CENTRES FOR EXCELLENCE IN MATHS

Using Contextualisation and the Ratio Table to enhance the teaching and learning experience.

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OUR PARTNERS

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About CfEM

Centres for Excellence in Maths (CfEM) is a five-year national improvement programme aimed at delivering sustained improvements in maths outcomes for 16–19-year-olds, up to Level 2, in post-16 settings.

Funded by the Department for Education and delivered by the Education and Training Foundation, the programme is exploring what works for teachers and students, embedding related CPD and good practice, and building networks of maths professionals in colleges.

Executive Summary

The national average for post-16 maths students in 2019 had an added value of + 0.09 points. This meant that, on average, students were making virtually no progress in maths post-16. Improvement was required so the government set up Centres for Excellence in Maths (CfEM).

This paper explores the potential of ratio tables to bring about significant changes in the way students approach a proportional reasoning problem. It was conducted in post-16 settings in the South West of England in which teaching approaches were more characterised by memorising and practising mathematical procedures with little understanding of their application, purpose or underlying concepts. To that end, at the start of the academic year 2020, Weston College and four of their Network Partners with eight teachers met biweekly to discuss how they would set about improving maths. Their Action Research question was: How could student proportional reasoning be improved?

A literature review set out findings from previous research. The group decided to action research using the Realistic Mathematics Education (RME) approach which gave a supported starting point from the research completed by Manchester Metropolitan University (MMU). The initial guidance from MMU gave the research group a clear focus. Teachers used reflections, student surveys as well as photographs of students' work to analyse the approach they used.

The results showed that all of the approximate 55 students who participated in the research liked the use of context, most students said the ratio table helped them understand the maths problems and all teachers would continue to use these methods in the future. 6 teachers wrote about having the need for persistence and continual informal practise with the ratio table, so students have a grip of it. Stating that otherwise students go back to old and incorrect ways of working. Using a sustained collaborative approach, teachers felt supported and able to identify ways to improve their pedagogy and this showed that sustained CPD is necessary whilst introducing new approaches to mathematical teaching.

The Action Research Group (ARG) were able to adapt quickly to online working due to the lockdown and decided to focus on shorter, snappier use of ratio tables as starters in a lesson. Although 4 teachers reported some students regressing to their previous algorithms on their return to class, the other 4 teachers were positive and starting to integrate the approach into their practice

During Covid, there was a need to rely on synchronous lessons, so there were teacher researcher constraints on data that could be collected on student workings, but from the insights in our data analysis, the case is made that ratio tables, when used in conjunction with RME which resonates with a mastery approach, has the potential to challenge current teacher practice and hence lead to a genuine transformation in this area of classroom practice for GCSE resit teachers.

Contents

Introduction:

The Colleges:

The five colleges involved in the Action Research project are mostly white, with a low proportion of ethnic minorities which reflect populations. There are mostly high employment levels within the South West, but all also have some areas of high deprivation. Weston and South Devon are dependent on seasonal tourism. The maths progression for the colleges is generally improving and from 2017 to 2019, progression data ranged between -0.21 to +0.28. Two of the other colleges taking part in this study showed significantly higher progression than the national average of +0.09. The two of the colleges were around 0.00 and one college had lower progression. (If the score is positive students are on average making progress, if negative they have on average achieved lower grades from their entry point). www.compare-school-performance.service.gov.uk/compare-schools?for=16to18

Why did we choose this Action Research Project?

This action research project highlights the problems involving proportional relationships, specifically those involving direct proportion. Proportionality underpins numerous aspects of the maths curriculum, including: multiplication, fractions, decimals, percentages, rates, scales, measurement, conversions, similarity, trigonometry, and probability. It is essential for students to identify and work accurately and efficiently with proportional relationships as it is a component of mathematical proficiency.

In this action research we explore different ways of thinking about and visualising proportional relationships. Ratio tables are introduced as a tool for illustrating different methods for operating on proportional relationships and for investigating the multiplicative nature of these relationships. In doing this we also explore and build on the work by MMU using Realistic Mathematics Education to provide meaningful contexts for students. The MMU study on post-16 GCSE resit students Nuffield-report-2017.pdf (mmu.ac.uk) involved interventions by the researchers, using the RME approach. The main findings were that there was a significant improvement of student outcomes on number. Although not wanting to replicate this research, we want to use this approach and create a model tool that teachers can use in the classroom. This approach involves looking at context in a scenario before introducing any maths. The problem is then introduced with the application of the ratio table to scaffold students to be able to then answer questions. We liked the idea of having one simple model that would support teachers in delivery and increase students' motivation and engagement as well as their mathematical reasoning.

Key Words:

Ratio Table: **Table 1** shows the Ratio table with 1 x 23 as a starting point and then making small variations to one variable (***Variation Theory***) to obtain different answers. 12.2 x 23 = ?

0.02	0.2	0.1	1	2	10	12	12.2
0.46	4.6	2.3	23	46	230	276	280

Table 1

Context: introducing a real-life activity such as filling your car with petrol or making pancakes to hook students.

Proportional Reasoning: a multiplicative relationship between two numbers 1x 23 =23 then 10 x 23 =230

RME Realistic Maths Education was originally developed by the Freudenthal Institute in the Netherlands, and is widely used there. What is RME? | Realistic Maths Education It is a way of

working introduced by using all the above. Context – Proportional Reasoning – and then presenting a question.

Literature Review

Didactic vs Context

Jerome Bruner postulated his constructivist theory of education that children must go through a series of experiences before they are able to think about numbers in a truly abstract way and construct their own meaning from these experiences. Bruner identified three stages of cognitive representation. Bruner, J. S. (1966). states that children need experience of three levels of representational thought: enactive mode (direct manipulation of materials and representation of knowledge through actions), iconic mode (visual use of images and pictorial representation) and symbolic mode (the use of words, numbers and signs in a question) to develop conceptual understanding.

We will be using a Model using Context, recommended by Anghileri, J., & Beishuizen, M. (1998) whilst developing students' longer term conceptual understanding and the ability to apply mathematics. We will then be using repeated contexts as a basis of all lessons. By 1999 in the UK, the teaching at primary level was still largely didactic and encouraged formalisation of methods before real understanding has taken place, DfEE (1999), but over the last ten years a pupil's experience of learning mathematics in primary school has significantly changed and there has been huge financial investment in mastery approaches including allowing children to go through a series of experiences before they are working in a truly abstract way. Mastery approaches are now starting to come through in secondary school at KS3 and KS4.

For those students in a post-16 setting in 2020-21, almost none have ever encountered mastery approaches. Current post-16 students in our settings, at least, are more used to computation and having to work, if they are able to, in the abstract. They view the GCSE curriculum as a series of disconnected topics which not only makes the maths seem more difficult, but is also to the detriment of their working memory which has to remember different algorithms and procedures for each topic. Teaching in a vocational post-16 setting with students who have greater capacities in the technical and practical rather than the academic, we have significant challenges of how to unpick misconceptions right the way back to KS2 whilst valuing and building on prior learning improving their self-efficacy and their belief in themselves. Part of the approach in post-16 is the need for classroom discourse, keeping open ended questions and referring back to the context will greatly improve the students taking ownership as recommended by Van den Heuvel-Panhuizen (2003).

Teaching to the Test

In a perfect situation, students need 2 years to complete a GCSE mathematics resit course according to the RME approach. Currently, Weston College and their network partners have a one year scheme of learning and arguably teachers do not have the space to unpick misconceptions and so are more likely to reinforce the algorithmic approach which students will have previously encountered throughout their school years. By having a one-year scheme, GCSE resit teachers are essentially forced to teach to the test.

According to Bell, A. W. (1994) learning fades when teaching to the test. Currently, the emphasis is on memorising and replicating procedures when teaching and practising GCSE exam questions (Ofsted, 2012). GCSE resit students are the most disillusioned students, with an increased lack of confidence that affects their self-efficacy which leads to low motivation and belief, as was found from previous research on the Thinking Environment by Weston College in 2020 and in Boaler, J., Wiliam, D., & Brown, M. (2000). Students are resistant to explaining their thinking, making connections, and asking questions (Brantlinger, A. 2014). A longer-term conceptual understanding and the ability to apply mathematics remains an issue (Anghileri, J., & Beishuizen, M. 1998). Also, students think it is their ability rather than effort that affects their own achievements. (Boaler, J., & Wiliam, D. (2001).

Following on from students' issues, teachers are also influenced by the nature of the test which dictates the way in which it is taught (De Lange, J. 1992). There is tension over teaching the content in a short period of time rather than give the students time to understand the content. Further, Swan, M. (2006) said that teachers are resistant to change and innovation. Teachers are confident of the success of their own methods, making innovation unnecessary (KoksalL, H., 2020).

Dickinson P., Eade F., Gough S., Hough S., Solomon Y. (2020) said, a slower placed intervention is required, with students taking ownership of the problem. By using The Thinking Environment (Cockerton 2020) and RME (Van den Heuvel-Panhuizen, M. 2003), student self-efficacy and belief can greatly improve in problem solving whilst students start questioning their own strategies. This leads our research to contextualising problems to real events before moving into the abstractas is supported also by Bruner.J (1978).

According to Dickinson et al (2020) teachers need sustained CPD. Courses need to focus on discussion involving questioning, sharing and evaluating ideas in order to support new understandings of mathematics and encourage students to take ownership of the subject**.**

Dickinson et al's RME students were able to use a range of strategies to answer the question. Their explanations often involved a drawing (usually a bar or a circle) to illustrate and make sense of the mathematics. Contexts such as cakes and pizzas were utilised to justify their solutions. Those control students who could remember the algorithm they had been taught were able to achieve the correct answer. Even the more able students were only able to justify their solutions by means of an algorithm and unable to show why. There were remarkable differences in the student ability to answer problem-solving questions.

Table 2 shows the results with lower ability students age 14-16 (fig 19.1 source Dickinson et al 2020)

Table 19.1
Key stage 4 (age 14–16) results of the fractions addition question shown in Fig. 19.6

	Target GCSE Grade C (middle ability) % correct	Target GCSE Grade D/E (lower middle ability) % correct	*n*
Project students	83	57	50
Control students	72	30	50

Table 2

As we needed to focus the action research group on a particular area of the curriculum, we chose a mathematical concept which would have greatest impact using the previous work of Weston College in 2019/20 and the DNA map created by Denholm Wilcox:

Table 3 shows the curriculum areas from an Exams Analysis of the Edexcel Examinations over the first 3 years of the Exam Cycles.

