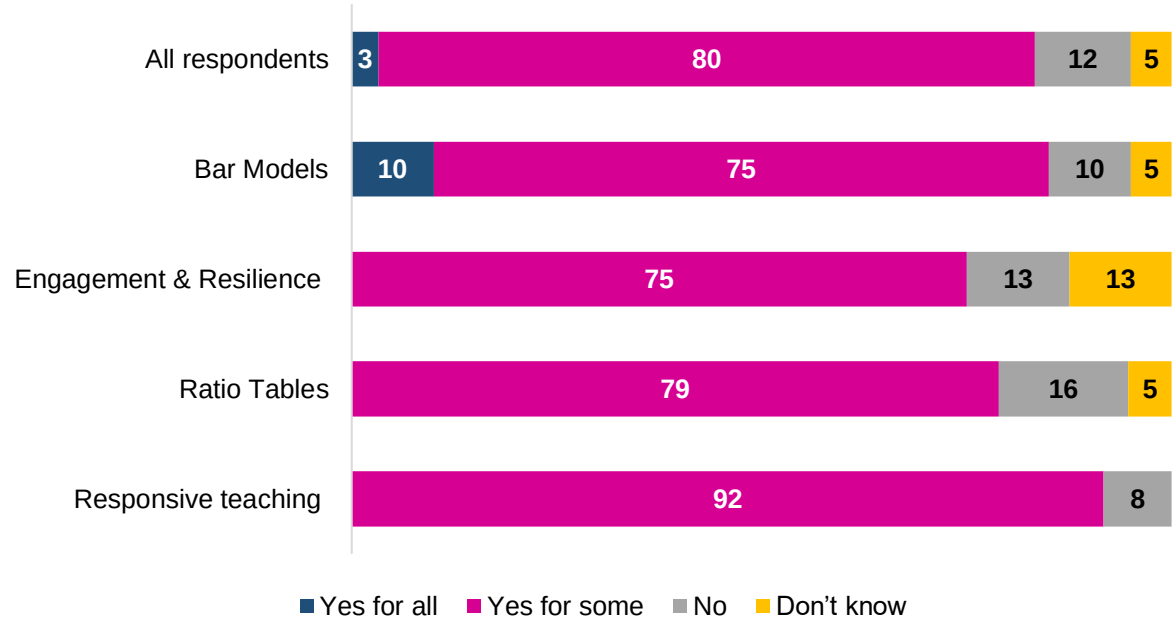
Table 4.4: Did the intervention help improve the maths capabilities of disengaged learners, by teacher experience of CfEM

	All Respondents	Respondents who took part in other aspects of the CFEM programme	Respondents who did not take part in other aspects of the CFEM programme
Yes, for all	2%	-	4%
Yes, for some	68%	67%	70%
No	22%	25%	17%
Don't know	8%	8%	9%

Base: Took part in previous CfEM programmes:36; Did not take part in previous CfEM programmes: 23

Of the 60 respondents, 83% felt the intervention they delivered helped improve the **confidence** in maths of all or some disengaged learners, and this proportion was highest amongst those teaching the Responsive Teaching intervention (92%, albeit on a low base size), as shown in Figure 4.2. No notable difference was found for teachers who had or had not previously taken part in CfEM programmes.

Figure 4.2: Did the intervention help improve the confidence of disengaged learners? %



Base: Bar Models: 20; Engagement & Resilience: 8; Ratio Tables: 19; Responsive Teaching:12

Of 46 respondents who provided additional comments and specified whether or not the intervention improved the confidence and capabilities of their more disengaged learners, there was an equal number (21) of those who think the intervention did improve the confidence and capabilities and those who think the opposite.

Amongst respondents who felt the intervention does improve the confidence and capabilities, these are the most frequently raised reasons:

- **Intervention content** (six) for example, the Bar Models intervention, provided examples and a tool for learners to discuss their understanding. In Responsive Teaching, the deconstructed exam questions were noted as helpful.

- **Different method** (five) and particularly the ability to choose between the methods was recognised as useful for learners in the Bar Models and Ratio Tables interventions.

- **More specialist approach** (four) in Engagement & Resilience and Responsive Teaching, including empathy, verbalising issues, providing feedback and focusing on peer-to-peer discussions.

- **Better accessibility** (three), specifically in the Bar Models group, using visual content and bar models in general was perceived to have allowed access to more complex issues, and encourages engagement between learners.

''Students were engaged and enjoyed the six learning sessions, some students mentioned that using bar models helped them to answer fraction and ratio problems. They were happy to have a second chance to work on questions that they missed on their first attempt of the assessment paper''. – Teacher, Bar Models

Additional comments note learners' stronger recognition of common mistakes (Responsive Teaching).

Respondents who say that the intervention did not improve the confidence and capabilities, most commonly mention the following reasons:

- **Some disengaged students have developed challenging attitudes** and are unwilling to try different methods (nine). This was most frequently stated for Ratio Tables, followed by Bar Models and Responsive Teaching.

- **Intervention content** (seven) was too advanced, or its format became tiring after a few weeks, which was referenced for Bar Models, Ratio Tables and Responsive Teaching in equal number, with only one comment on Engagement and Resilience.

- **Time allocated for tasks** (four) with the main point being that six weeks is too short to generate an impact for disengaged learners, which was noted for Engagement and Resilience and Ratio Tables.

> *''The level of challenge changed dramatically between fairly simplistic and very challenging so many students felt like they were progressing only to then feel like they didn't understand the concept anymore which was a blow to their confidence. The timing of the intervention also meant that most students were already at a low-ebb in their engagement following the Nov exam".* – Teacher, Ratio Tables

Additional comment refers to lack of teaching support to deliver the intervention.

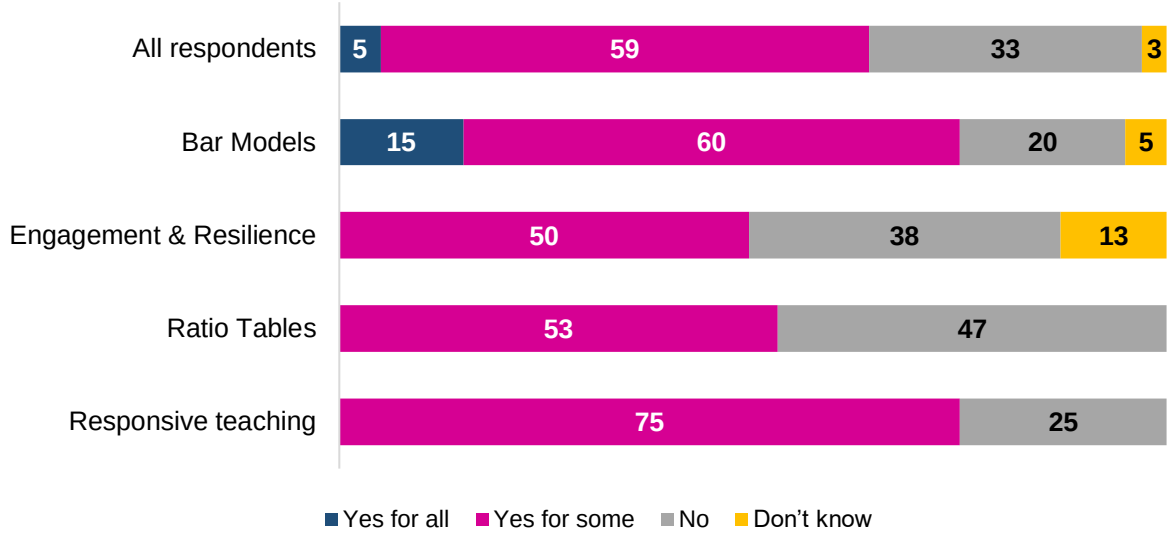
Learner impact -all learners

The survey also explored impact on all learners, not just disengaged learners,

A majority of respondents (64%) felt that the intervention helped improve the **maths capabilities** for at least some of their maths resit learners in general. This is lower than the 70% of teachers who reported an improvement in maths capabilities for all or some of their *disengaged* learners (Figure 4.3).

There are no notable differences by whether or not the teacher had previously take part in CfEM activities.

Figure 4.3: Did the intervention help improve the maths capabilities of ALL learners, by intervention group, %



Base: Bar Models: 20; Engagement & Resilience: 8; Ratio Tables: 19; Responsive Teaching:12

Teachers were asked to elaborate on the impact on all learners. Most commonly, teachers reported challenges including learners' lack of enthusiasm, low attendance, the intervention being difficult for some learners, e.g., those already lacking enthusiasm, confidence, or learners on the autism spectrum and the approach needing to be more structured:

It needed to be introduced in a more scaffolded approach with manipulatives and not just drawings, but I stuck to the script. Some were left feeling inadequate as they struggled to understand. - Teacher, Bar Models

Seven respondents noted that learners preferred using their own methods or methods that have been tried and tested, which was most commonly noted for teachers on the Ratio Tables intervention.

Six comment on level of stretch for learners and state that it was appropriate for some students, and for others it was challenging. Five mention, mainly for Ratio Tables, that the intervention worked better for students with higher existing maths enthusiasm.

Five comment on the content, giving a mix of views, including the content not being engaging enough, particularly for those learners who are already familiar with the topic of the intervention, or the content. However, most of these commenting on the content state that they were able to interest learners in the content, e.g. by adjusting it to their level of knowledge or confidence.

