EDUCATION & TRAINING FOUNDATION

CENTRES FOR EXCELLENCE IN MATHS

RATIO TABLES

AN INTERVENTION FOR FE MATHS PRACTICAL CLASSROOM BOOKLET

%	100	10	20	120
AMOUNT	32	3.2	6.4	38.4

Contents

Please scan this QR code to access resources on the Padlet referred to throughout this booklet.

Thank you for doing your bit on behalf of the whole FE maths sector

By doing this intervention you are contributing to the FE Sector's knowledge of what works well in the unique context of FE maths resits as well as improving your learners' experience and progress in FE maths by taking this opportunity to reflect on and develop your own practice.

Summary

This booklet is a practical guide to help plan, prepare and have in your classrooms while trying out a six-week intervention. This intervention was first developed by a group of GCSE maths resit teachers in Further Education colleges in England through action research projects from 2020 to 2022. Then, a larger number of maths resit teachers and learners tried out and evaluated the intervention, to inform the wider FE maths sector and possible future DfE initiatives for FE maths, nationally.

The booklet describes an intervention which may mean introducing something new into your usual teaching practice. Like other teachers who've already tried this intervention, you can integrate it into your existing planning, and make and share adaptations that suit your learners. The intervention is made up of a coherent series of short and focused teaching and learning activities and approaches over a six week period:

Week 1 and 6 are when learners' attitudes and performance is measured using questions provided.

Weeks 2 to 5 are a set of short activities and/or approaches to do with your GCSE maths resit learners.

This booklet is one of many resources produced from several years of research and development by FE maths teachers participating in Centres for Excellence in Maths (CfEM). CfEM is a five-year government-funded improvement programme aimed at delivering sustained improvements in maths outcomes for 16 to 19 year olds, up to Level 2. Discover more CfEM resources and evidence at ETF Maths webpages.

Overview of the intervention

Introduction

The intervention is an approach to using Ratio Tables. The following pages summarise what you could do each week and has links for the necessary resources. The intervention was designed for 16 to 19 year old maths resit learners and face-to-face delivery.

Example of a ratio table:

%	100	10	20	120
AMOUNT	32	3.2	6.4	38.4

Rationale

Proportional reasoning is central to many aspects of mathematical learning, employment and everyday life. The purpose of a ratio table is to help learners think slowly, deeply and conceptually about proportion. Used in this way, ratio tables become an alternative to set methods used previously that are forgotten under the pressure of an exam. This intervention addresses the issue of learners having a reliable tool – ratio tables – to use in exams and to support their understanding of proportionality.

Evidence for the intervention idea

Action research findings from maths GCSE resit teachers Weston College, Harlow College and Leyton Sixth Form College have found that ratio tables in relatable contexts supports an understanding of proportionality which is a far more reliable than learners using methods that rely heavily on memory.

In the past three years of this action research, ratio tables have been used for:

Percentage of an amount	Best buys
Percentage increase and decrease	Exchange rates
Reverse percentages	Standard units e.g. time, length, area, volume/capacity, mass
Direct proportion	Compound units e.g. speed, prices, rates of pay, density, pressure
Recipes	

Timeline and support

The research that took place in Autumn 2022 followed the timetable below, though teachers doing this intervention after this date can do it at any suitable time of year.

Autumn term	Half term 1	A. Induction	• Watch this short introductory **Ratio Table intervention video** (Available on the Padlet). • **Planning discussion** with your Intervention Coordinator (IC) if applicable or colleague.
		B. Training	• **CPD:** Watch Session 1. And Session 2 videos (Available on the Padlet).
	Half term 2	C. Intervention	• **Week 1** Baseline measures. • **Week 2** Introduction to ratio tables. • **Week 3** Best buys. • **Week 4** Petrol vs electric – "per" problems. • **Week 5** Speed. • **Week 6** Follow-up measures.
Spring term	Half term 1	D. Reflection	• **Reflection on what worked well and you'll continue. Share with colleagues. For example, in January.**

If doing the intervention in the Autumn term, your **Week 1** is likely to be in the same week that November resits end or the one after that. Activities must be done in class time. Ensure you print enough paper maths assessments and questionnaires to give to each of your learners, and the mark scheme – all available on the Padlet. Create unique anonymising codes for the front cover of the assessment and questionnaire only if wanted.