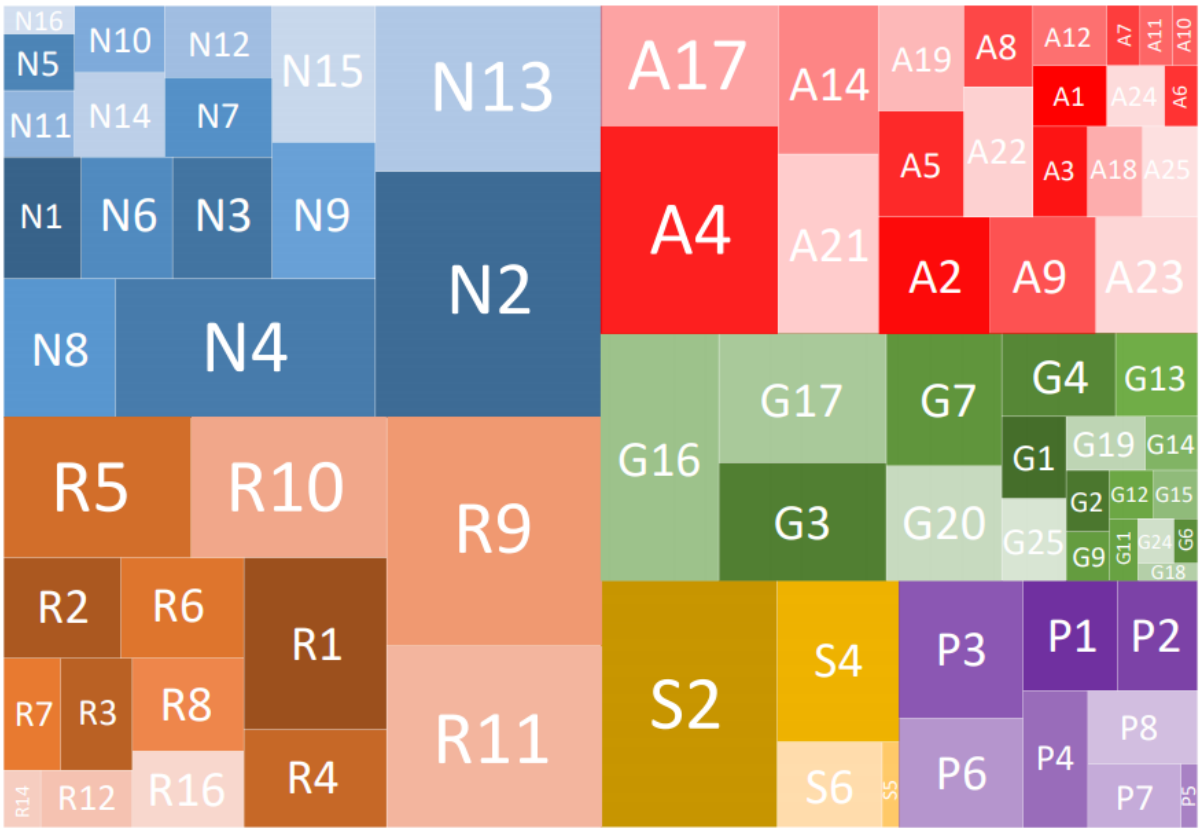

Table 3

Using the exam analysis of what students were getting wrong at Grade 3 compared to a Grade 4, we found that R1, R5, R8, R9 and R10 were consistently in students' top 10. R stands for Ratio. This finding is backed up by research as being a fundamental concept in the development of mathematical understanding and there is a known difficulty that students have in the transition from additive to multiplicative reasoning when answering ratio questions *Orton, A. 2004, Bright & Litwiller 2002 and Hansen 2017).

Developing our Model

Our research into which model we wanted students to draw on to help them move into the abstract provided three options: the bar model, the double number line and the ratio table.

- Bar models are a form of representation that can be used to show the proportional and multiplicative relationships of ratio and for making connections between it and multiplication, division and fractions (NCETM, April 2014). However, we found they were better suited to be introduced as a tool for non-calculator problems and we wanted a tool which could do both calculator and non-calculator problems.
- From the work from the pilot trials in CfEM we also looked at double number lines but decided not to pursue as another CfEM was already looking at these.
- The ARG decided to use ratio tables building on the existing research from Manchester Metropolitan University which had been carried out in a post-16 setting and also provided us with ready-made resources which we could use to start us off on our journey of exploration.

In conclusion, there was good evidence that a mastery approach in general and the thoughtful use of ratio tables can improve students' learning, so our hypothesis was that teachers would believe that it is worth experimenting with these techniques and students doing GCSE resit would be open to a more contextual approach to bridge their conceptual understanding of proportional into the abstract.

Methods

The Students and Teachers:

Table 4 shows the number of students in the Action Research project, their levels at outset and their teachers.

Colleges	GCSE grade U-2	GCSE grade 3	FS level 1
Weston College	37	4	3
Weston College	47	0	0
Heart of Worcester	13	3	0
Heart of Worcester	2	14	0
Heart of Worcester	12	12	0
New College Swindon	8	0	0
Yeovil	35	3	3
South Devon	6	6	0
Totals	**160**	**42**	**6**

Table 4

The Cycles:

We conducted 3 cycles of collaborative planning, teaching, gathering evidence and reflection, based on our research. We practised and made sure we had mastered the techniques before teaching the lessons to our classes. It was vital that we were all confident so we could address any misconceptions or problems which may have arisen. During face to face lessons we took photos of students' work (see Appendix E). After delivering the lesson we reflected on the lesson informally in the shared workroom and formally in writing and discussion. As part of this process we discussed how the lesson could be improved for next teaching.

Appendix D shows the lessons developed over the cycles.

- Cycle 1 was the delivery of The Pancake lesson.
- Cycle 2 was the development of lessons by teachers shared on a padlet.
- Cycle 3 Used starters based from Mathsbot with informal chats about context.

Table 5 shows the Pancake Model. All Lessons were based on this Model throughout the Action Research Process

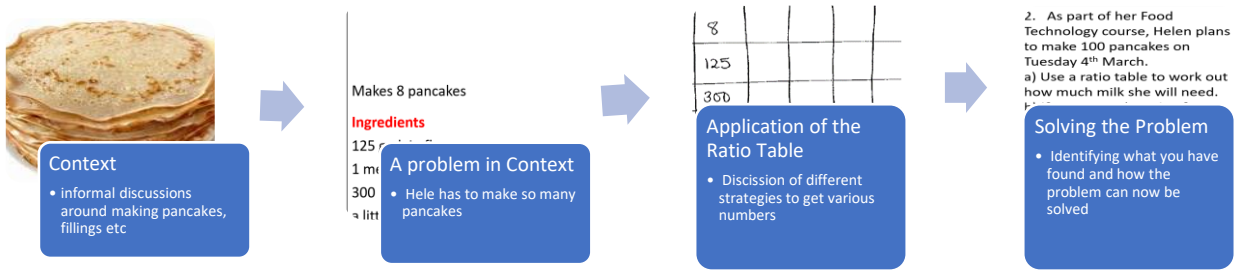

Table 5

Collecting Evidence:

As well as collecting examples of student work in the lesson, we conducted surveys with the students to establish what they thought of the approach. We used Microsoft Forms for this so that the data could be held securely and confidentially in Appendix C. Throughout the process we used the thinking environment as a collaborative meeting process. Care was taken so that all teachers could speak freely and share their experiences. We recorded and transcribed the meetings to show how the cycles evolved, which have been coded in Appendix F. This process enabled teachers to adapt the teaching within and for the next cycle depending on the overall needs of students.

Impact of Covid

We adapted our model in Cycle 2 to creating starter activities. Student pre-tests and post-tests initially set up had to be changed to observations of student work. A post teacher questionnaire alongside a post student questionnaire were created to help assess impact.

Informed Consent Form sent to all students can be found in Appendix B

Data Collection templates can be found in Appendix C

Lessons can be found in Appendix D

Results and Discussion

Student and Teacher Survey Results

A summary of the evidence from the surveys.

Topic	Students responding to survey
Proportion (Ratio Tables)	55

Table 6 shows that out of the 55 students surveyed all students preferred a certain amount of context in a lesson to help them understand the maths as no one answered not at all.

Survey Question	1 star not at all	2 star	3 star	4 star	5 star a lot	3+	4+
When the teachers used real life examples to explain the beginning of the lesson did that help you understand the maths?	0	3	19	22	11	**95%**	**60%**
When the teacher used the ratio table to show how to work through problems did this help you to understand the maths?	3	11	17	15	9	**93%**	**43%**
Do you feel confident in using these methods to solve problems.	2	10	20	17	6	**78%**	**42%**

Table 6

One concern about teaching students on GCSE resit maths using context and ratio tables was that the context would not be useful and that students would use more familiar algorithms to answer the question. Only 2 of the 55 students did not think the methods helped them to solve problems so for the majority of students surveyed this was not the case.

95% of the 55 students surveyed felt that context is important to them to help their understanding of the problems. With 60% of the 55 students scoring this question at least 4 stars.

93% of the 55 students surveyed gave a score of 3 stars or above when asked “when the teacher used the ratio table did it help to understand the maths. This was not as strong as using context as when looking at least 4 stars the percentage reduced to 44% of the 55 students. Only 3 students felt it did not help at all.

78% of the 55 students surveyed wrote a score of 3 stars or above that they feel confident solving problems using the methods. 42% scored this as at least 4 stars which is a significant proportion having a stronger opinion that it helped them with their problem-solving skills.

Topic	Teachers responding to survey
Proportion (Ratio Tables)	8

Table 7 shows that most of the teachers saw an increase in student engagement when using context in the class.

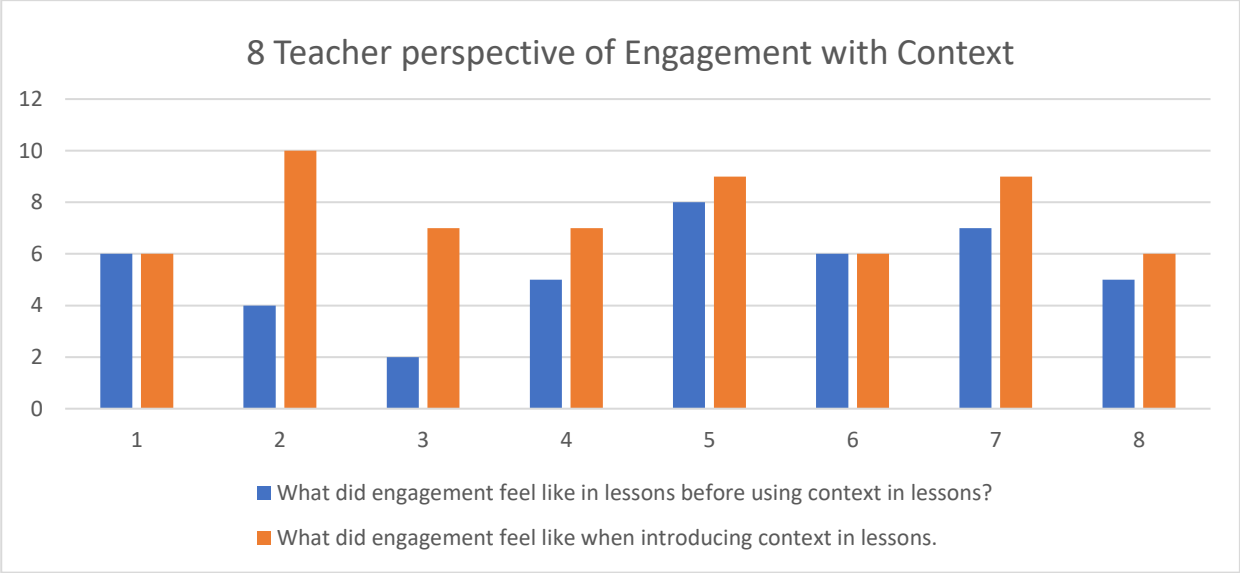

Table 7

The data shows that from the teacher perspective, students appeared more engaged when Maths was contextualised. Interestingly, of the teachers that did not see a significant change in engagement were Grade 3 students (the only grade that is required to resit GCSE as part of the condition of funding). One reason for this could be that the problem was too straight forward for a Grade 3 student, but from our results, lower ability students i.e. below a Grade 3 found the contextual problem more engaging.