The theory was useful for all, the implementation would need to be more carefully thought through as by the end of the intervention, only the most motivated and able were capable of coping with the level of challenge. – Teacher, Ratio Tables

Further comments relate to timing of the intervention or noting that it would work better in smaller groups.

A final open question asked teachers about the impact of the intervention generally on learners. Of 35 respondents to this question, 17 again identified challenges they experienced in the pilot, notably around timing, various disruptions including low attendance,

sick leave, and rail strikes. Additional issues referenced were learners' frustration with the intervention, approach, difficult questions, and some intervention activities not being environmentally friendly.

It felt rushed with the result that some students weren't in college for the final session. Week 5 was overall the one which had the most impact even on those who were quite confident already. – Teacher, Bar Models

More positively, teachers pointed to aspects of the interventions which worked well, such as having method options, appropriate resources, support for teachers and good learning methodology and content.

Teacher impact

A number of questions were asked regarding impact on teachers' skills and confidence, reported in Table 4.5. The table shows that for 72% of respondents, taking part in the intervention has increased their **skills as a maths teacher** to some extent but a quarter (25%) report no increase. Just over half of respondents (53%) believe that the intervention has increased their **confidence as a maths teacher** a little or a lot.

Almost two in three respondents (65%) felt that the intervention has increased their **skills in engaging maths resit learners** a little or a lot. Almost three in ten (28%) report the intervention had not increased these skills and 7% reported there was no need to improve skills in engaging maths resit learners. Around the same proportion (62%) felt that the intervention has increased their **confidence in engaging maths resit learners.**

Table 4.5: Teacher improvement in teaching skills and confidence through the intervention

	Yes – a lot	Yes – a little	Not at all	Didn't need to improve my skills/confidence
Increase skills as a maths teacher	18%	53%	25%	3%
Increase confidence as a maths teacher	15%	38%	27%	20%
Increase skills in engaging maths resit learners	10%	55%	28%	7%
Increase confidence in engaging maths resit learners	10%	52%	30%	8%

Base: All respondents: 60; Took part in previous CfEM programmes:36; Did not take part in previous CfEM programmes: 23

Teacher rating of intervention overall

All respondents were asked to **rate the intervention overall** and this was on average 6.5 on a scale of 1 to 10, as shown in Table 4.6. Those who were teaching Bar Models rated the intervention the highest (7.5), and teachers of Engagement and Resilience (5.5) the lowest, although this is a smaller base. Respondents who had engaged with other parts of the CfEM programme gave a very slightly higher rating (6.7) than those who had not (6.3).

Table 4.6: Teachers rating of the intervention they participated in, using a 1 to 10 scale

	Average
All respondents	6.5
Bar Models	7.5
Engagement and Resilience	5.5
Ratio Tables	5.9
Responsive Teaching	6.5

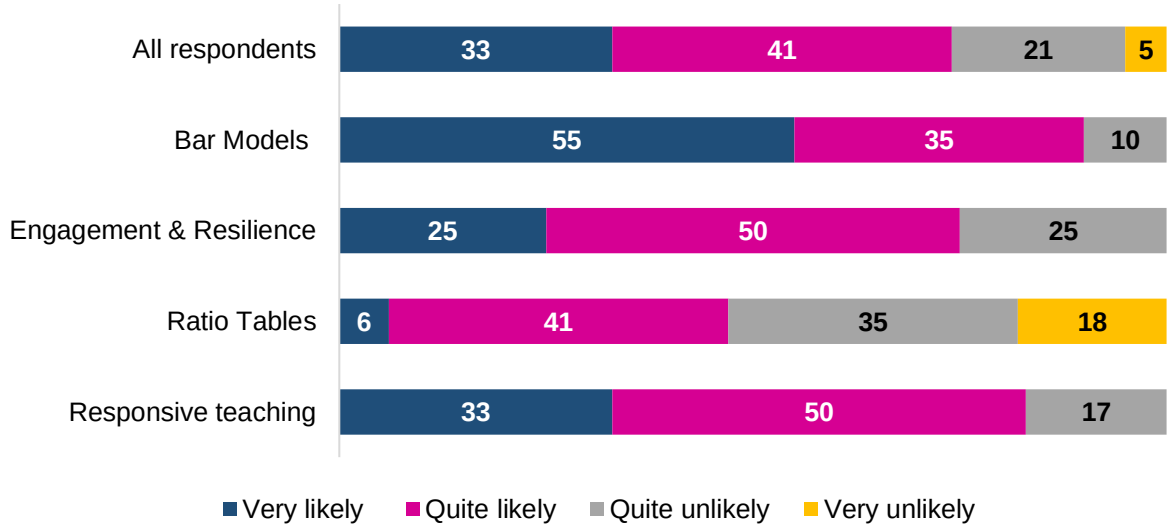
Base: Bar Models: 20; Engagement & Resilience: 8; Ratio Tables: 19; Responsive Teaching:12

Teacher advocacy

To further assess teacher perspective of the interventions, the survey explored whether teachers would use the materials or techniques again or recommend them to others.

A large majority of teacher respondents (74%) are **likely to use** these intervention materials or techniques in teaching maths in the future (Figure 4.4). This was most notable amongst those teaching Bar Models. Around a quarter (26%) said they are unlikely to do so, particularly for Ratio Tables (53%).

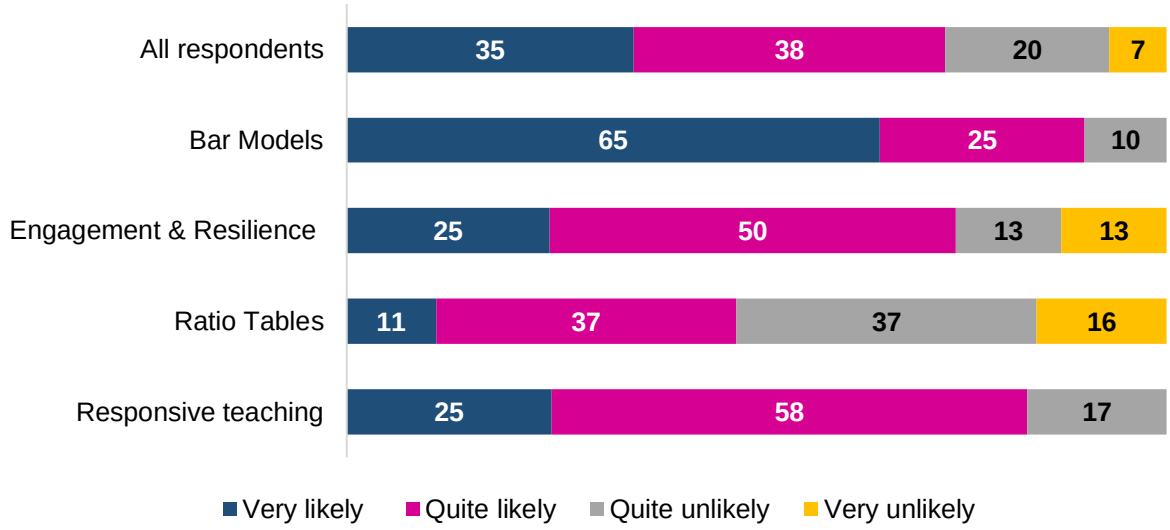
Figure 4.4: Likelihood of using these intervention techniques or material in the future, by intervention group, %



Base: Bar Models: 20; Engagement & Resilience: 8; Ratio Tables: 19; Responsive Teaching:12

This was further supported by roughly the same proportion (73%) saying they would likely **recommend** the intervention materials or techniques to other maths teachers, a measure of advocacy. By way of contrast, 90% of those who delivered the Bar Models intervention would recommend the intervention to others, compared to 48% of those who delivered the Ratio Tables intervention (Figure 4.5).

Figure 4.5: Likelihood of recommending these intervention techniques or material in the future, by intervention group, %



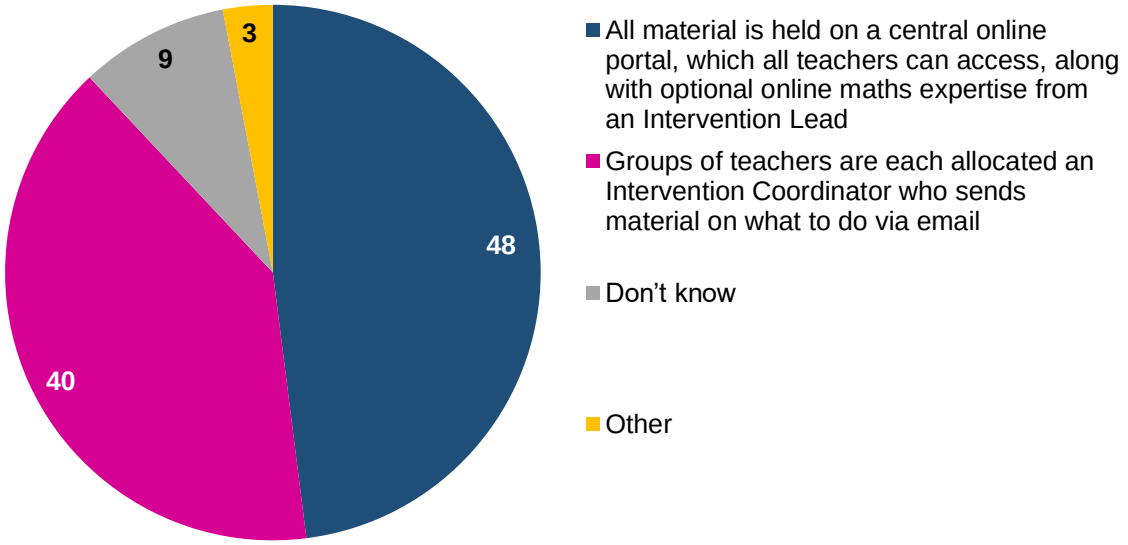
Base: Bar Models: 20; Engagement & Resilience: 8; Ratio Tables: 19; Responsive Teaching:12

4.4 Teacher views on wider roll out

The survey specifically explored the means of communications used in the study. The role of an Intervention Coordinator is new for this study, so this was of particular interest to ETF.