Then, in **Weeks 2 to 5**, you will follow activities in this booklet so that learners can use ratio tables as a tool to solve problems that they can relate to – wages, recipes, shopping and fuel. There is weekly reflection box which can be used to record notes on what you did and how it went.

In **Week 6**, learners will complete the follow-up measures, so that results can be compared with the baseline. Again, this must be done in class time to ensure independence, pastoral support and high completion rates.

Note: Teachers taking part in the research in Autumn 2022 received an online questionnaire to feedback their experiences and views on the effectiveness of the intervention. This gave invaluable insights on how well the intervention worked and how it could be improved.

Independent researchers published anonymised and aggregated findings in March 2023.

Week 1

Baseline measures: maths assessment and attitudinal questionnaire

Introduction

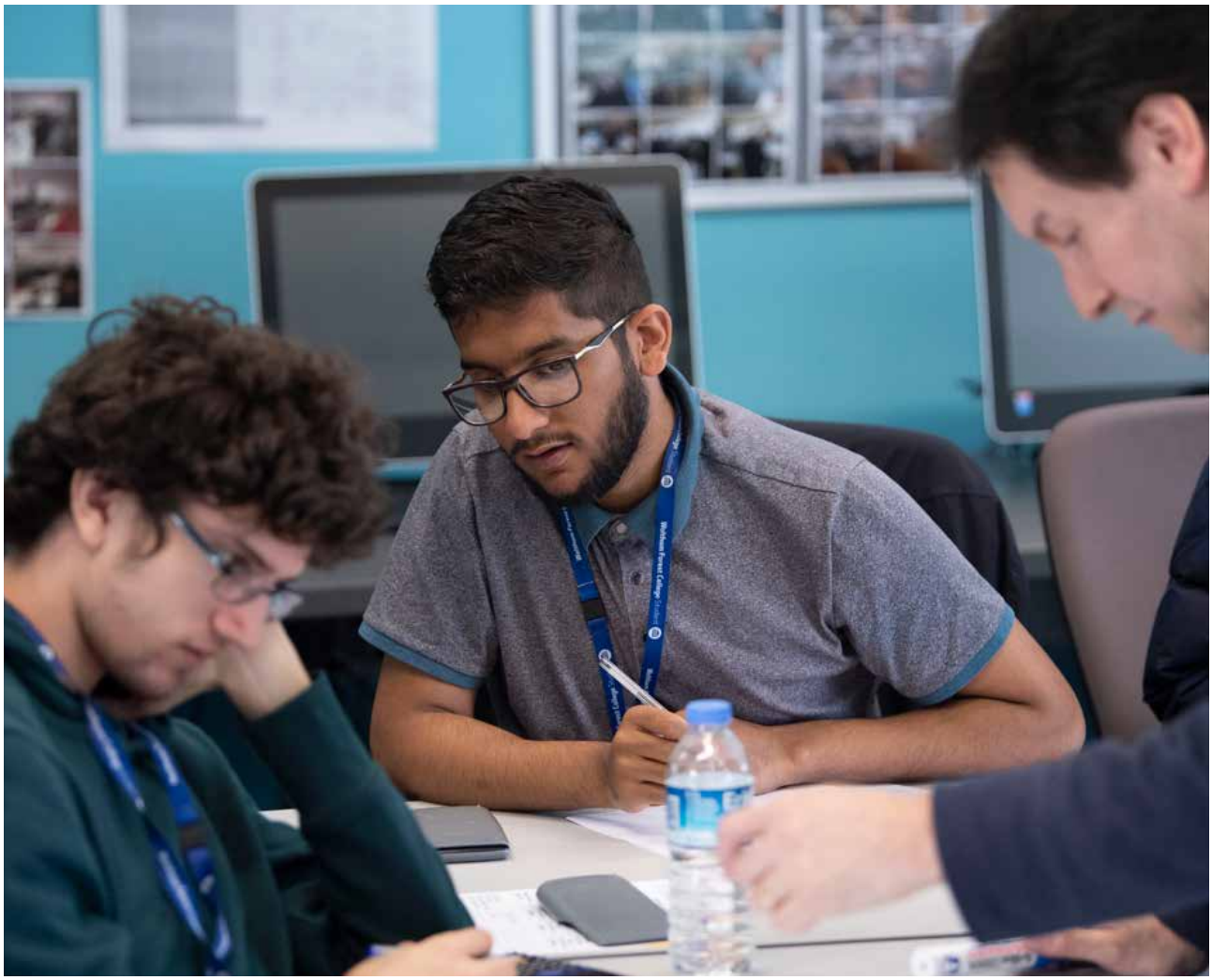
By now, you'll be aware that there are two baseline measures for all your 16-19 year old maths resit learners and that these are available on the Padlet along with all other intervention resources:

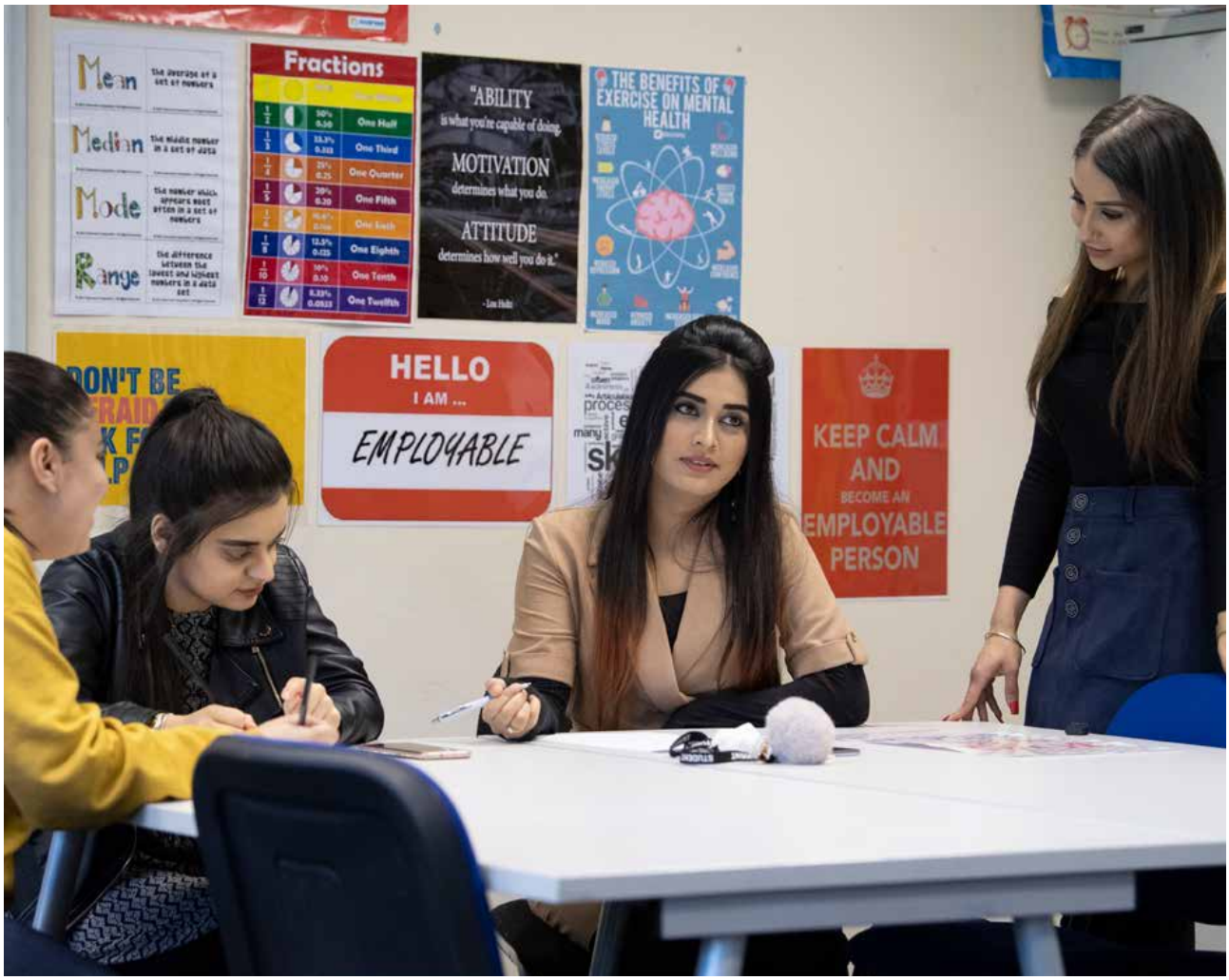
1st **a paper-based maths assessment, with approximately 10 GCSE-type questions of varying difficulty on fractions, ratio and proportion.**