Table 8 shows that out of the 8 teachers surveyed most of the teachers saw an increase in student progress when using ratio tables in the class.

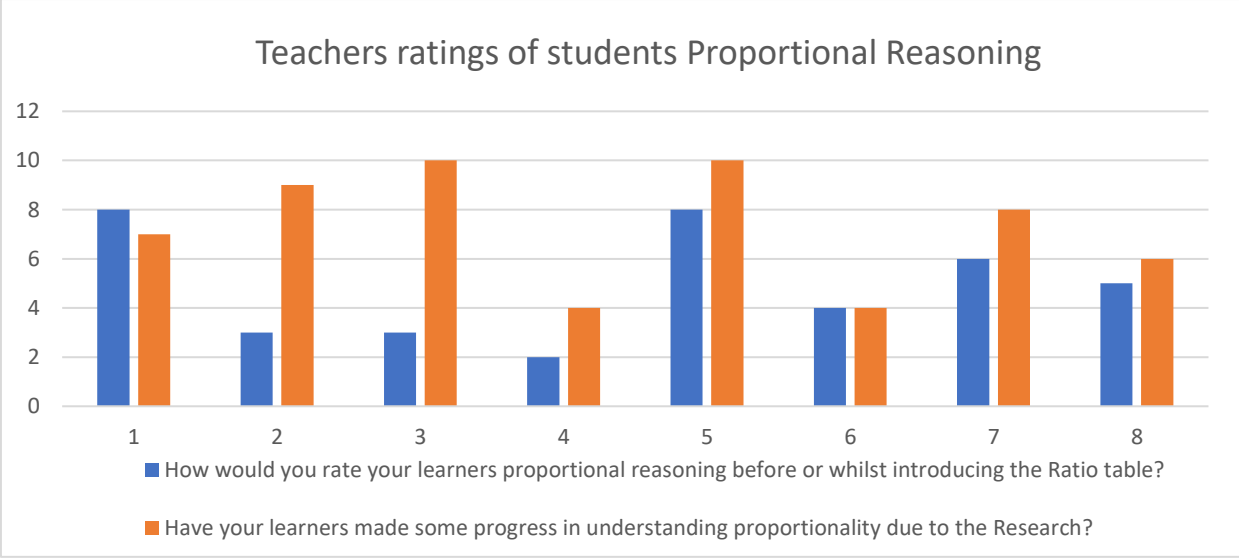

Table 8

Table 9 shows the teachers' ratings of using ratio tables before the Research and using the ratio tables in the future.

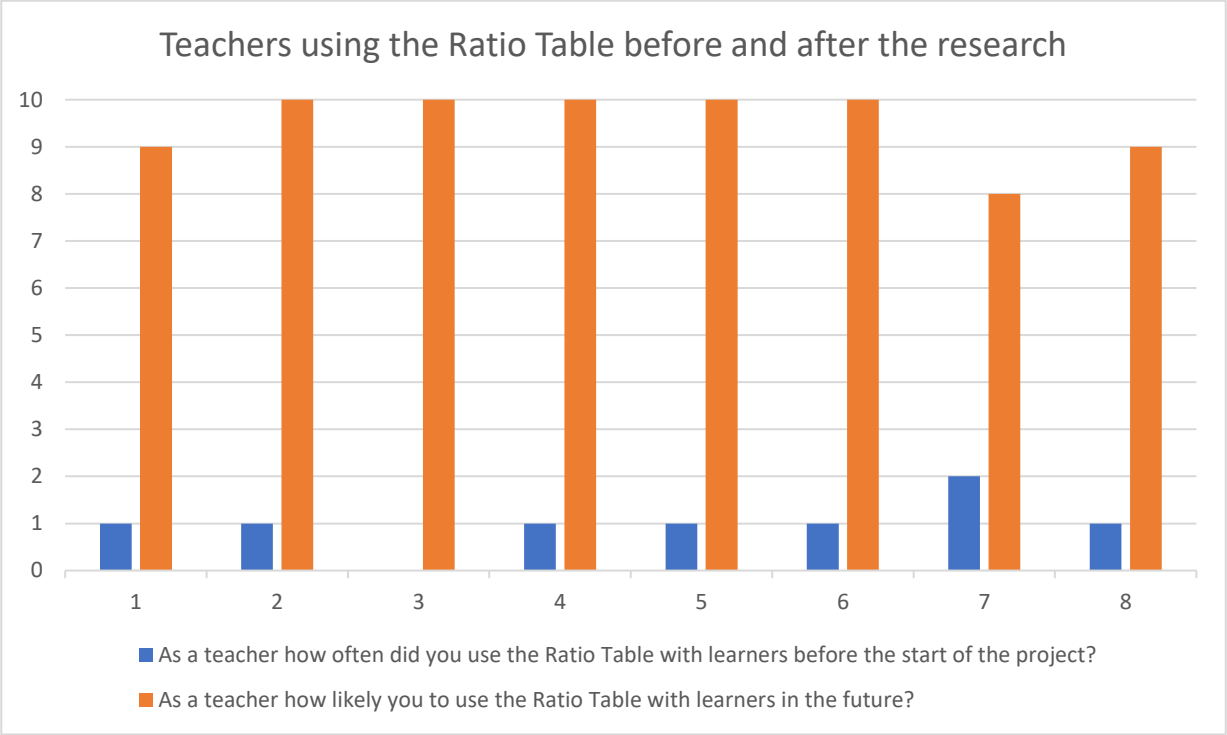

Table 9

Most teachers felt very strongly about using the Ratio Table. Table 9 shows that 5 teachers scoring 10/10 as their likelihood at using the table. Many teachers also started out with little or no prior knowledge of the Ratio Table.

Table 10 shows how teachers were able to articulate their journey at the end of the Action Research.

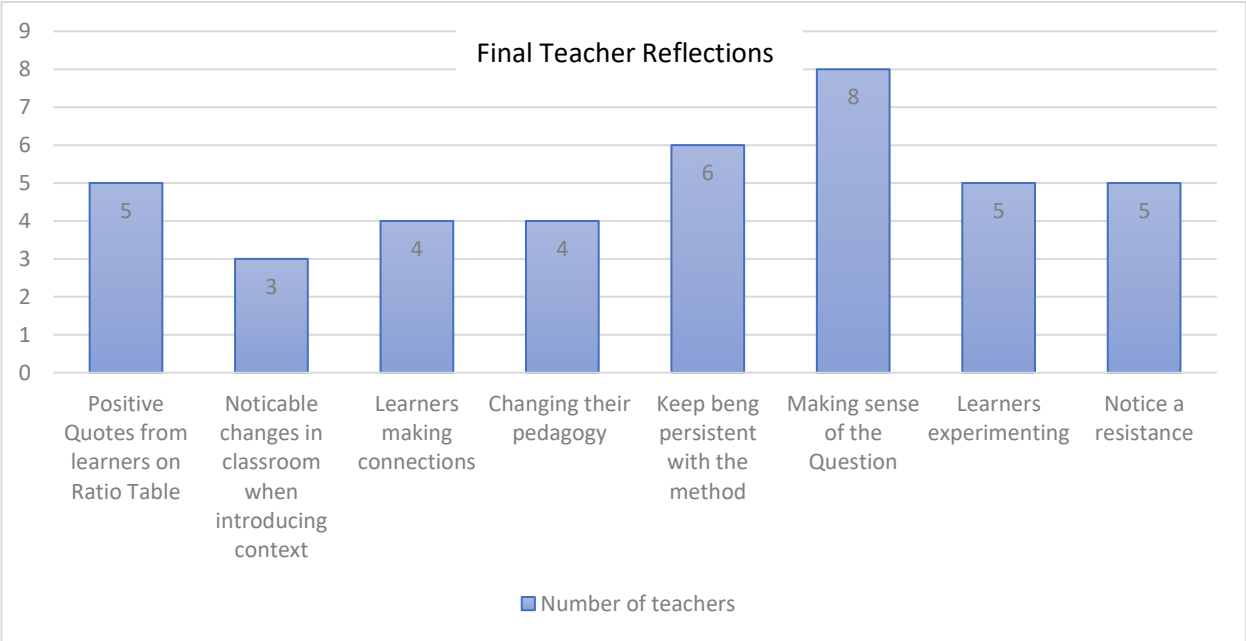

Table 10

Teachers' Reflections at the end of the Year in Table 6 (further details in appendix G):

Four different teachers gave quotations of what their students had said about the use of the ratio table during the year. 3 different teachers enthused how engaged students were whist using context in the lesson. 4 different teachers recognised that students were identifying connections. Teachers discussed their pedagogy from final reflections. 4 teachers recognised how they would move forward in the pedagogy by:

- Making the maths relevant to the student whether personally or through their vocational subject.
- The ratio table gives fluency, validity and enables students to access problems they could not previously access.
- It has been great to have another method in my armoury.
- I have been pleased to see the method in some of the mock papers.

6 teachers wrote about having the need for persistence and continual informal practise with the ratio table, so students have a grip of it. Stating that otherwise students go back to old and incorrect ways of working.

With the context of food and the lesson on making pancakes from MMU the use of ratio tables helped to frame discussions about multipliers/ dividing / scale factors. Students seemed better able to engage with the context and relate it to their experiences of food which enabled a rich classroom discourse where the real-life context enabled them to contribute to mathematical talk. This matches the research, in the literature review, by Van den Heuvel-Panhuizen (2003) that keeping open ended questions and referring back to the context will greatly improve the students taking ownership.

From Teachers' Reflections throughout the year we looked at the experience from a teacher's growth perspective, and the ability to embrace a new different approach to teaching proportionality (see appendix F). This matched the research we found from Dickinson et al (2020) about teachers needing sustained CPD and courses focusing on discussion involving questioning, sharing and evaluating ideas in order to support new understandings of mathematics and encourage students to take ownership of the subject**.**

In Cycle 1, teachers reported an apprehension and vulnerability and 4 of the 8 teachers expressed feelings of resistance to their usual ways of working. This was in the context of Covid in the late autumn months of 2020 and in the height of the pandemic, so perhaps some of these feelings related to external factors rather than maths pedagogy, but you would expect a degree of reluctance by teachers.