Looking forward to a potential national roll out and how communication between parties should be managed, a large minority of teacher respondents (48%) recommended that all material is available to all teachers on a central online portal, with optional online maths expertise from an Intervention Lead. Other methods suggested by two teacher respondents are having short videos or brief plans and an overview of work, as well as communicating by college rather than by groups of college, to ensure control and easier implementation.

Figure 4.6: Potential way forward for sharing information, in %



Base: 60

Teachers were also asked to provide views on a potential national roll-out.

Reflecting the positive results in the survey, some commented positively on a future roll-out, for example:

I think this intervention would be good to roll out again and would be keen to once again take part - Teacher, Engagement & Resilience

But for many who commented, there was usually a suggested improvement, for example:

I think it can be introduced on a national scale. It could be helpful, but it needs to be presented at the early stages of learning, with a piece-meal approach that helps learners to perceive it as another helpful tool. This would stir interest and engagement, that can eliminate students' perception of its being burdensome. – Teacher, Ratio Tables

Of the 30 who responded to this question, five identify attendance as critical to success but that attendance was hampered during the intervention, either because low attendance is fairly typical, or due to external factors such as rail and college labour disputes.

The intervention is massively influenced by attendance, the attendance is such a big challenge for these types of learners - Teacher, Responsive Teaching

Four recommended allowing more time for the intervention, i.e. more than six weeks, and more time for communication regarding deadlines and courier collection.

It is very difficult to do any research like this when we are so restricted for time to teach just the basic skills for their GCSE - Teacher, Ratio Tables

Three note it would work better if the interventions are delivered at different time of year, for example at the start of the college year in September, or in January following resit exams results publishing. An additional three (10%) suggest changes to the content, mostly for Ratio Tables, e.g. more connection between different themes to ensure *better flow* of the content and providing more examples to improve learners' understanding.

Further comments were raised around further teaching support, clearer instructions for teachers and smaller class sizes.

This section goes on to detail views on wider roll-out obtained through the surveys and focus groups and considers key issues of time, communication, teaching and interventions.

Timings

A major point raised is time:

- Time for the intervention, i.e., more than six weeks, and more time for communication regarding deadlines and courier collection, particularly if the interventions could be delivered at a different time of year, for example at the start of school year in September, or in January following resit exams results publishing. The choice of this term (October to December) was seen as a difficult term to launch this, although it was acknowledged every term has its challenges.
- There was a chance that some teachers had to relearn their approach to teaching maths and the timings for that were regarded as being too short.

on the Responsive Teaching… I felt it was a bit rushed. I'm not 100% sure that [the intervention was] shown in the best possible light.

- Practical issues: working part-time is an issue to be able to respond to immediacy of requests for action
- Getting information on a Friday afternoon for use on Monday morning.
- Different teachers started at different times

Communication

- This seems to work if everyone knows each other and are on the same site, face to face communication is much easier than by email.
- Difference between this evaluation and earlier Action Research projects undertaken by CfEM– this method came as a surprise as it seemed less instructional and there was less interaction.
- Challenges of working remotely and not being part of a team and this was made worse with teacher absences and illness.
- Emails were informational, but there was a need for instant messages so they have to be cut down to 2 lines for teachers
- Teachers don't always have access to Padlet (more use SharePoint or Teams) this had to be done by an IC.
- Limited access to a photocopier was a barrier to making things happen more smoothly

Structure/Approach

- Due to the difficulties mentioned above, an IC felt one IC per college would have been more productive.
- Fewer learners in the wider roll-out may be beneficial because of the administration requirements.
- The timing was such that it was difficult to do both the maths assessment and survey and the assessment alone should have been sufficient.

Teaching

- There was some uncertainty about the teaching and how to approach these intervention methods. This seems to be borne out with the lower ratings as scored by teachers with regard to their understanding of the theory and method (see Table 4.2).
- ICs understood that for this to be as robust a study as possible, there needed to be uniformity in the teaching, but this did constrain them in the classroom on occasion.
- This might be aided if the designers of the approach and material could have more involvement in the training to then be able to have a more uniform approach via face-to-face meetings.
- Future scaling up would need more training and professional development to engage teachers and most effectively implement the intervention .

Interventions

- Comments in support of this suggested that the Bar Models intervention was pitched toward key marginals whereas Ratio Tables was pitched better. Grade 3s are less willing to try something new as they felt they already know what they're doing. Others pointed out that bar models been around for years but are still new to some teachers.

- With Responsive Teaching it allows time to talk to students which always raises confidence, it was notable that learners got better at explaining their answers. IC/Teachers indicated that students took it on board as they liked the idea of doing project and getting involved. But to be effective it needs to be repeated, that 6 weeks is too short.

Other suggestions included further teaching support, clearer instructions for teachers, and smaller class sizes.

4.5 Conclusions

Overall, teacher perspectives on the programme are positive, as demonstrated by the two-thirds (64%) who reported an increase in maths capability amongst their learners and their likelihood to use the materials again (73%).

Teachers also reported an increase in their own teaching skills or confidence during the intervention, which suggests a longer term positive impact of the intervention.

Inevitably, a number of improvements were advanced by teachers in the open questions in the survey and by Intervention Coordinators in the focus groups, revolving around time and resources; content and structure and the administration and communications involved in such trials.

These findings, together with the learner impact reported in Chapter 3, are now drawn together in the concluding chapters.

5. Conclusions

5.1 Introduction

This chapter draws together the evidence presented in the report to address the key research questions of the study and evaluation.

Critically the scale-up study explores whether to conduct a wider, national roll-out of the interventions trialled within CfEM. The key questions to address are whether the interventions improved the maths capabilities and confidence of learners; the impact on teachers and their perceptions of the interventions; what aspects of delivery were successful and why and what aspects worked less well and why. We will consider the evidence relating to these questions and present recommendations on if, and how, any national roll out should be implemented.

5.2 Did learners improve their maths capabilities?

The 1,202 matched maths assessments show that learners did improve their score between pre-intervention to post-intervention from 11.2 to 12.5 out of 29 possible marks. Given the evaluation methodology, it is not possible to say whether this change might be likely over any 4-week teaching period and therefore to isolate the impact of the intervention.

However, to support this positive result, the evaluation also finds that:

- In the maths assessment, there were 299 fewer instances of all learners not answering a question in Week 6 compared to Week 1, thus indicating an improved willingness to answer questions at the end of the intervention.
- In the attitudinal questionnaire, there was a small, but statistically significant, increase in learner self-assessment of their ability to draw bar models (from 5.7 to 6.0 on a scale of 1 to 10) and their ability to draw ratio tables (from 4.7 to 5.5).
- 68% of learners who completed the attitudinal questionnaire reported that they had found the last 4 weeks of maths classes a bit or much better than before, with 29% reporting no change.
- 70% of the 60 teachers who completed the teacher survey reported that they believed the intervention had helped improve the maths capabilities of at least some disengaged maths resit learners.

These results point to some, if limited, improvement in maths capabilities in just 4 weeks. The conditions in which they are more likely to arise is considered in later questions.

5.3 Did learners improve their maths confidence?

The attitudinal questionnaire was included in the evaluation to ensure a broader impact assessment than maths capabilities, including assessing learner confidence in maths.

Overall, there were small, but statistically significant increases among learners for all confidence measures. Confidence was at a higher starting point regarding being in a maths classroom and asking for help. The change in scores is highest for confidence in the maths assessment they had just completed (an increase in 0.5 on the 1 to 10 scale) and confidence in doing an assessment (0.4), a vital consideration for learners resitting exams.

The interventions had a small impact on how happy learners were to be studying maths again. These learners are often disengaged and have previously failed or, for some reason,

not sat a maths exam. Happiness to be doing maths again increased from 4.6 to 4.8 – a small change which suggests the difficulty in changing the crucial attitude to maths in such a short period (a point made by teachers).

5.4 Did these learner impacts differ by intervention?

The scale up study was designed to enable comparison across the four interventions. Although the target number of teachers and learners were not achieved, it is still possible to draw out differences between the interventions based on the matched assessments and questionnaires. However, the data do not all definitively point to one intervention being more effective than another, as illustrated below:

- Learners on the Engagement & Resilience intervention achieved the highest improvement in the maths assessment, raising their marks from 10.52 to 12.99 out of 29, or an increase of 2.5. This is followed by Ratio Tables (1.6 increase) and Bar Models (1.5 increase). Learners on Responsive Teaching intervention had the lowest increase in marks, rising from 11.7 to 12.5 out of 29, or 0.8.