2nd **a short questionnaire that mainly focuses on their attitudes to learning maths.**

Before starting, plan when in Week 1 to do both these baseline measures. In Week 1, please give learners the maths assessment first and the attitudinal questionnaire second. This is because there is a question in the attitudinal questionnaire that asks about their experience of doing the maths assessment. Both baseline measures can be used as learning opportunities.

Note that the same approach to data collection is used in Weeks 1 and 6.





Activity

Inform all learners about the research (10 mins). For example, you could say that you are taking part in some research which involves trying out a new approach in your teaching. You'd really like their help! The aim is to find out how well that approach works. Tell your learners that they have the right to opt out of participating in this research at any time and be ready to provide alternative activities just in case.

Baseline maths assessment (30 mins). After informing all your learners about the research and giving out the unique identifier codes, please ask them to complete the maths assessment. Papers are expected to take approximately 30 minutes (there is no strict time limit). Review the scripts by looking for methods and mis-concepts in workings out and skipped questions as well as marks.

Baseline attitudinal questionnaire (10 mins). Download a print-ready version from the Padlet. Please distribute a printed copy to all your learners during a maths lesson and explain that this is to find out their thinking about maths (it isn't a test). To re-iterate, the questionnaire should be completed by learners in class, face-to-face with you. This is to motivate and support learners to complete the task, independently. Please do not ask learners to do the questionnaire in their own time or remotely.

Supervise their completion of the questionnaire. Each individual learner should complete their own questionnaire. The questionnaire has approximately 15 questions. It is expected to take 10 minutes but there is no strict time limit. The questions are about the learners' confidence and experience of learning maths, in general. Teachers must not answer questions for learners or suggest answers but can help with question comprehension. Strict exam conditions are not required.

Week 2
Introduction to ratio tables (60 mins)

Introduction

Ratio tables are a way into tricky worded problem-solving questions (including A03). They encourage students to structure their thinking by drawing a simple grid. They also expose any misconceptions for teachers (and learners) to see and help teachers with targeted questioning. Ratio tables give students the opportunity to explore their thinking, trying out possible steps towards a solution, in a low-stakes way, as opposed to following a set procedure.

Week 2 is an introductory lesson. It starts with three quick questions and then leads into recipe questions which are common on the GCSE. The numbers have been chosen so the calculations are hard to do in their heads, but if a students can do them mentally try to encourage them to provide their reasoning and model their answer on the board. You can also change the numbers to reflect your cohorts but please keep the framework of the activity provided.

As the questions become more challenging through the four weeks of this intervention, students will have benefited from joining in from this first lesson. They will have become familiar with drawing a ratio table to help structure their thoughts and answer questions they would have previously missed out in their exam. Realistically, you may find some learners are reticent to try something different so this lesson does require a conciliatory tone and skill to manage these situations. An important part of the approach is not to discount their existing strategies but use ratio tables as a support for the explanation of their methods.

Resources

1. Intervention Power Point slides 1-8 – Activity 1 (download in advance from the Padlet).
2. *Suggestion: 1cm square paper for students who may struggle to draw the ratio table OR mini whiteboards/pens (easier for students to correct drawings).

Activities

Begin by explaining to your students that you are going to be introducing them to a (potentially) new method for organising their working with topics that have a proportional basis to them and that this is good because it will help them with a whole range of questions.