By cycle 2 in early January teachers' attitudes were changing and 7 out the 8 teachers felt they were really developing their practice with the ratio table, but time was an issue for 3 teachers because using this mastery approach needed more time than they had available in their scheme of learning.

By cycle 3 and with end of term assessments the ARG decided then to focus on shorter, snappier use of ratio tables as starters in a lesson. Although 4 teachers reported some students regressing to their previous algorithms, the other 4 teachers were positive and starting to integrate the approach into their practice.

With the appropriate contexts for 16-18 year olds, and the use of ratio this mastery approach to help to frame discussions about multipliers/ dividing / scale factors, students were able to

engage with a meaningful context which enabled a rich classroom discourse where the real life context enabled them to contribute to mathematical talk. This matched the research from work on The Thinking Environment Cockerton (2020) and Realistic Education in Maths (REM) Van den Heuvel-Panhuizen, M. (2003) that student self-efficacy and belief is greatly improved in problem solving whilst students start questioning their own strategies.

These results then translated to the student assessment (see appendix **H)** , although limited evidence of this is available due to teacher time constraints during TAGs.

Completed Scripts pre-test and post-test	25

Table 11 Questions answered by the students before and after the Research.

Test Questions from 25 Scripts					
Question Number	1	2	3	4	5
Used Ratio tables seen before Research	3	0	0	0	0
Used Ratio tables seen after Research	11	10	4	0	0
Total student Scripts	25	25	25	25	25

Table 11

Scripts were analysed from the first five questions. We used the first five as that had the greatest number of questions answered. We cross checked if they used the ratio table before the intervention and then after the intervention.
Some students started using the ratio tables after the intervention to answer the first three questions.

Table 12 Gives the number of questions answered correctly by the students before and after the Research.

Correct Pre-test	51
Correct Post-test	73

Table 12

Table 12 shows the number of questions answered correctly improved after the intervention however this may not have been because of the ratio table.

Table 13 and 14 show an examples of students' work

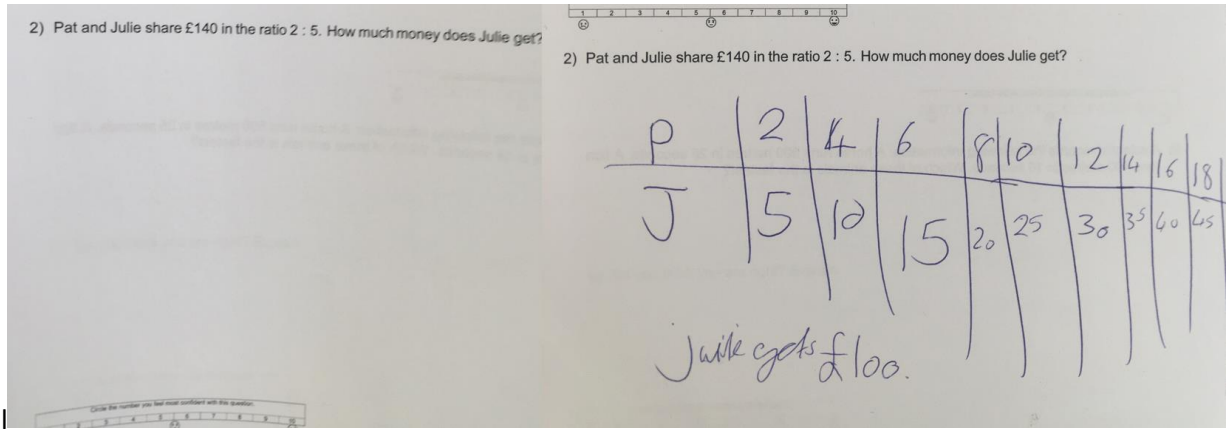

Table 13

This student has been unable to answer this question, however for the post test there is a clear visual of the ratio table. The student has gone up in 2's then come back to check where he can identify the answer.

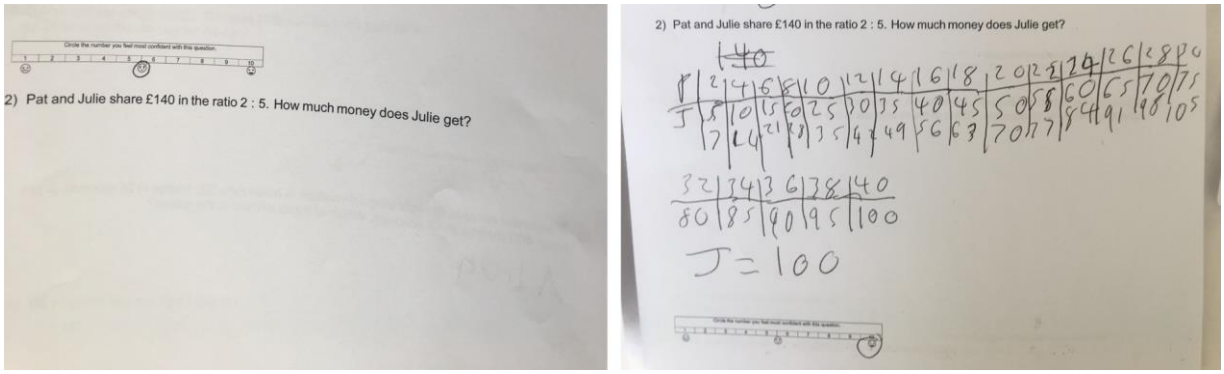

Table 14

This student has also gone up in the 2 times table until he found this answer. This was a grade 1 student.

Other students work in Appendix E shows different grade students attempting different starting activities. Clearly showing the difference between their fluency in maths and their different approaches to the problem.

Conclusions and Recommendations

Discussion and Limitations

This paper explores the potential of ratio tables to bring about significant changes in the way students approach proportional reasoning problems. It focused on post-16 settings in the South West of England where teaching approaches were more characterised by memorising and practising mathematical procedures than understanding their application, purpose or underlying concepts. It reports on one action research project, involving the author and seven teacher researchers who worked to genuinely engage and empower students in a relaxed atmosphere using contexts which were meaningful to them and using a tool to provide a logical structure to develop deeper conceptual understanding. The research project was conducted in a collaborative, systematic and rigorous way.

During Covid there was a need to rely on synchronous lessons and there were teacher researchers constraints on data that could be collected on student workings. From the insights in our data analysis, the case is made that ratio tables when used in conjunction with RME, which resonates with a mastery approach, has the potential to challenge current teacher practice and hence lead to a genuine transformation in classroom practice for GCSE resit teachers.

Conclusions (from a limited data set)

1. Students found lessons more relevant and engaging when the ratio table was introduced with relevant context.
2. Teachers saw an uplift in student proportional reasoning especially students with lower attained grades.
3. Teachers were surprised about the use of the ratio table and the impact of using relevant context in lessons. Their own self efficacy developed when exploring topics using RME could be developed.
4. Teachers found that the students quickly forget newly learnt methods, so persistency in delivery is required to embed the methods.

Recommendations

1. An increased data set would be required to be able to draw stronger conclusions around the transformative power of ratio tables, however the findings affecting practise in the ARG was strong. The ARG model of reflection was strong and worth replicating.
2. Continue looking at other areas of the curriculum to explore further mastery approaches independently or alongside the RME Approach.
3. Develop a SOW to incorporate our research findings across the academic year. Creating starting activities where there is a clear contextual scenario to hook students - model the ratio table - let students articulate their work - ask problem solving questions. - develop the abstract.
4. Continued high quality CPD to upskill staff on how to use ratio tables and RME approaches. Sue Hough's webinar CfEM teach meet – Contextualisation CPD session (on24.com) was a good starting point and creating spaces to enable teachers to reflect with other teachers.
5. Further development of a positive maths cross college culture, "It's Everyone's Business"

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Appendix A

Topics that can be used for the Ratio Table.

Metric Conversions
Conversion graphs
Ratio
FDP
Exchange
Capacity
Density
speed
rates of pay
Best Buy - common multiples
Place value
Times tables
Ordering decimals
Scale diagrams maps

Similar shapes
Context continuously showing the difference between m m2 m3

1d measure
2d measure
3D measure
Money problems
Decorating problem solving.
Defining the differences between distance area and volume.
Compass points.
Fraction of
% of
Decimal of ?
Equivalent fractions
Whole fractions improper fractions by size
Direct proportion
Inverse proportion
Simple and compound interest
Circles
Pie charts

Common multiples
Common factors

Appendix B

Informed Consent Form

CENTRES FOR EXCELLENCE IN MATHS

EDUCATION & TRAINING FOUNDATION

WESTON COLLEGE

Centres for Excellence in Mathematics: Action Research Teaching approach

Research Participant (student) Information

Weston College, it's network partners and the Centres for Excellence in Mathematics are funded by the Government through the Department for Education.

The aim of the work is to improve the teaching of mathematics for GCSE learners and the improved progression of all 16-19 learners. As part of this work your maths teacher is taking part in developing innovative teaching in Maths. This will result in your teacher using a number of carefully designed resources with you over the forthcoming year. The research team will investigate the effectiveness of the approach by gathering some data from you. This will involve you being asked to complete short surveys during the year and your GCSE or Functional Skills outcome data being used for the data collection.

The research team from your College would very much appreciate your willingness to take part in the research. It has the potential to assist generations to come to experience better teaching in mathematics.

Data Protection

Your data will be tracked but anonymized. We will not be sharing your name, only the progress that you as pupil (x) have made.

If you wish to withdraw from participating in the research, you should tell your teacher now and at any time over the next year and complete the form that is part of the participant privacy notice. If this form is submitted at any time all of your data collected to that point will be destroyed and no further data collected relating to you.

We do hope, however, that you are happy to participate given the potential that the research has to inform us how to improve teaching of maths.

Ethical issues

We will ensure your anonymity at all stages and no survey or GCSE outcomes will be identifiable as belonging to you personally. In the case of any use of video for any purposes additional permissions will be sought from you.

If you would like any further information about the work of the CfEM programme in general or of the research programme in more detail please contact Katheryn Cockerton Katheryn.cockerton@weston.ac.uk or Xenos Cotham Xenos.cotham@weston.ac.uk

Katheryn Cockerton
CfEM Coach and Maths Lecturer
Weston College

OUR PARTNERS

touchconsulting

Working in partnership with the Education and Training Foundation to deliver this programme.