- Learners on the Engagement & Resilience intervention achieved the greatest improvement in willingness to answer questions, while learners on the Ratio Tables intervention reported the lowest.

- Learners on Bar Models and Engagement & Resilience reported higher levels of increases in confidence across each of the 8 measures in the attitudinal survey. These learners also reported increased in happiness to be taking maths again – increases of 0.5 for both, on the 1 to 10 scale

- Also, in the attitudinal questionnaire, 71% of learners on the Bar Models intervention reported that their maths classes had been better in the last 4 weeks compared to previously, compared to an average of 68%. Learners on Engagement & Resilience were least likely to report this improvement (63%), despite recording the highest improvements in the assessments.

The sample sizes for the individual interventions are small in the teacher questionnaire and therefore do not allow a conclusive analysis.

5.5 Did teachers improve their skills?

A key objective for CfEM was to ensure the enhancement of teaching skills across the FE sector. Encouragingly, almost three-quarters of respondents to the teacher survey reported that the intervention has increased their skills as a maths teacher. Those who have not previously participated in a CfEM programme, are more likely to report that they did not need to improve their skills (9%) whereas no teacher with CfEM experience reported they did not need to improve their skills.

Slightly fewer reported that their skills in engaging maths resit learners has increased, though is still a high proportion at 65%.

These are arguably positive results, likely to have a longer-term impact, for a relatively short intervention.

5.6 What worked well?

As a result of the evaluation the scale-up study has demonstrated improvements in maths capability and confidence amongst maths GCSE resit learners, with small variations between the interventions themselves.

Feedback from teachers through the questionnaire and from Intervention Coordinators in the focus groups allowed us to explore what worked well regarding the interventions and evalautin method to identify some best practice to build on.

Intervention Coordinators found it easier to work with teachers on same site as themselves, which allowed for easier communications and 'check-ins'.

Some of the interventions were reported to work well, as demonstrated by intention of teachers to use again and their advocacy for the interventions, but not necessarily in these pilot, test conditions, where the implementation was rushed.

Engagement & Resilience is reported as least similar to how teachers have taught before but achieved highest levels of assessment improvement and improvements in confidence, suggesting some value in this approach.

5.7 What worked less well?

Attendance

The main contextual factor which impacted on the study was teacher and learner absence. The usual causes of absence, such as learners not attending, illness, were accounted for in the original design of the study. However, transport strikes prevented learners and teachers from attending colleges as did some college staff strikes, which were not accounted for in design. This may also have impacted on attendance for some or all the intervention sessions, with unknown impacts on results.

Teaching material

On a scale of 1 to 10, teachers rated learner engagement with the teaching material at 6.2, implying quite low engagement and there were also negative comments regarding the teaching materials or design. However, these did not tend to be consistent, e.g., material was varying too advanced or too easy, and there were not clear patterns by intervention nor learner ability. This may imply the need to allow teachers to be flexible in the use of the materials according to their learners' needs, which would happen outside an experimental evaluation setting.

Ability to engage disengaged learners

Although 80% of teachers reported that the intervention had helped improve the confidence in maths of disengaged learners, some of the teachers who provided additional comment reported that learners have already developed challenging attitudes to maths which are difficult to overcome.

Factors identified by teachers which were associated with increased confidence included the *content* of the intervention (e.g., Bar Model intervention provided a tool for learners to discuss their understanding and the deconstructed exam questions in the Responsive Teaching model were thought to be useful); the *different method*s available within the Bar Model and Ratio Tables interventions, and the more *specialised approaches* including empathy, verbalising issues and providing feedback through peer-to-peer discussion as techniques in the Engagement & Resilience and Responsive Teaching interventions.

Intervention timing

Attendees at Focus Groups made a number of comments regarding the timing of the intervention. It was felt to be rushed – both in the time allowed for the delivery of the intervention but the design of the study as a whole. Some intervention coordinators reported a lack of time to deliver the type of intervention. For example, on Responsive Teaching, there was a considerable amount of work required between lessons.

Additionally, the timeslot allocated to the study – between November resits and Christmas – was felt to be unhelpful. At the start of the year or in January, following the publication of November resit results, would have been preferred by (some) teachers though learner enrolments continuing to October and November resit preparation and cohort changes as well as the March reporting deadline made this unfeasible

Training

On the whole, teachers felt prepared for the intervention. They reported being less prepared when it came to the specific intervention methods and the underpinning theory behind the teaching method. The online training was tailored for each of the interventions but tended to focus on the practical aspects of the study as opposed to discussing the theory and method.

Some attendees of the Focus Groups commented that they did not feel there was enough opportunity to discuss the specifics of the intervention – that the training was very 'one-way' and there was no opportunity thereafter to discuss the specifics of the method. However, respondents also recognised that there was a need for all the information received by all teachers across the interventions needed to be the same, to control for communication and training differences within the scale-up study. It is perhaps the case that the need to control for these factors meant that some teachers did not receive as much guidance on the theory and method of the intervention as they might have liked or found beneficial. Overall, it does suggest that the training and development provided was perhaps insufficient.

Some of the Intervention Coordinators reported familiarity with the basic tools and techniques but noted that training had been insufficient for newer teachers, and they needed more support. Due to the limited sample size, we are unable to provide analysis for teachers who have been teaching less than 3 years.

5.8 Should these interventions be rolled out nationally on a wider trial basis?

The answer to this question very much depends on being able to implement improvements in the implementation of the study and the coordination of evaluation activities, and on what is being piloted.

What to roll out?

With regards to what is being piloted, one of the drawbacks has been the need to implement all the interventions within the available timeframe, at the same time. Although suitability for this mode of delivery was a criterion for selection of the intervention, there does seem to have been standout differences between the interventions which made some more and some less suitable for the time and the timing allowed.

- For example, Engagement & Resilience achieved higher impact on learner marks and improved confidence, but the limited evidence in the teacher survey (based on 8 respondents) suggested this intervention presented difficulties for teachers in the learning method, perhaps because it was a less similar and more novel approach. It may be that a wider roll out of this requires more training for teachers and time for delivery.

- The Bar Models intervention was the most familiar and most popular with teachers but yielded the third highest increase in scores. Some teachers reported this was pitched at 'key marginals' and may have less impact on better performing learners.
- Ratio Tables were thought to work better for Grade 3 learners, and indeed it delivered the second highest increase in marks. But it did not deliver increase in confidence and teachers responding to the questionnaire had low levels of familiarity with the method and rated it poorly.
- Responsive Teaching intervention was reported to be rushed, needing time outside the lessons to review and prepare a greater than usual amount of material.

What this suggests is that there are positive results to emerge from this study, but that careful planning and design overall, and more opportunity for tailoring delivery according to the design of the specific intervention ought to be allowed than was possible in this study.

From an evaluation perspective, this suggests a need for a different mode of testing, which might be more suited to use of control groups across colleges matched on the basis of known characteristics. For example, to roll out any of the interventions in one college and compare and contrast results with learners in a matched college which did not implement the intervention. While this raises considerable ethical considerations, it would allow for better planning of implementation and more rigorous results.

How to roll out?

As discussed above the timing for any further roll out should be carefully considered and be designed to fit the specific design of the intervention and typical FE maths academic year.

Whilst it is seemingly very difficult to select a good time in the academic year for an intervention, whatever time is selected needs to be within a project timescale which is not constrained by financial years. A key lesson from this study is the time needed to plan, organise, train, administer and evaluate is considerable, squeezing the time available for the intervention itself. Any wider pilot should allow for this. This could mean enhancing the resource available in planning, organising and managing as well as the time for teachers to prepare delivery and complete administrative tasks.

As discussed above teachers also need the opportunity for more training.

The value of the intervention coordinator role was generally recognised but posed some challenges in the administration of the study. Seemingly no party was resourced for the organisation needed to deal with the administration of assessments and examiners – an integral part of the study. Intervention coordinators should perhaps be given this role too, but perhaps in that scenario intervention coordinators would be needed at each college site or group. In general, wider testing will require significant resource to administer.

Awaiting the delivery and reporting on further testing should not delay the dissemination of the materials and techniques used in these interventions as all are found to have some degree of success with disengaged learners. If further testing requires more time and resource, this risks missing out on one or two cohorts of learners who may benefit from a wider dissemination of these techniques, with accompanying teacher CPD.

6. Recommendations

A consistent theme of the evaluation is the potential value of all the interventions, depending on the metric considered, but that the study itself potentially diminished the value of the intervention due to the 'test' conditions. Our recommendations seek to take these factors into account.