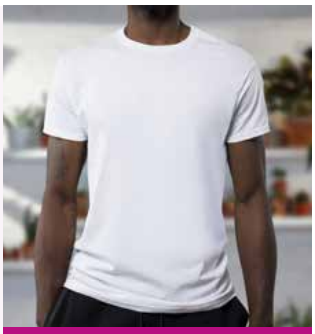
This approach is not meant to replace any methods they currently use but to support them when they get stuck. Let them know that ratio tables have been successfully used in some colleges and that your students are part of a research project to see if they work as well for a wider range of students. Their help with this will lead to improved teaching for students across the country. To promote student discussion in these activities please make sure your students work in pairs/small groups.

On the PowerPoint provided, show slides 2-4 ‘Introduction to ratio tables’. For each of these slides, show your students the context and question. Briefly ask a question that relates to the context, for example, on slide 2 you could ask “Is £18.50 expensive for a t-shirt?” Ask students what information they know and what they want to find out, showing this in the table. Get all your students to work out the answer before revealing the answer. Ask one student how they worked it out and show this working on the table, for example, “I multiplied 18.50 by 2” emphasising that they doubled the number of t-shirts so they doubled the cost.

x2

No. of T-shirts	1	2
£	18.50	37

x2



Buying t-shirts

There are questions to ask on slide 3 about Saturday jobs, but you may want to explore the context first and find out how many students have Saturday (or other part time) jobs. Slide 4 models a sample of student's work using ratio tables.

On PowerPoint slides 5-8 are some Recipe questions. The peanut butter cookie recipe allows students to experiment with trying out different methods for finding other proportional values. This may include multiplying along the table or multiplying between the rows. It is important to let students try to find values using methods they are comfortable with even if they are not the most efficient at this stage. Spend some time collating different answers from students using mini-whiteboards if available and their methods onto the table on slide 6, again adding in the arrows and working. This will model different correct methods for finding other values but may also highlight misconceptions around additive rather than multiplicative methods.

The chocolate cake activity is more directed and usually requires students finding smaller values first before finding the answer for 15 people. Again, collate the different methods that students use on the board, highlighting that no method is wrong if it gets the correct answer. Having shared a range of students methods, ask them to think about which one they prefer to use in this situation.

Week 3

Best buys (30 mins)

Introduction

In Week 3, you're going to build on your students' understandings of how to draw a ratio tables and how they can visually represent a question using a ratio table. Students will look find the best value in shopping for cans of drinks and fresh tomatoes.

Resources

Intervention PowerPoint – slides called "Activity 2" (slides 9-15) on the Padlet (scan QR code on page 2 to access).

Activity

This activity is about using ratio tables to find out which is the 'Best Buys' for cans and tomatoes

'Best buy' drinks

Start with slides 9-11 of the PowerPoint on **single and multi-pack cans**. These slides show the need to draw two ratio tables, one for each situation you are comparing. Students are looking for the cost the same amount of things. As with the previous activity, briefly discuss the context of each question with students. For example, you might ask "Do you normally buy cans individually? When might you buy them in packs? What are the advantages/ disadvantages of this?"

With the **tomatoes question** on slides 12-13 get students to draw a ratio table with the initial information for each type.

Then take some suggestions from students about what amount of grams you could compare for both types of tomatoes.

Any correct method could be used but show them how it can be done by converting each price to that for 1000g.

250g for 50p

300g for 62p

Finally, move on to the Smart Shopping on slides 14 and 15 of the PowerPoint. Ask students to solve the problem using ratio tables. Model some of their answers on the ratio tables on slide 15.

Representing the information in a ratio table

No. of cans	3				
£	2.05				

Week 4
Petrol vs electric – "per" problems (40 mins)

Introduction

This week, learners will learn more about solutions to travel that both help reduce CO2 emissions and impact on their finances.

Resources

Intervention PowerPoint slides 16-22 called "Activity 3" from the Padlet (scan QR code on page 2 to access).

Activity

Start with the **Petrol Activity** (slides 17-20). Begin by asking about the picture, for example:

- What do the numbers on the petrol pump mean?
- Does anyone in the class drive or learning to drive?

Ask students to create a ratio table for the initial information and find other values showing their working.

Summarise some of your student's methods on the table on slide 18.