FUNDED BY Department for Education

Appendix C

Pre/post questions

		Pre test	Question Number	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9a
College Learner code	Current Grade	Vocational Area	Question Topic	It takes a photocopier 18 seconds to produce 12 copies. How long would it take at the same speed to produce 30 copies	Confidence Rating	Pat and Julie share £140 in the ratio of 2:5, how much does Julie get?	Confidence Rating	In 1976 the average yearly wage was £3300. On average people spent 17% of their wage on a family holiday. How much money is this?	Confidence Rating	Find 3/8 of £600	Confidence Rating	A scientist record the following information. A horse runs 500m in 25 seconds. A lion round 400m in 18 seconds. Which is the fastest?	Confidence Rating	Work out 1/3 + 1/2	Confidence Rating	Susan sold her car for £6820. This was 20% less than she paid for it. How much did she pay for the car? Explain	Confidence Rating	Alfie Bertie and Charlie Share £66. The amount Alfie and Bertie get is in the Ratio of 9:5. The amount Bertie and Charlie get is the ratio of 2:1. How Much does Alfie get?	Confidence Rating	The 2 Trainagles ABC and PQR are similar. Angle A = Angle P, Angle B = Angel AB = 8m, AC = 26cm, PQ = 12cm, QR = 45cm. A) Calculate the length of PR, of BC.
			pre test																	
			Maximum Mark	2	10	2	10	3	10	2	10	3	10	3	10	2	10	3	10	2
W1	3	brickwork	pre test	2		2		3		2		3		3		2		3		2
W2	2	brickwork	pre test											1	0	1	1	0		

Date: **Current Grade:** **Name:**

Action Research Pre-Test

College: **Current Grade:**

Time of starting test: **Time of finishing test:**

1) It takes a photocopier 18 seconds to produce 12 copies. How long would it take at the same speed to produce 30 copies?

4) Find $\frac{3}{8}$ of £600

5) A scientist records the following information: A horse runs 500 metres in 25 seconds. A lion runs 400 metres in 18 seconds. Which of these animals is the fastest?

6) Fractions

a) Work out $\frac{1}{3} + \frac{1}{5}$

b) Do you think you are right? Explain.

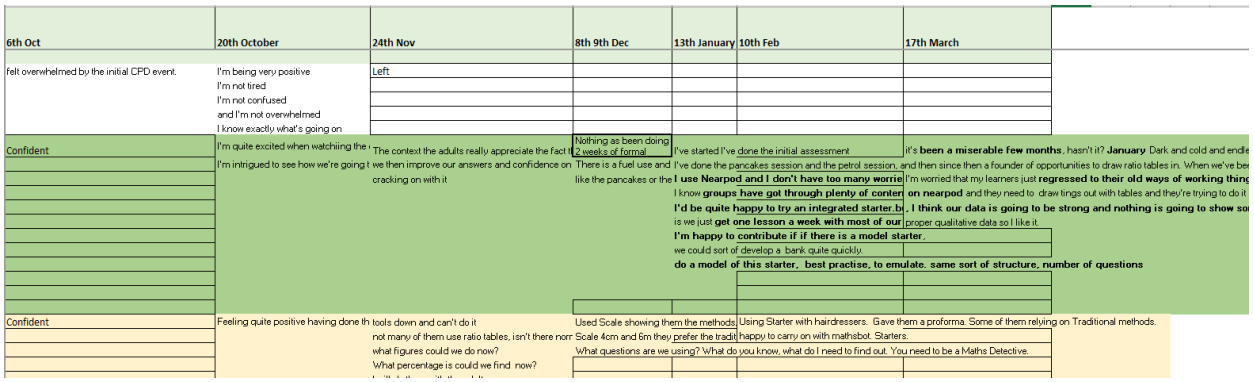
7) Susan sold her car for £6820. This was 20% less than she paid for it.

a) How much did she pay for the car?

b) Do you think you are right? Explain.

Thank you very much for completing these questions for us.

Sample of Transcription of teacher reflections



6th Oct	20th October	24th Nov	8th 9th Dec	13th January	10th Feb	17th March
felt overwhelmed by the initial CPD event.	I'm being very positive I'm not tired I'm not confused and I'm not overwhelmed I know exactly what's going on	Left				
Confident	I'm quite excited when watchiing the I'm intrigued to see how we're going t	The context the adults really appreciate the fact t we then improve our answers and confidence on cracking on with it	Nothing as been doing 2 weeks of formal There is a fuel use and like the pancakes or the	I've started I've done the initial assessment I've done the pancakes session and the petrol session, and then since then a founder of opportunities to draw ratio tables in. When we've be **I use Nearpod and I don't have too many worrie** I know **groups have got through plenty of conten** **I'd be quite happy to try an integrated starter.bu** is we just **get one lesson a week with most of our** **I'm happy to contribute if if there is a model starter**, we could sort of develop a bank quite quickly. **do a model of this starter, best practise, to emulate. same sort of structure, number of questions**	it's **been a miserable few months**. hasn't it? **January** Dark and cold and endle I'm worried that my learners just **regressed to their old ways of working thing** **on nearpod** and they need to draw tings out with tables and they're trying to do it **, I think our data is going to be strong and nothing is going to show so** proper qualitative data so I like it.
Confident	Feeling quite positive having done th	tools down and can't do it not many of them use ratio tables, isn't there norr what figures could we do now? What percentage is could we find now?	Used Scale showing them the methods Scale 4cm and 6m they prefer the tradit What questions are we using? What do you know, what do I need to find out. You need to be a Maths Detective.		Using Starter with hairdressers. Gave them a proforma. Some of them relying on Traditional methods. happy to carry on with mathsbot. Starters.	

Teacher Questionaires

Teacher Questionnaire

Please complete this in as much detail as you can. This will be used for our data gathering. Thank you All.

1. Teachers Name

Enter your answer

2. How did you feel when starting the project? Use 3 different descriptive words.

Enter your answer

3. What did engagement feel like in lessons before using context in lessons? *

☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆

4. What was engagement feel like when you introducing context in lessons. *

☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆

5. Give examples of what learners said or did differently in particular lessons when you introduced the context into lessons. *

Enter your answer

6. How would you rate your learners proportional reasoning before or whilst introducing the Ratio table? *

☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆

7. How did the learners respond to the Ratio Table / Proportional Reasoning table (give examples of what learners said or did in particular lessons.) *

Enter your answer

8. Have your learners made some progress in understanding proportionality due to the Research? *

☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆

9. Can you explain why you think they made the progress? *

Enter your answer

10. How did the learners initially respond to the open ended questions? *

☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆

11. Give examples of what learners said or did in particular lessons when faced with no question... just open ended...if applicable

Enter your answer

12. What were the learner responses that most stood out for you?

Enter your answer

13. How will you use this method in the future?

Enter your answer

14. Have you learnt anything that you will take forward in your teaching?

Enter your answer

15. How likely are you to use these methods going forward?

☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆

16. What concerns or problems did you have through the project and how did that affect you. External or internal. *

Enter your answer

17. How do you feel at the end of the project? Three descriptive words.

Enter your answer

18. As a teacher how often did you use the Ratio Table with learners before the start of the project?

☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆

19. As a teacher how likely you to use the Ratio Table with learners in the future?

☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆

Student Questioaires

1. When the teachers used real life examples to explain the beginning of the lesson did that help you understand the maths? 1 Star = not at all. 5 Stars = A lot

☆ ☆ ☆ ☆ ☆

2. When the teacher used a ratio table to show how to work through problems did this help you understand the maths? 1 Star = not at all. 5 Stars = A lot

☆ ☆ ☆ ☆ ☆

3. Do you feel confident in using these methods to solve problems. 1 Star = not at all. 5 Stars = A lot

☆ ☆ ☆ ☆ ☆

4. Did you get on with online lessons? 1 Star = not at all. 5 Stars = A lot

☆ ☆ ☆ ☆ ☆

5. Thank you for taking part in this survey. Please make any other comments to help us improve teaching Maths.

Enter your answer

Appendix D

Cycle 1 Lesson 1 – Pancakes

Slide 1

Discuss pancakes and what type of fillings you might have in your pancakes

Pancakes

Slide 2

Recipes

Pancakes

Makes 8 pancakes

Ingredients

125 g plain flour

1 medium size egg, beaten

300 ml milk

a little oil for frying

Slide 3

Recipes

Helen decides to use the ratio table below to work out the ingredients needed for different numbers of pancakes.

Number of pancakes	8				
Plain flour (grams)	125				
Milk (ml)	300				
Eggs	1				

Copy the table and fill in four more columns showing the ingredients needed for different numbers of pancakes

Pancakes

Makes 8 pancakes

Ingredients

125 g plain flour

1 medium size egg, beaten

300 ml milk

a little oil for frying

Slide 4

Recipes

There are 28 people in Helen's college group and she wants to make pancakes for all of them.

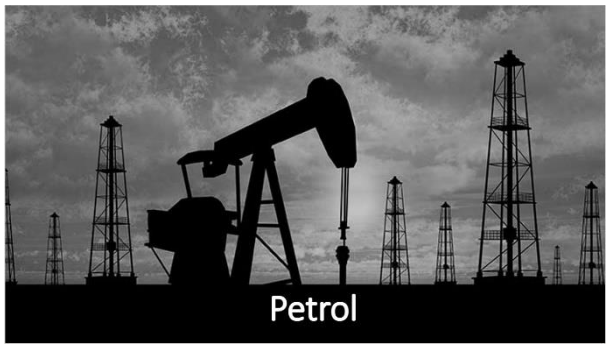
1. Decide how much of each ingredient she will need.

2. As part of her Food Technology course, Helen plans to make 100 pancakes on Tuesday 4th March.
a) Use a ratio table to work out how much milk she will need.
b) If you were shopping for Helen, how much milk would you buy?

Number of pancakes	8				
Plain flour (grams)	125				
Milk (ml)	300				
Eggs	1				

Cycle 2 Lesson 2 – Petrol

Slide 1



Slide 2

Slide 3

Question: If my car has a capacity to take 60 litres of petrol. It drives at 7 miles per litre, what else could I find out?

Slide 4

- Petrol costs £1.20 per litre. I want to travel to Newcastle, which is 420 miles away. How much will it cost me, and how many times will I need to fill up?
- I can borrow my friend's electric car for the journey. It has a 75kWh battery. It has a real-world range of 250 miles. If Electricity is 15p per kWh. How much would I save by using their car?

Lesson 3 – Running a Marathon

Slide 1

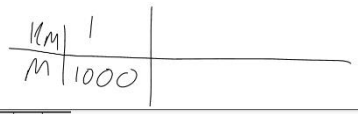
Slide 2

Resources Required:

- Starter: Maths box km to m conversion using the ratio table **Print**
- Discussion about using the ratio table when converting 20 mins
- Marathon Example
- Discussion about speed sports. 10 mins
- Ask to complete a ratio table for approximate times for learners.
- Outside 15 mins
- Flip chart ready
- Meter stick
- Back inside to complete Ratio Table distance and time.
- Review tables 10 mins
- Check out Exam based Questions. **Print**

Slide 3

Starter:- 1 KM = 1000m Use the table to help you convert the km and m KILO means 1000



5100 m	95 m	0.3 km	0.65 km	1.065 km	0.755 km	1 km	3000 m	1.045 km
1050 m	3 km	1.275 km	5510 m	0.5 km	0.095 km	2.1 km	1.05 km	0.925 km
1.2 km	0.6 km	0.2 km	0.8 km	0.05 km	5.1 km	450 m	1275 m	5.51 km
1.06 km	1500 m	2.7 km	0.45 km	2100 m	1065 m	50 m	1200 m	650 m
925 m	1000 m	1.2 km	755 m	1045 m	1060 m	1.5 km	600 m	2700 m

TOTAL

Slide 4

What is the Distance of a Marathon?