6.1 Recommendation: Bespoke Randomised Control Trials (RCT) for each intervention

We suggest there is value in conducting further testing of the each of the interventions, but to allow more time for each (not necessarily the same amount of time, but a suitable amount of time based on the content of the intervention) and to manage them separately. This would include the following:

- An RCT for each intervention conducted across colleges which have been matched on criteria such as maths progress; Free School Meal intake; Ofsted rating and other relevant indicators.
- We would suggest 6 colleges per intervention (6 colleges running the intervention and 6 matched colleges not running the intervention, totalling 48 colleges (for 4 interventions). Colleges should be given flexibility of selecting which classes or which teachers would be included within the RCT, based on the intervention. Some over-recruitment is likely to be needed to allow for any drop-out of teachers or colleges over the summer period.
- Start earlier by running the intervention from September and continue for the required duration of the intervention, though this should probably not be any longer than one term (to avoid the risk of continuing with an unsuccessful intervention and to ensure continued teacher buy-in to conducting the experiment).
- Whilst not all learners will have enrolled in September, only those who have started in September will be included in the RCT, other will simply join in the same lessons, but without being tested. Whilst late enrolments do cause some disruptions to classes, this would appear to be the least worst start date for any future trial.
- Consider use of the summer results and November resit results as the assessment tests, negating the need for additional testing for learners and reducing the burden for teachers and administrators of the trial.
- Intervention should be planned more in advance with recruitment and training taking place in the summer term and materials ready for first lesson of the new term.
- Colleges and teachers should be 'kept warm' over the summer holidays with occasional encouraging and engaging reminders, to mitigate against drop-out.
- Design of the intervention must take into account the longer time frame allowed and should be consistent with the sequencing of teaching. This will require more extensive planning.
- Support should be available to teachers via regular updates and debrief – but ensuring all teachers receive the same information throughout the trial period.
- Attitudinal questionnaires could still be administered

- Intervention coordinators for each college site to: ensure all teachers are properly trained and fully aware of any additional briefing and support; administer teaching materials; regularly 'check-in' with all teachers; administer maths assessments and questionnaires.
- Teachers should be given support to conduct all necessary administrative activities associated with the trial, including maintaining attendance records.

6.2 Recommendation: Ensure resource availability by prioritising if necessary.

A risk of the above recommendation is that resources are not available to properly manage or implement the intervention. In which case we would recommend prioritising the Engagement & Resilience intervention first, and Bar Models second, as these recorded high impacts on maths scores and highest improvements in attitudinal scores (which could lead to longer-term improvements in maths performance).

6.3 Recommendation: Roll out materials immediately

Whilst Randomised Control Trials represent the 'gold standard' of policy testing, they do require considerable resource, planning and training, as reflected in the recommendations above. They are also inflexible, requiring interventions to be delivered in the same way to accurately test differences. Whilst teachers were committed to the test conditions within this study, the Focus Groups suggested they would find it difficult to maintain this commitment for a longer period of time, because teachers require more flexibility than an RCT would allow to deal with the specific challenges of teaching maths resit learners.

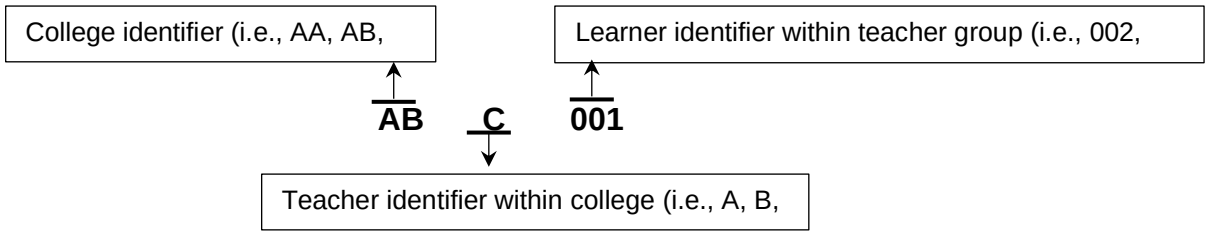
Therefore alongside RCTs, or as an alternative, we suggest the materials are reviewed by designers in light of the evidence arising from this evaluation, perhaps in a conference or similar, and made available to FE maths teachers as soon as possible.The material should be accompanied by CPD for teachers and regular opportunities to check and clarify with designers and experts. There should be a proportionate evaluation of the roll-out, to ensure the materials are effective and the method is helping to improve maths engagement and achievement amongst learners in FE colleges. This evaluation would be less rigorous than an RCT and the implementation would be, correspondingly, more flexible, enabling teachers to adapt according to their learners' needs.

Appendix 1: Colleges from which matched data were received

Intervention	Institute	Assessments matched	Questionnaires matched
Bar models	Croydon college	18	44
Bar models	Fareham College	28	41
Bar models	Hereford Ludlow & N Shropshire College	28	0
Bar models	John Ruskin College	10	0
Bar Models	Leicester College	18	27
Bar Models	Newham College	8	11
Bar models	Shooters Hill Sixth Form College	2	0
Bar models	Southampton City College	17	40
Bar models	Sparsholt College	15	0
Bar models	St Vincent College	6	11
Bar models	WCG – Warwickshire College	19	0
Bar Models	West London College	41	23
Engagement and resilience	Bedford College	1	15
Engagement and resilience	College of West Anglia	45	0
Engagement and resilience	CRC – Cambridge Regional College	27	36
Engagement and resilience	Furness College	20	0
Engagement and resilience	GBMC – Brighton Metropolitan College	5	23
Engagement and resilience	Grantham College	44	45
Engagement and resilience	Grimsby College	0	37
Engagement and resilience	Writtle College	23	24
Ratio tables	Barnet and Southgate College	3	4
Ratio tables	Blackburn College	21	0
Ratio tables	Bridgwater and Taunton College	32	42
Ratio tables	Harlow College	30	36
Ratio tables	Heart of Worcestershire College	13	28
Ratio tables	Leeds City College	46	74
Ratio tables	New College Swindon College	28	32
Ratio tables	Runshaw College	9	11
Ratio tables	St Francis Xavier's College	35	48
Ratio tables	Uxbridge College	8	0
Ratio tables	West Thames College	11	12
Responsive teaching	Dudley College	13	31
Responsive teaching	EKC (East Kent College) Group	10	0
Responsive teaching	Franklin College	69	88
Responsive teaching	Gateshead College	33	67
Responsive teaching	Manchester College	1	0
Responsive teaching	Newcastle and Stafford Colleges Group	14	108
Responsive teaching	Reaseheath College	9	45
Responsive teaching	Sunderland College	16	19
Responsive teaching	Tameside College	35	102
Responsive teaching	Tyne Coast College	21	28
Responsive teaching	Wilberforce College	33	50

Appendix 2: Learner tracking and matching

In order to track individual learner submissions from week one to week six in each college, learners were given unique identifying codes to input on their assessments and questionnaires. These followed the format of ABC001, ABC002 etc, which indicates:



Codes were allocated to teachers from AAA to CFA. The teachers then allocated these codes to their learners with incrementally larger numbers, such that each learner had a unique three-letter, three-number coding.

The learners were asked to add their unique identifier to their submissions on the questionnaires and maths assessments, along with their first and last name. Their names were utilised only as a verification of matched data and were kept anonymous and not offered as part of the analysis or outputs. The matching of the data was a highly complex process due to a number of factors and lessons for the future are to consider:

i. Inputting the college identifier incorrectly – often due to autocorrect functions on mobile devices (i.e., BYA changed to BYE), missing one of the three letters, inputting a code that does not align to any college, or inputting a code that aligns to a different college that learners did not attend.

ii. Inputting individual numbers incorrectly – a common mistake was to miss the last digit of the number, input the number of another learner or input a number that was not assigned to any student.

iii. Inputting their name incorrectly –names were utilised purely for verifying codes in cases where codes were not correct. Sometimes learners spelled their names wrongly, inputted fake names, left off their surname, used nicknames, or were not consistent in their chosen name for their first and last papers and questionnaires.

iv. Responding to the questionnaire more than once either for the pre- and post-intervention content.

The questionnaire and maths assessment data were matched using duplication functions within Microsoft Excel. These were then manually cleaned via multiple passes, ensuring codes matched teacher provided codes, names were inputted correctly, and matched codes were for the same learners across week one and week six content.

Assessment and questionnaire discrepancies

The discrepancies between the number of assessments and questionnaires received in each week can be partially attributed to the fact the assessments were issued as paper print-out copies, whilst the questionnaires were specifically designed to be completed on learner mobile phones as requested by ETF. Teachers pointed out they are very familiar with the process of setting paper-based work, whilst being able to guarantee each learner has completed the assessment, however the learner questionnaire will have been harder to monitor, particularly in scenarios where learners may claim they have submitted a response.

Additionally, MS Forms does not save partially completed submissions, so in the event of a learner forgetting to press the submit button, this will not have been retained or submitted.

The retention of learners from week one to week six is approximately 50%. Interventions were not allocated on any known factors of colleges, but on college choice - therefore there may be unobserved differences between colleges which may impact on results and make a comparison between interventions problematic. Other factors came into play.

1. **November resits** – some teachers were unable to take part in the initial week one due to the November resits. And, some teachers were unable to complete the full six weeks of the intervention on time.
2. **Illnesses** or **teacher drop-out** – as anticipated several teachers fell ill which had consequences for couriers, and final week completions.
3. **Communication with teachers** – the only form of communication with teachers was via intervention coordinators, some coordinators themselves became ill, or worked only part time thus not being able to respond to emails as regularly as full time colleagues. This also had implications on collections of papers by couriers resulting in a number of failed collections.
4. **Disruption leading up to and beyond Christmas:** these included Union strikes, travel strikes, postal services leading to high demand for all courier services with a few occasions of couriers not turning up on the designated day due to sheer demand and overloaded services.
5. **Refusal from learners** – a few teachers reported that occasions of learners refusing to participate with the questionnaire or the assessment; particularly for week six as it was so close to the week before Christmas.
6. **Matched codes** – Not all learners who participated in week six content have a matched set of data for their participation in week one. Overall, approximately 10% of the learner groups incorrectly inputted their individual identifying code (i.e., ABC001) or their name, and as such could not be compared to their previous data. In some cases, the codes were left blank. However, for all possible scenarios where only minor errors occurred, the learner codes were manually post-fixed to match their data. In some cases, the codes and names provided contained too many errors to be accurately coupled, and therefore had to be discarded from the data set.