Slide 19 adds a lot more data to the question.

- What other pairs of things are we being asked to consider?

Get students to draw the extra two ratio tables that are required.

Cost of petrol

And on slide 20 discuss what values you are looking for to be able to move between the tables. For example:

- 420 miles needs how many litres?
- So, how much does that amount of litres cost?

Students can use ratio tables to solve the problem. Pick out a student's method to model on slide 20.


Charging an electric car

Move on to the **Electric Activity** (slides 21-22). This problem is less structured and students themselves need to identify that they will need two ratio tables. The key supporting questions are: Which pairs of units are linked? For example, X per Y. What information will we need from the original Petrol Activity to compare the final prices?

Week 5
Speed (20 mins)

Introduction

In this final week of delivering the intervention learners will look at using ratio tables for rates of change problems.

Resources

Intervention PowerPoint slides 23-25 called "Activity 4 – Speed" from the Padlet (scan QR code on page 2 to access).

Activity

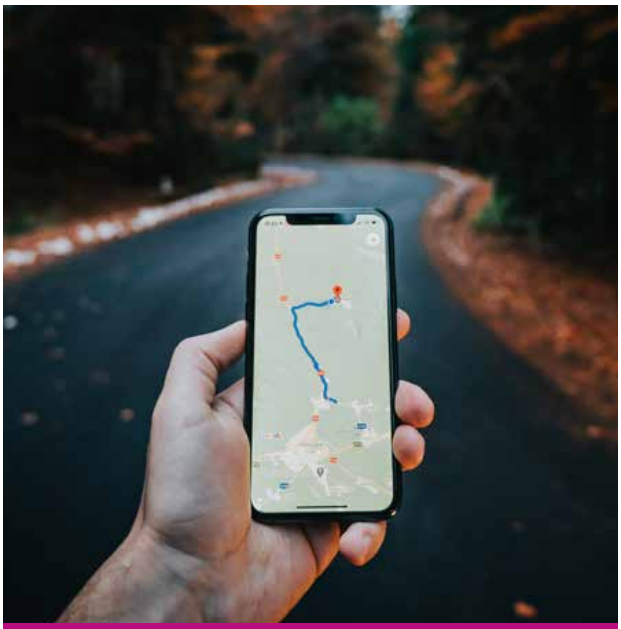
Use the Speed Activity on slide 23 and 25 of the PowerPoint. This activity builds on the previous "per" problems by looking at speed, which is a compound measure (it is one unit per another unit, such as miles per hour (mph).

Again, begin with the context:

- Do students use google maps?
- Do they look at directions and how long it will take to take somewhere?
- Does it always take the time google maps says or is it usually longer/shorter?

Students should now be quite used to setting up ratio tables for situations so see if you can give them only minimal support for these two problems.

Ask students to model their answers on slide 25.



Car journeys

Discussion:

- How do students think the ratio table help them solve these problems?
- Can they remember which topics they have used them for in this intervention?
- What other topics could they use them for?

Week 6

Follow-on measures: maths assessment and attitudinal questionnaire (50 mins)

In Week 6, please repeat the process that you followed in Week 1 so that all – or as many as possible – of your 16–19-year-old maths learners complete both measures:

1st a paper-based maths assessment, with approximately 10 GCSE-type questions of varying difficulty on fractions, ratio and proportion.

2nd a questionnaire that mainly focuses on their attitudes to learning maths.

Once learners have completed the assessment and questionnaire, review your weekly reflections and compare the results from Week 1 and Week 6.

Conclude your research by deciding what to teach particular learners next and what worked well enough to continue or adapt in future and share with colleagues.

Key points:

1. In Week 6, please remind learners of their unique identifier codes (10 mins) and administer both measures – the follow-on maths assessment paper (30 minutes) and then the questionnaire (10 minutes). Return to Week 1 for details.
2. Remember, both measures do not have to be done immediately after each other or in the same lesson, but they do need to be completed in Week 6.
3. Compare results from Week 1 and 6, reflect again on Weeks 2 to 5 and use this evidence to inform your future teaching.

Thank you

Teacher reflection/notes

Teacher reflection/notes

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