How much time does it take?

Slide 5

What is the Distance of a Marathon?
How much time does it take?

Have you ever walked or ran a long distance?

Distance (miles)	26	13	6.5						
Time (hours)	4 hours?	2	1						

Slide 6

We are going outside.

Wear Masks, Socially distance and mind cars.

You are going to time yourselves to see how long it takes to get around the campus.

What do you need to know?

We can gather around socially distanced around the flip chart.

Then we are coming back in to complete your ratio tables to find your speed

Slide 7

Josh leaves his house at 3pm and arrives at Riley's house at 5pm the distance was 9 miles. What else could you find out?

Distance								
Time								

Slide 8

What was your speed?

Distance								
Time								

Slide 9

NON CALCULATOR

9 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.

(*a*) Work out the distance Ruth walked.

..... miles
(2)

Slide 10

CALCULATOR

18 Machine A and machine B both make car parts.

Machine A makes 6 parts every 10 minutes.
Machine B makes 13 parts every 15 minutes.

On Monday
machine A makes parts for 12 hours
machine B makes parts for 10 hours

Work out the total number of parts made by the two machines on Monday.

Lesson 4 – Holidays and exchange rates

Slide 1

Slide 2

Where would you like to go on holiday?

What would you need to take?

What's the Maths?

Slide 3

Beth goes on holiday to Spain.
The exchange rate is £1 = €1.13

Slide 4

1 Beth goes on holiday to Spain.
The exchange rate is £1 = €1.13

She changes £350 into Euros (€).

(a) Work out how many Euros she receives.

€.....

When Beth returns from holiday she changes €120 back into pounds.
The exchange rate is now £1 = €1.16

(b) Work out how many pounds (£) Beth receives.
Give your answer to the nearest penny.

£.....
(Total for question 1 is 4 marks)

Slide 5

Ben went on holiday to Australia. He changed £350 into Australian dollars ($).
The exchange rate was £1 = $2.1

Slide 6

Ben went on holiday to Australia. He changed £350 into Australian dollars ($).
The exchange rate was £1 = $2.1

(a) Work out how many Australian dollars Ben should have received.

$.....

When Ben returned he changed $100 back into pounds.
The new exchange rate was £1 = $2.2

(b) Work out how many pounds Ben should have received.
Give your answer to the nearest penny.

£.....
(Total for question 2 is 4 marks)

Slide 7

Mario is on holiday in Japan

He stays in a hotel for 7 nights.
The hotel costs ¥10000 for each night.

The exchange rate is £1 = ¥140

Slide 8

Mario is on holiday in Japan

He stays in a hotel for 7 nights.
The hotel costs ¥10000 for each night.

The exchange rate is £1 = ¥140

Calculate how much Mario spends on the hotel in pounds.

£.....
(Total for question 5 is 2 marks)

Lesson 5 – Plastering

Slide 1

Slide 2

How can Ratio fit into plastering?

Slide 3

Ratio

One 25 kg bag uses 5 litres of water.

kg	25	250	100	1000
water	5	50	20	200

Slide 4

Mixing Plaster and Ratio

One 25 kg bag will cover 1.5 square meters and will be 10 mm thick.

Bags	0	1	4	40	~~80~~
kg	25	50	100	1000	~~100~~
m^2	1.5	3.0	6	60	30

Slide 5

Ratio

1 square meter = £5 to £70

m^2	1	10	160	
£	70	140	1408	

Slide 6

Making Plaster

1. What does a square meter look like to you?
2. How many bags of plaster would I need to cover 12 Square meters?
3. What if I only needed 1 Square meter covered?
4. How much would it cost to cover 100 square meters of wall with the most expensive plaster?

Cycle 3 – Starter Lesson Template

What could I buy for £280?

Which town is 680 km from Weston?

100%	50%	25%	75%	10%	20%	5%	2.5%	17.5%
£280								
	680 km							

100%	50%	25%	75%	10%	20%	5%	2.5%	17.5%
£280	£140	£70	£210	£28	£56	£14	£7	£49
1360 km	680 km	340 km	1020 km	136 km	272 km	68 km	34 km	238 km

Use the table to help answer the following Questions

1 What is 15% of £280?
2 What is 2.5% of £280?
3 What is 30% of £280?

4 What is 1% of 136km
5 What is 21% of 136km
6 What is 70% of 1360km

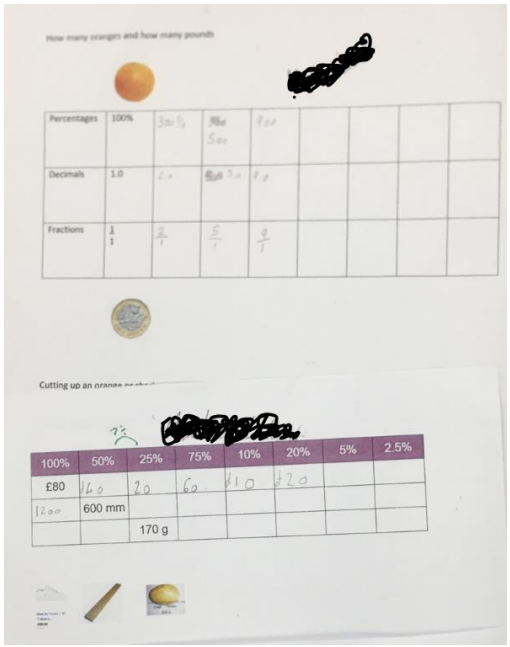
Examples of online tool used on Mathsbot

Whole	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{3}{4}$	$\frac{1}{10}$	$\frac{1}{5}$	$\frac{1}{20}$	$\frac{1}{40}$	$\frac{7}{40}$	$\frac{1}{100}$
840 kg	420 kg	210 kg	630 kg	84 kg	168 kg	42 kg	21 kg	147 kg	8.4 kg
£1040	£520		£780						

100%	50%	25%	75%	10%	20%	5%	2.5%	17.5%	1%
160 g	80 g	40 g	120 g	16 g	32 g	8 g	4 g	28 g	1.6 g
1560 cm	780 cm		1170 cm						

Serves 4	Serves 8	Serves 12	Serves 2	Serves 1	Serves 3	Serves 10	Serves 20
312 g butter	624 g	936 g	156 g	78 g	234 g	780 g	1560 g
304 ml milk	608 ml		152 ml				

Appendix E

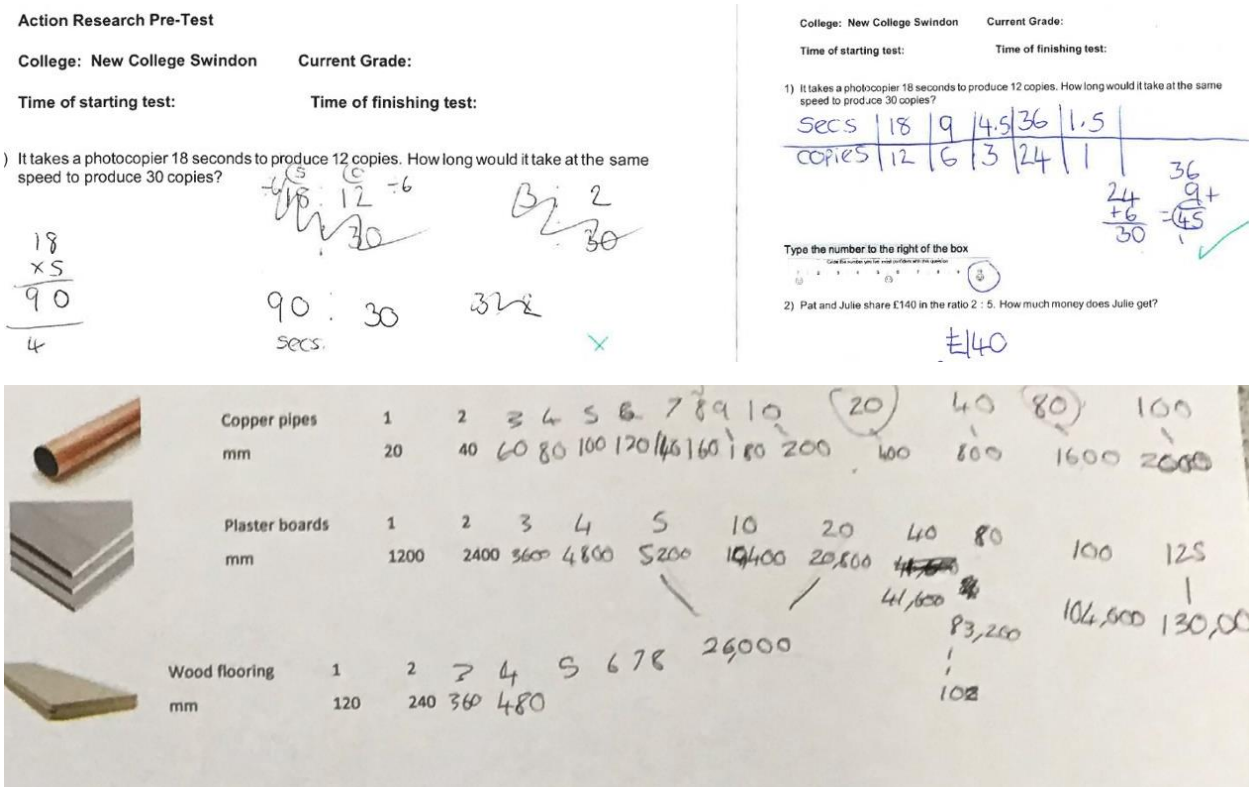


Percentages	100%							
Decimals	1.0							
Fractions	1/1							

Cutting up an orange or two

100%	50%	25%	75%	10%	20%	5%	2.5%
£80	£40	£20	£60	£10	£20		
1200	600 mm						
		170 g					

Grade 1 student work



Action Research Pre-Test

College: New College Swindon **Current Grade:**

Time of starting test: **Time of finishing test:**

) It takes a photocopier 18 seconds to produce 12 copies. How long would it take at the same speed to produce 30 copies?