Appendix 3: Assessment and Questionnaires

Maths Assessment was made up of ten questions are detailed below:

Question Number – learners to calculate/work out:	**Maximum marks that could be awarded – the more marks available 'the more complex the question'**
Q1 - a fraction of an integer	1 mark
Q2 - the distance a person walked, given the time and speed they travelled	2 marks
Q3 - whether the ratio between two fractions, in different formats, is the same.	3 marks
Q4 - the fraction of money one person received based on a ratio between three people	2 marks
Q5 - the cost of land built on given a total cost and fraction spent on the building itself.	3 marks
Q6 - the fraction of money awarded to one person based on uneven fractions, and then compare to the amount awarded if split equally between three.	4 marks
Q7- the amount of ingredients required for scones from ten to 25, returning the value for sugar.	2 marks
Q8 - which of two shops offered the cheapest set of batteries, given different pack sizes and costs	4 marks
Q9 - a ratio between three people to determine the difference in stickers between two of the people.	3 marks
Q10 - the number of cars using petrol given a ratio of cars to vans, a fraction of electric cars, and a percentage of diesel cars.	5 marks

*These assessments consisted of ten questions from – with permission - Edexcel GCSE mathematics past papers. A maximum of 29 marks were available.

The exact questions are as follows.

Question 1. [1 mark]

Work out $\frac{1}{6}$ of 66.

Question 2. [2 marks]

Ruth left her home at 9 am and walked to the library.
She got to the library at 10 30 am.
Ruth walked at a speed of 4 mph.

Work out the distance Ruth walked.

Question 3. [3 marks]

There are two drama groups in a school.
In one group there are 36 boys and 48 girls.
In the other group, $\frac{3}{7}$ of the students are boys and the rest of the students are girls.
Ann says,
"The ratio of the number of boys to the number of girls is the same for both groups."

Is Ann correct?

You must show how you get your answer.

Question 4. [2 marks]

Ali, Ben and Cathy share an amount of money in the ratio 6 : 9 : 10

What fraction of the money does Ben get?

Question 5. [3 marks]

A stadium cost £600 million.
$\frac{13}{15}$ of this cost was for the building.
The rest of the cost was for the land.

Work out the cost of the land.

Question 6. [4 marks]

Rachel, Samina and Tom share £600 between them.
Rachel gets $\frac{2}{5}$ of the £600 Samina gets $\frac{1}{4}$ of the money that is left over.
Tom gets the rest of the money.

Tom says,

"I would have got more money if we had shared the £600 equally between us."
Is Tom correct?

You must show how you get your answer.

Question 7. [two marks]

Here is a list of ingredients for making 10 scones.

Ingredients for 10 scones

75 g	butter
350 g	self-raising flour
40 g	sugar
150 ml	milk
2	eggs

Mia wants to make 25 scones.

Work out how much sugar she needs.

Question 8. [4 marks]

Here are the costs of the same type of batteries in two shops.

Shop **A**	Shop **B**
Pack of 4 batteries	Pack of 6 batteries
£1.60	£2.70

Harry needs to buy at least 30 batteries.
He assumes that he has to buy batteries in whole packs.
Harry wants to buy the batteries as cheaply as possible from the same shop.

Which shop should he buy the batteries from, shop A or shop B?

You must show all your working.

Question 9. [3 marks]

Rosie, Matilda and Ibrahim collect stickers.

number of stickers Rosie has	:	number of stickers Matilda has	:	number of stickers Ibrahim has	=	4 : 7 : 15

Ibrahim has 24 more stickers than Matilda.

Ibrahim has more stickers than Rosie.
How many more?

Question 10. [4 marks]

A delivery company has a total of 160 cars and vans.

The number of cars : the number of vans = 3 : 7

Each car and each van uses electricity or diesel or petrol.

$\frac{1}{8}$ of the cars use electricity.

25% of the cars use diesel.

The rest of the cars use petrol.

Work out the number of cars that use petrol.

You must show all your working.

Learner Attitudinal Questionnaire

Introduction

This short questionnaire asks you to reflect on your feelings about, and understanding of, Maths.

There are no right or wrong answers. This is about YOU and everyone is different. We just ask you to consider each question carefully before answering.

Your answers will be anonymised, so please be as open and honest as you can. Your feedback is REALLY important.

Firstly, please enter your unique reference, given to you by your teacher in the following format

3 letters (e.g. X, Y, Z) _ _ _

3 numbers (e.g. 7,8,9) _ _ _

About you

Firstly, we need to know a little bit about you.

1. Full name (open)
2. Age as of today: 16, 17, 18, 19 (tick one)
3. What grade did you get the last time you did a GCSE maths exam: 1, 2 or 3, Don't Know
4. And are you on a GCSE or Functional Skills programme?

Your feelings about Maths

We are now going to ask some questions about how you feel about Maths. For each of these questions please choose one number on a scale of 1 to 10, where 1 is "not at all" and 10 is "completely".

5 How happy are you to be doing maths again this year? Remember, 1 is "not at all happy" and 10 is "completely happy".

1	2	3	4	5	6	7	8	9	10

6 How confident do you feel walking into your maths classroom? Remember, 1 is "not at all confident" and 10 is "completely confident".

1	2	3	4	5	6	7	8	9	10

7 How confident do you feel being asked a maths question in front of the rest of your class? Remember, 1 is "not at all confident" and 10 is "completely confident".

1	2	3	4	5	6	7	8	9	10

8 How confident do you feel asking your maths teacher for help? Remember, 1 is "not at all confident" and 10 is "completely confident".

1	2	3	4	5	6	7	8	9	10

9 When a new topic is introduced in maths, how confident do you feel that you will understand it? Remember, 1 is “not at all confident” and 10 is “completely confident”.

1	2	3	4	5	6	7	8	9	10

10 When you were told you were doing a Maths assessment today, how confident did you feel about doing it? Remember, 1 is “not at all confident” and 10 is “completely confident”.

1	2	3	4	5	6	7	8	9	10

11 How confident are you that you got most of the answers right in the Maths assessment you have just done? Remember, 1 is “not at all confident” and 10 is “completely confident”.

1	2	3	4	5	6	7	8	9	10

Learning

With the following questions remember, there are no right or wrong answers here.

12 How well do you usually understand the maths you have been taught? Please answer this on a scale of 1-10 scale where 1 means you do not understand at all, and 10 means you completely understand what you have been taught.

1	2	3	4	5	6	7	8	9	10

Thinking back over the last 4 weeks, how much have you improved in each of the following? Please **answer on a scale of 1 to 10, where 1 is “no improvement” and 10 is “a lot of improvement”.**

13 Has your **belief** that you **can do** maths improved? Using the 1-10 scale, where 1 is ‘no improvement’ in your belief you can do maths over the last 4 weeks to where 10 is ‘a lot of improvement’ over the last 4 weeks.

1	2	3	4	5	6	7	8	9	10

14 **Drawing bar models,** using the same 1-10 scale, where 1 is ‘no improvement’ over the last 4 weeks in your ability to draw bar models and 10 is ‘a lot of improvement’ over the last 4 weeks in your ability to draw bar models

1	2	3	4	5	6	7	8	9	10

15 **Drawing ratio tables**, using the same 1-10 scale, where 1 is ‘no improvement’ over the last 4 weeks in your ability to draw ratio tables and 10 is ‘a lot of improvement’ over the last 4 weeks in your ability to draw ratio tables

1	2	3	4	5	6	7	8	9	10

POST QUESTIONNAIRE ONLY

16 Over the last 4 weeks, your teacher has been using a new way of teaching Maths. How have you found the last 4 weeks of Maths classes (please select one only):

- Much better than before
- A bit better than before
- No difference
- A bit worse than before
- Much worse than before

17 Why do you say this? (open)

Teacher Questionnaire

(sent to all 110 teachers who were scheduled to deliver the intervention)

Thank you for signing up to deliver the Centres for Excellence in Maths (CfEM) intervention last term. As you know, to inform the evaluation, PyeTait have gathered data from learners. Now we want your views, as teachers, on the intervention.

Please complete this questionnaire, regardless of how much of the intervention you delivered, or even whether you were able to start the intervention at all. We want to understand all teacher experiences.

The questionnaire should take about 20 minutes to complete depending on your answers.

It's really important to the evaluation to get your views, as well as being a requirement of the DfE funding of the CfEM programme.

All of the data PyeTait gathers are confidential and all reporting is anonymised. No teacher can or will be identified from your responses.