18 × 5 = 90 / 4

90 : 30 secs

College: New College Swindon **Current Grade:**

Time of starting test: **Time of finishing test:**

1) It takes a photocopier 18 seconds to produce 12 copies. How long would it take at the same speed to produce 30 copies?

secs	18	9	4.5	36	1.5	
copies	12	6	3	24	1	

24 + 6 = 30 (36, 9+ = 45)

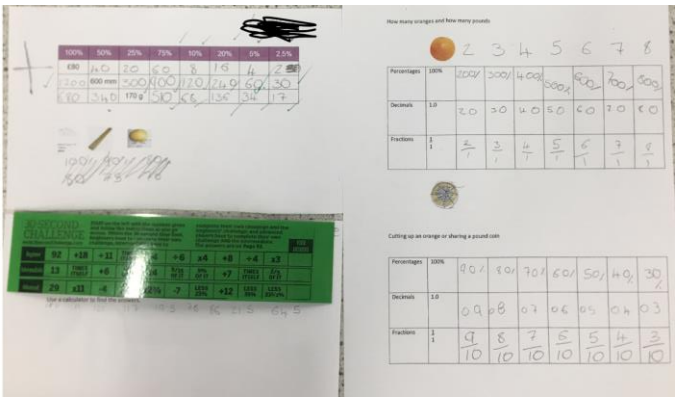
Type the number to the right of the box

2) Pat and Julie share £140 in the ratio 2 : 5. How much money does Julie get?

£140

Copper pipes	1	2	3	4	5	6	7	8	9	10	20	40	80	100					
mm	20	40	60	80	100	120	140	160	180	200	400	800	1600	2000					
Plaster boards	1	2	3	4	5	10	20	40	80	100	125								
mm	1200	2400	3600	4800	5200	10,400	20,800	41,600	83,200	104,000	130,000								
Wood flooring	1	2	3	4	5	6	7	8	26000	10									
mm	120	240	360	480															