Background

1. Which intervention did you, or did you intend to, take part in?
   i. Engagement and Resilience
   ii. Responsive teaching
   iii. Bar Modelling
   iv. Ratio Tables
   v. Don't know

2. How long have you been a maths teacher for (please do not include any breaks between posts, just the total time you have been teaching maths)?
   i. Less than 1 year
   ii. 1-3 years
   iii. More than 3 years

3. Have you taken part in any other aspects of the Centres for Excellence in Maths programme, before this specific intervention?
   i. Yes
   ii. No
   iii. Don't know

Completing the intervention

4. Did you complete the activities for **all** 6 weeks of the intervention with **at least some** learners?
   i. Yes
   ii. No

[IF YES go to Q5; IF NO go to Q4a:]

4a) Which of the weeks of the intervention did you complete with at least some learners? Tick all which apply

i. Week 1
ii. Week 2
iii. Week 3
iv. Week 4
v. Week 5
vi. Week 6
vii. None/Don't remember **[can only tick this]**

[IF NO to Q4:]

4b) Why were you unable to complete all 6 weeks of activities in the intervention?

i. I was absent for some of the days/weeks
ii. I had higher college, curriculum and/or classroom priorities
iii. I wasn't fully prepared/ready
iv. Intervention activities weren't working well for me/my learners
v. Other – please specify

[IF INTERVENTION NOT WORKING (OPTION 4b iv):]

4c) Please can you provide more information on why the intervention activities were not working for you or your learners?

Preparing for the intervention

[ASK ALL]

5. Which of the following sources of information or support did you use to help prepare for the intervention (tick all which apply)?

i. Preliminary information received in Summer term 2022
ii. Teacher recruitment fliers
iii. CPD sessions delivered in September/October
iv. Information Booklet
v. Accessing the information on the Padlet
vi. Support from the Intervention Coordinator
vii. Support from the Intervention Lead

We'd like to explore how well prepared you felt for the intervention based on all of the information and support (written and verbal) you received.

6. **Thinking about the maths content of the intervention**, how well did you understand the underpinning **theory** behind the design of the intervention, i.e. **why** the maths was being taught as it was? Please rate on a scale of 1 to 10 where 1 is not at all well and 10 is very well.

1	2	3	4	5	6	7	8	9	10

7. How well did you understand the maths teaching **method** for your intervention, i.e. **how** the intervention was to be delivered using one of the four methods – responsive teaching, engagement and resilience, bar models, ratio tables? Please rate on a scale of 1 to 10 where 1 is not at all well and 10 is very well.

1	2	3	4	5	6	7	8	9	10

8. And, thinking more broadly about the intervention, how well did you understand that the intervention is part of a research project to explore how well the intervention would work in different FE colleges and settings in preparation for a wider, national roll-out? Please rate on a scale of 1 to 10 where 1 is not at all well and 10 is very well.

1	2	3	4	5	6	7	8	9	10

9. How well did you understand **your role** in the intervention – i.e. to complete all the assigned tasks as described, including the maths assessment and to encourage learners to complete their survey? Please rate on a scale of 1 to 10 where 1 is not at all well and 10 is very well.

1	2	3	4	5	6	7	8	9	10

10. How well did you understand that the **target audience** for the intervention was mainly 16 to 19 year old GCSE maths resit learners? Please rate on a scale of 1 to 10 where 1 is not at all well and 10 is very well.

1	2	3	4	5	6	7	8	9	10

11. How well did you understand that the intervention needed to be delivered between the November GCSE resits and completed by Christmas? Please rate on a scale of 1 to 10 where 1 is not at all well and 10 is very well.

1	2	3	4	5	6	7	8	9	10

12. If this was to be implemented nationally, which of these communication methods would you recommend:

a. Groups of teachers are each allocated an Intervention Coordinator who sends material on what to do via email?
b. All material is held on a central online portal, which all teachers can access, along with optional online maths expertise from an Intervention Lead
c. Don't know
d. Other – please describe:

Delivering the intervention

[ASK ALL]

Please answer this section whether you completed NONE, SOME or ALL of the intervention. Each question includes a 'Don't know' option if you do not feel able to comment.

13. How **similar** was the intervention to how you usually teach Maths? Please rate on a scale of 1 to 10 where 1 is not at all similar and 10 is very similar

1	2	3	4	5	6	7	8	9	10	Don't know

14. In general, how well did the intervention **activities match your learners' skill level**? Please rate on a scale of 1 to 10 where 1 is not very well and 10 is very well

1	2	3	4	5	6	7	8	9	10	Don't know

15. How well **did learners engage** with the teaching material? Please rate on a scale of 1 to 10 where 1 is not at all well and 10 is very well

1	2	3	4	5	6	7	8	9	10	Don't know

Impact

Qs 16 to 20 is for all those who answered Yes to Q4, or No to Q4 and who ticked at least one of the weeks.

If answered No to Q4 and did not tick any week teaching, or answered 'none/don't remember in 4a – do not ask qs 16-20 – direct to q21.

16. By the end of the intervention/or the parts of the intervention you were able to deliver, do you feel it helped improve the **confidence** in maths of **disengaged** learners?

i. Yes for all
ii. Yes for some
iii. No
iv. Don't know

17. By the end of the intervention/or the parts of the intervention you were able to deliver, do you feel it helped improve the maths **capabilities** of **disengaged** maths resit learners?

i. Yes for all
ii. Yes for some
iii. No
iv. Don't know

18. Please can you say more about how the intervention did or did not improve the confidence and capabilities of your more **disengaged** learners?

19. By the end of the intervention/or the parts of the intervention you were able to deliver, do you feel it helped improve the maths capabilities amongst **all** your Maths resit learners?

i. Yes for all
ii. Yes for some
iii. No
iv. Don't know

20. Why do you say this, e.g. are there particular groups the intervention was more or less useful for?

[ASK ALL]

21. Thinking about the impact (or otherwise) of the intervention on your learners, is there anything else you would like to say?

22. How likely are you to use these materials or techniques in teaching maths in the future?

i. Very likely
ii. Quite likely
iii. Quite unlikely
iv. Very unlikely

22. How likely are you to recommend these materials or techniques to other maths teachers?

i. Very likely
ii. Quite likely
iii. Quite unlikely
iv. Very unlikely

23. Do you think taking part in this intervention has increased **your skills** as a maths teacher?

i. Yes – a lot
ii. Yes – a little
iii. Not at all
iv. Didn't need to improve my skills as a maths teacher

24. Has the intervention increased **your confidence** as a maths teacher?

i. Yes – a lot
ii. Yes – a little
iii. Not at all
iv. Didn't need to improve my confidence as a maths teacher

25. Has the intervention increased **your skills in engaging** maths resit learners?

i. Yes – a lot
ii. Yes – a little

iii. Not at all
iv. Didn't need to improve my skills in engaging maths resit learners

26. Has the intervention increased **your confidence in engaging** maths resit learners?
i. Yes – a lot
ii. Yes – a little
iii. Not at all
iv. Didn't need to improve my confidence in engaging maths resit learners

27. Please can you say more about the **impact**, or not, of the intervention as you implemented it, on your learners?

28. How would you rate the intervention overall? Please rate on a scale of 1 to 10 where 1 is not successful at all to 10 highly successful?

1	2	3	4	5	6	7	8	9	10

29. If you have any comments on the potential for rolling this out on a national scale to resit GCSE maths learners please include them here.

Thank you for your time and cooperation with this intervention and all your work to help resit GCSE maths learners improve.

Appendix 4: Intervention efficacy and impact of Bar Models

As explained the Bar Models intervention focuses on using pictorial representations to depict fractions and ratio problems, and aids learners in understanding key related maths concepts.

Below the assessment data indicate performance, conceptual understanding and the number and proportion answering each question (indicating willingness to answer) of those learners who took part in the Bar Models intervention.

Table A4.1: Average total marks pre- and post-intervention – Bar Model group

Intervention group	Week 1 average mark	Week 6 average mark	Change
Bar Models	11.69	13.17	1.48

Base: Bar models: 197 learners.

Table A4.2: Performance – pre- and post-intervention mean and change, by quartile – Bar Model Group

Bar Models	Lower Quartile (Q1)	Median (Q2)	Upper Quartile (Q3)	Maximum (Q4)
Learners	49	50	49	49
Week 1 mean score	3.8	9.0	13.7	20.3
Week 6 mean score	4.0	10.0	15.6	23.1
Change in mean score	0.2	1.0	2.0	2.8

Base: Bar models: 197 learners.

Table A4.3: Use of models and representations – bar models pre- and post-intervention – Bar Model Group

Bar Model Group	Pre-Intervention		Post-Intervention		Change
Questions relevant to use of bar models	Count	%	Count	%	Percentage point
Q1	0	-	7	3.55%	+3.55 pp
Q3	1	0.51%	21	10.66%	+10.15 pp
Q4	2	1.02%	9	4.57%	+3.55 pp
Q5	1	0.51%	17	8.63%	+8.12 pp
Q6	1	0.51%	20	10.15%	+9.64 pp
Q9	1	0.51%	25	12.69%	+12.18 pp
Q10	1	0.53%	12	6.09%	+5.56 pp

Base: Bar models: 197 learners.

Table A4.4: Use of models and representations – ratio tables pre- and post-intervention – Bar Model Group

Bar Model Group	Pre-Intervention		Post-Intervention		Change
Questions relevant to use of ratio tables	Count	%	Count	%	Percentage point
Q2	1	0.51%	6	3.05%	+2.54 pp
Q7	18	9.14%	25	12.69%	+3.55 pp
Q8	2	1.02%	0	0.00%	-1.02 pp

Base: Bar models: 197 learners.

Table A4.5: Not answered – pre- and post-intervention – Bar Models Group

Question	Pre-Intervention	Post-Intervention	Change
	%	%	Percentage point
Q1	6%	5%	-1 pp
Q2	17%	14%	-3 pp
Q3	39%	32%	-7 pp
Q4	21%	20%	-1 pp
Q5	19%	14%	- 5 pp
Q6	23%	18%	-5 pp
Q7	8%	11%	+3 pp
Q8	17%	21%	+4 pp
Q9	57%	38%	-19 pp
Q10	50%	41%	-9 pp

Base: Bar models: 197 learners.

Appendix 5: Intervention efficacy and impact of Engagement & Resilience

The Engagement & Resilience intervention focuses on learner participation and enjoyment, the Engagement & Resilience intervention addresses fixed-mindsets and negative attitudes towards maths, with the aim of creating a more positive learning environment with low-risk, goal-free activities.

Below the assessment data indicate performance, learners conceptual understanding and the number and proportion answering each question (indicating willingness to answer) of those learners who took part in the Engagement & Resilience intervention.

Table A5.1: Average total marks per intervention group pre- and post-intervention

Intervention group	Week 1 average mark	Week 6 average mark	Change
Engagement & Resilience	10.52	12.99	2.47

Base: Engagement & Resilience: 180.

Table A5.2: Performance – pre- and post-intervention mean and change, by quartile – Engagement & Resilience Group

Engagement & Resilience	Lower Quartile (Q1)	Median (Q2)	Upper Quartile (Q3)	Maximum (Q4)
Learners	45	45	45	45
Week 1 mean score	3.0	7.6	12.1	19.5
Week 6 mean score	4.0	10.5	15.1	22.4
Change in mean score	+1.0	+2.9	+3.1	+2.9

Base: Engagement & Resilience: 180.

Table A5.3: Use of models and representations: bar models pre- and post-intervention– Engagement & Resilience Group

Engagement & Resilience Group	Pre-Intervention		Post-Intervention		Change
Questions relevant to use of bar models	Count	%	Count	%	Percentage point
Q1	2	1.11%	0	0.00%	-1.11 pp
Q3	2	1.11%	9	5.00%	+3.89 pp
Q4	4	2.22%	9	5.00%	+2.78 pp
Q5	1	0.56%	1	0.56%	0.00 pp
Q6	1	0.56%	1	0.56%	0.00 pp
Q9	4	2.22%	17	9.50%	+7.28 pp
Q10	1	0.56%	4	2.23%	+1.67 pp

Base: Engagement & Resilience: 180.

Table A5.4: Use of models and representations – ratio tables pre- and post-intervention – Engagement & Resilience Group

Engagement & Resilience Group	Pre-Intervention		Post-Intervention		Change
Questions relevant to use of ratio tables	Count	%	Count	%	Percentage point
Q2	2	1.11%	9	5.00%	+3.89 pp
Q7	17	9.44%	27	15.08%	+5.64 pp
Q8	2	1.11%	2	1.11%	0.00 pp

Base: Engagement & Resilience: 180.

Table A5.5: Not answered – pre- and post-intervention – Engagement & Resilience Group

Question	Pre-Intervention	Post-Intervention	Change
	%	%	Percentage point
Q1	6%	3%	-3 pp
Q2	17%	12%	-5 pp
Q3	46%	37%	-9 pp
Q4	26%	14%	-12 pp
Q5	21%	20%	-1 pp
Q6	31%	28%	-3 pp
Q7	14%	10%	-4 pp
Q8	27%	27%	+/- 0
Q9	62%	47%	-15 pp
Q10	57%	49%	-8 pp
Total	6%	3%	-3 pp

Base: Engagement & Resilience: 180

Appendix 6: Intervention efficacy and impact of Ratio Tables

The Ratio Tables intervention utilises a method of solving proportional reasoning problems, which builds on learners' intuitive understanding without relying on algorithms.

Below the assessment data indicate performance, learners conceptual understanding and the number and proportion answering each question (indicating willingness to answer) of those learners who took part in the Ratio Tables intervention.

Table A6.1: Average total marks per intervention group pre- and post-intervention

Intervention group	Week 1 average mark	Week 6 average mark	Change
Ratio Tables	10.24	11.80	1.56

Base: Ratio Tables: 287 learners.

Table A6.2: Performance – pre- and post-intervention mean and change, by quartile – Ratio Tables Group

Ratio Tables	Lower Quartile (Q1)	Median (Q2)	Upper Quartile (Q3)	Maximum (Q4)
Learners	72	72	72	71
Week 1 mean score	2.6	7.5	12.5	18.5
Week 6 mean score	2.9	8.9	14.4	21.1
Change in mean score	+0.3	+1.5	+1.9	+2.6

Base: Ratio Tables: 287 learners.

Table A6.3: Use of models and representations – bar models pre- and post-intervention – Ratio Tables Group

Ratio Tables Group	Pre-Intervention		Post-Intervention		Change
Questions relevant to use of bar models	Count	%	Count	%	Percentage point
Q1	0	0.00%	0	0.00%	0.00 pp
Q3	2	0.70%	4	1.39%	+0.69 pp
Q4	2	0.70%	11	6.67%	+5.97 pp
Q5	2	0.70%	1	0.35%	-0.35 pp
Q6	2	0.70%	2	0.70%	0.00 pp
Q9	3	1.05%	7	2.44%	+1.39 pp
Q10	3	1.05%	5	1.75%	+0.70 pp

Base: Ratio Tables: 287 learners.

Table A6.4: Use of models and representations – ratio tables pre- and post-intervention – Ratio Tables Group

Ratio Tables Group	Pre-Intervention		Post-Intervention		Change
Questions relevant to use of ratio tables	Count	%	Count	%	Percentage point
Q2	7	2.44%	12	4.18%	+1.74 pp
Q7	31	10.80%	48	16.72%	+5.92 pp
Q8	4	1.39%	11	3.85%	+2.46 pp

Base: Ratio Tables: 287 learners.

Table A6.5: Not answered – pre- and post-intervention – Ratio Tables Group

Question	Pre-Intervention	Post-Intervention	Change
	%	%	Percentage point
Q1	4%	5%	+1 pp
Q2	15%	11%	-4 pp
Q3	33%	30%	-3 pp
Q4	19%	16%	-3 pp
Q5	20%	20%	+/-0
Q6	24%	25%	+1 pp
Q7	16%	15%	-1 pp
Q8	22%	25%	+3 pp
Q9	49%	52%	+3 pp
Q10	47%	54%	+7 pp
Total	4%	5%	+1 pp

Base: Ratio Tables: 287 learners.

Appendix 7: Intervention efficacy and impact of Responsive Teaching

The Responsive Teaching intervention centred on different elements than the Bar Models and Ratio Tables interventions, Responsive Teaching uses diagnostic questions to identify learners' misconceptions and address them through group peer discussions

Below the assessment data indicate performance, learners conceptual understanding and the number and proportion answering each question (indicating willingness to answer) of those learners who took part in the Responsive Teaching intervention.

Table A7.1: Average total marks per intervention group pre- and post-intervention

Intervention group	Week 1 average mark	Week 6 average mark	Change
Responsive Teaching	11.75	12.53	0.78

Base: Responsive Teaching: 538 learners.

Table A7.2: Performance – pre- and post-intervention mean and change, by quartile – Responsive Teaching Group

Responsive Teaching	Lower Quartile (Q1)	Median (Q2)	Upper Quartile (Q3)	Maximum (Q4)
Learners	135	134	135	134
Week 1 mean score	3.2	8.9	14.0	20.9
Week 6 mean score	4.0	9.4	15.2	21.6
Change in mean score	+0.8	+0.5	+1.1	+0.7

Base: Responsive Teaching: 538 learners.

Table A7.3: Use of models and representations – bar models pre- and post-intervention – Responsive Teaching Group

Responsive Teaching Group	Pre-Intervention		Post-Intervention		Change
Questions relevant to use of bar models	Count	% of group learners	Count	% of group learners	Percentage point
Q1	1	0.19%	6	1.13%	+0.96 pp
Q3	7	1.45%	25	5.05%	+3.60 pp
Q4	35	6.85%	50	9.62%	+2.77 pp
Q5	5	0.99%	10	1.95%	+0.96 pp
Q6	6	1.22%	5	1.01%	-0.21 pp
Q9	39	8.99%	53	11.94%	+2.95 pp
Q10	25	5.66%	30	6.76%	+1.10 pp

Base: Responsive Teaching: 538 learners.

Table A7.4: Use of models and representations – ratio tables pre- and post-intervention – Responsive Teaching Group

Responsive Teaching Group	Pre-Intervention		Post-Intervention		Change
By question relevant to ratio tables	Count	%	Count	%	Percentage point
Q2	23	4.49%	24	4.61%	+0.12 pp
Q7	128	24.95%	132	26.35%	+1.4 pp
Q8	9	1.82%	17	3.56%	+1.74 pp

Base: Responsive Teaching: 538 learners.

Table A7.5: Not answered – pre- and post-intervention – Responsive Teaching Group

Question	Pre-Intervention	Post-Intervention	Change
	%	%	Percentage point
Q1	5%	4%	-1 pp
Q2	17%	12%	-5 pp
Q3	33%	29%	-4 pp
Q4	21%	14%	-7 pp
Q5	22%	17%	-5 pp
Q6	24%	23%	-1 pp
Q7	13%	14%	+1 pp
Q8	19%	23%	+4 pp
Q9	57%	55%	-2 pp
Q10	52%	47%	-5 pp
Total	5%	4%	-1 pp

Base: Responsive Teaching: 538 learners.