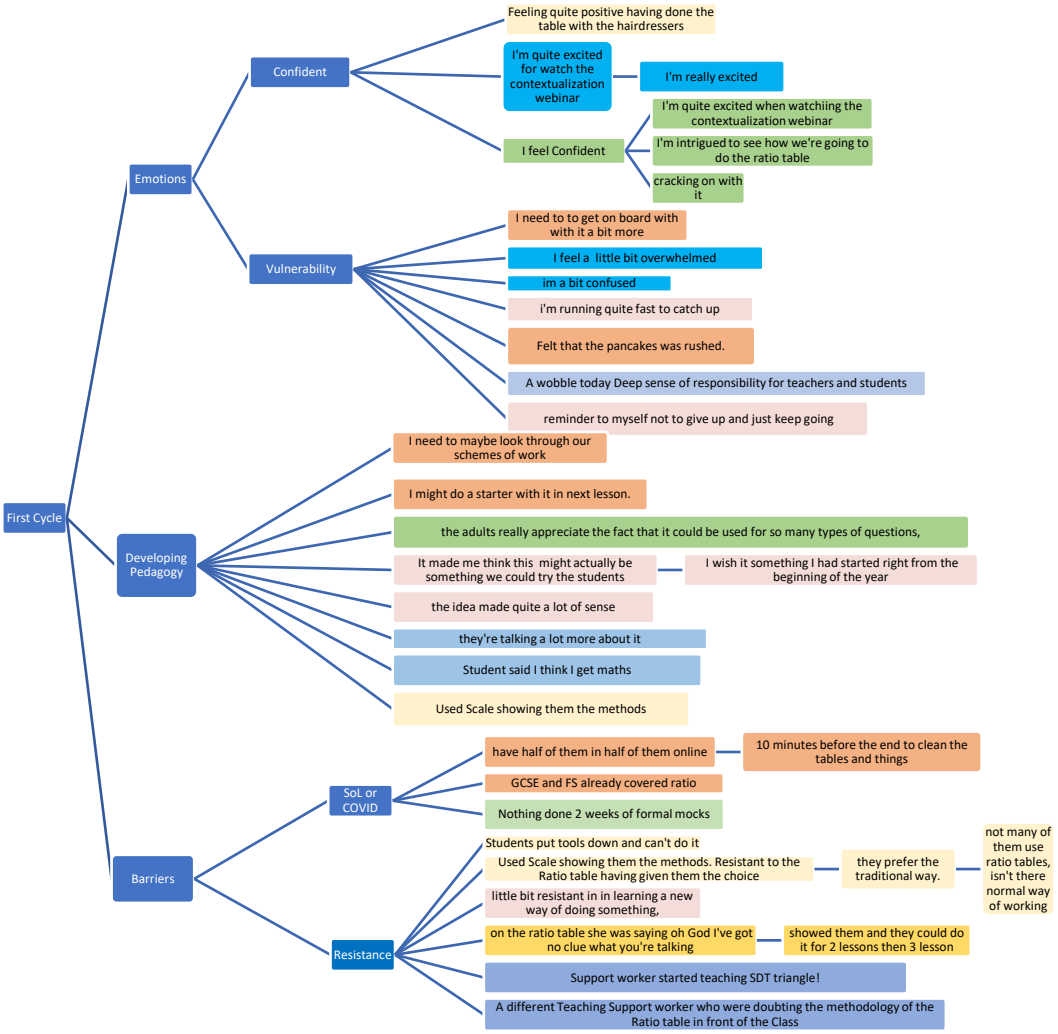
2 different Grade 2 student's work

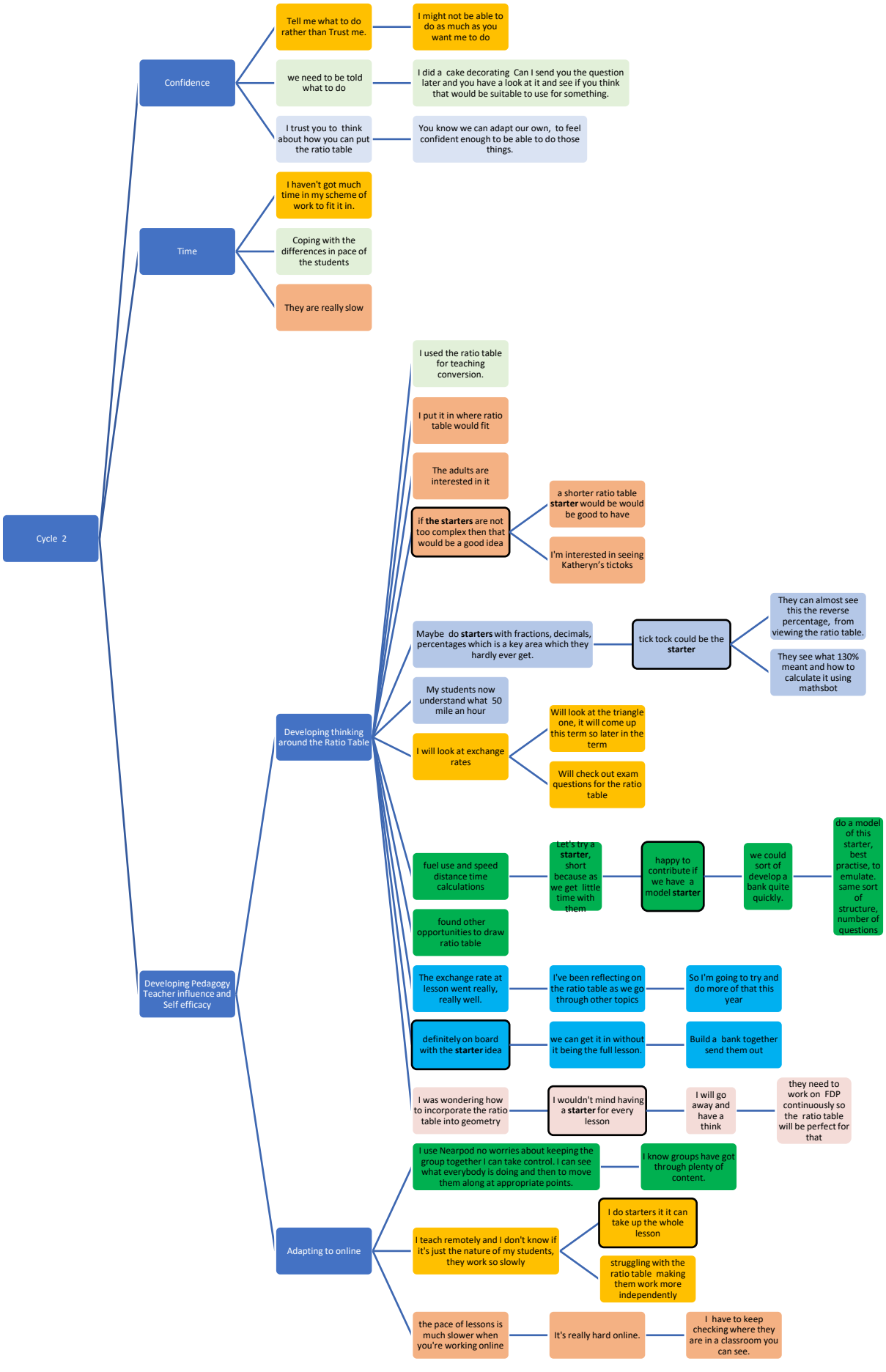


Grade 3 student work

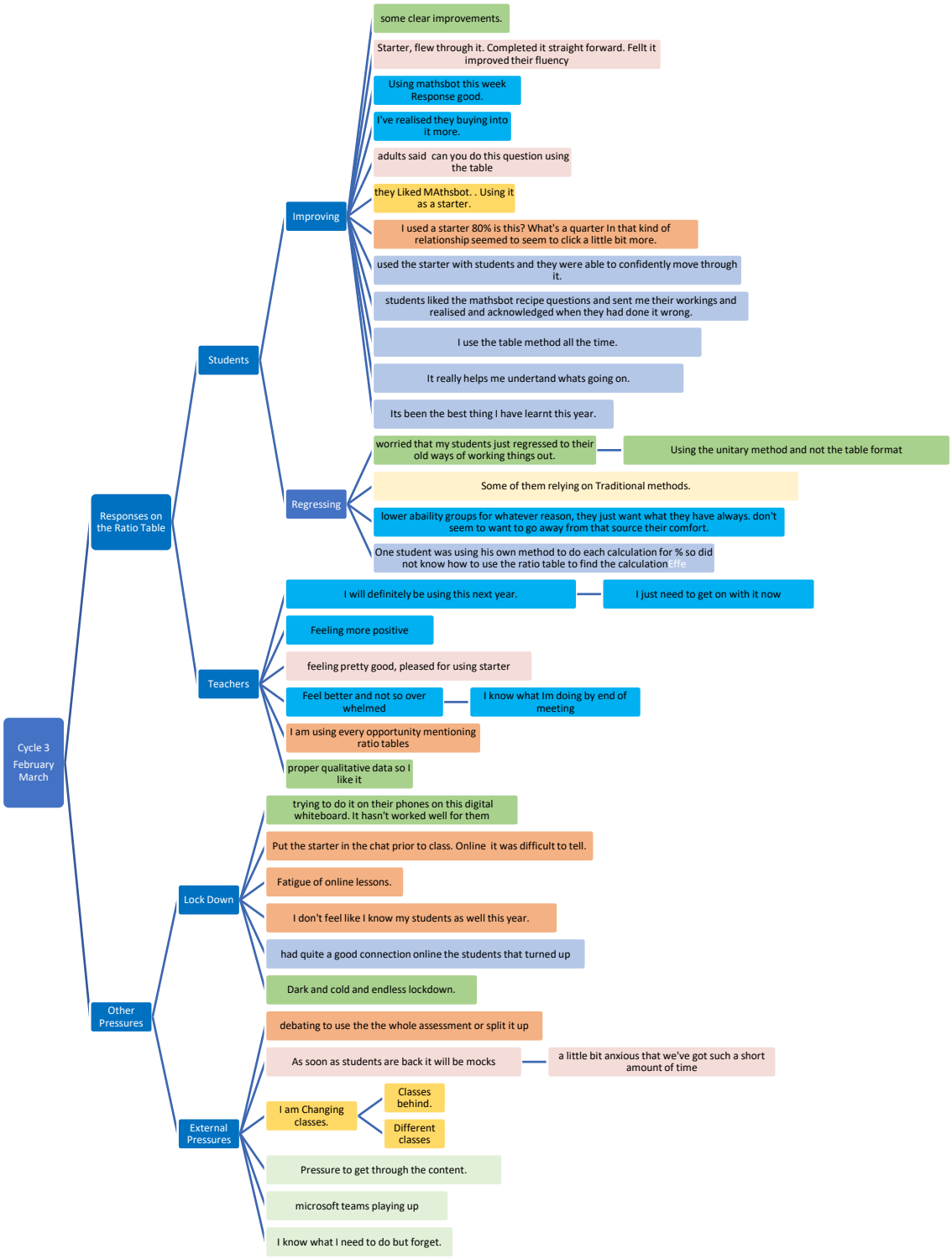
Appendix F

Teacher Reflections from Cycle 1




Cycle 2
Confidence
Tell me what to do rather than Trust me.
I might not be able to do as much as you want me to do
we need to be told what to do
I did a cake decorating Can I send you the question later and you have a look at it and see if you think that would be suitable to use for something.
I trust you to think about how you can put the ratio table
You know we can adapt our own, to feel confident enough to be able to do those things.
Time
I haven't got much time in my scheme of work to fit it in.
Coping with the differences in pace of the students
They are really slow
Developing Pedagogy Teacher influence and Self efficacy
Developing thinking around the Ratio Table
I used the ratio table for teaching conversion.
I put it in where ratio table would fit
The adults are interested in it
if the starters are not too complex then that would be a good idea
a shorter ratio table starter would be would be good to have
I'm interested in seeing Katheryn's tictoks
Maybe do starters with fractions, decimals, percentages which is a key area which they hardly ever get.
tick tock could be the starter
They can almost see this the reverse percentage, from viewing the ratio table.
They see what 130% meant and how to calculate it using mathsbot
My students now understand what 50 mile an hour
I will look at exchange rates
Will look at the triangle one, it will come up this term so later in the term
Will check out exam questions for the ratio table
fuel use and speed distance time calculations
Let's try a starter, short because as we get little time with them
happy to contribute if we have a model starter
we could sort of develop a bank quite quickly.
do a model of this starter, best practise, to emulate. same sort of structure, number of questions
found other opportunities to draw ratio table
The exchange rate at lesson went really, really well.
I've been reflecting on the ratio table as we go through other topics
So I'm going to try and do more of that this year
definitely on board with the starter idea
we can get it in without it being the full lesson.
Build a bank together send them out
I was wondering how to incorporate the ratio table into geometry
I wouldn't mind having a starter for every lesson
I will go away and have a think
they need to work on FDP continuously so the ratio table will be perfect for that
Adapting to online
I use Nearpod no worries about keeping the group together I can take control. I can see what everybody is doing and then to move them along at appropriate points.
I know groups have got through plenty of content.
I teach remotely and I don't know if it's just the nature of my students, they work so slowly
I do starters it it can take up the whole lesson
struggling with the ratio table making them work more independently
the pace of lessons is much slower when you're working online
It's really hard online.
I have to keep checking where they are in a classroom you can see.

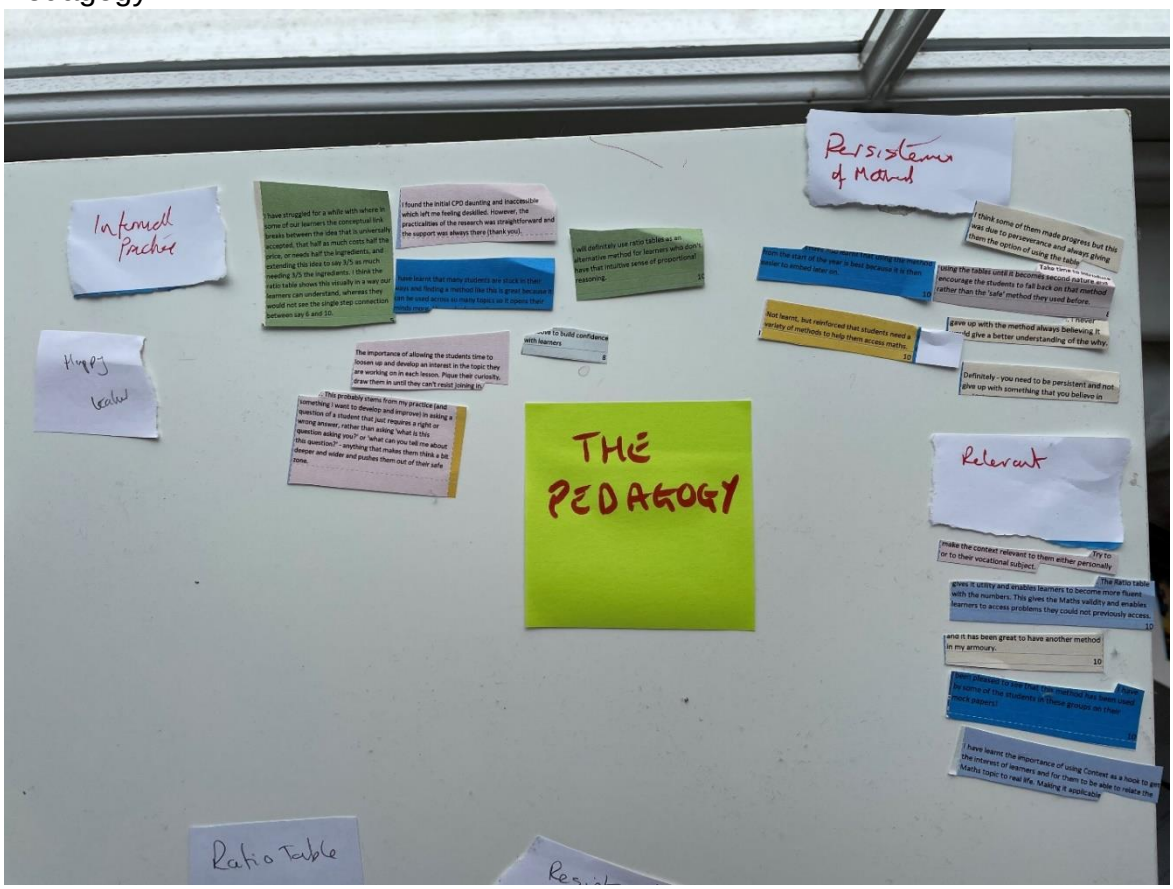
Teacher Reflections from Cycle 3



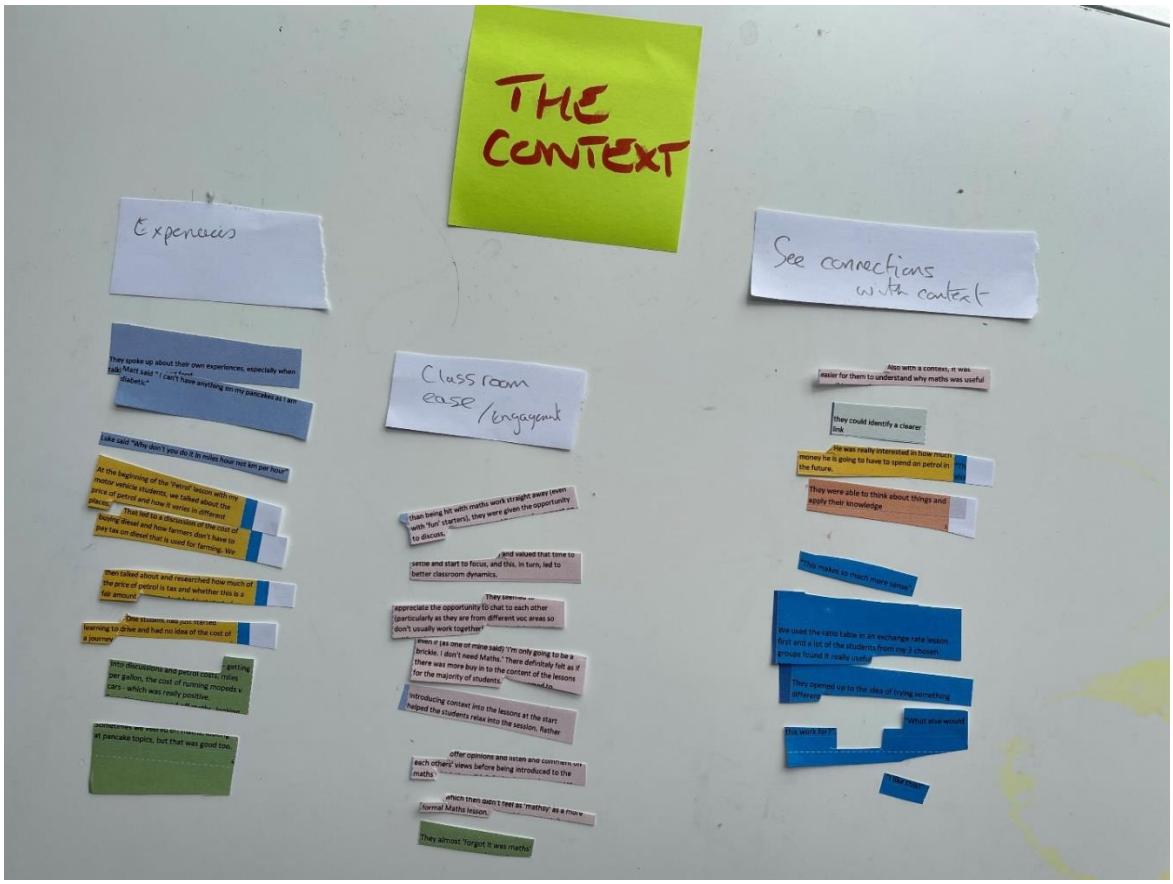
Appendix G

Teacher Final Reflections from Microsoft Form

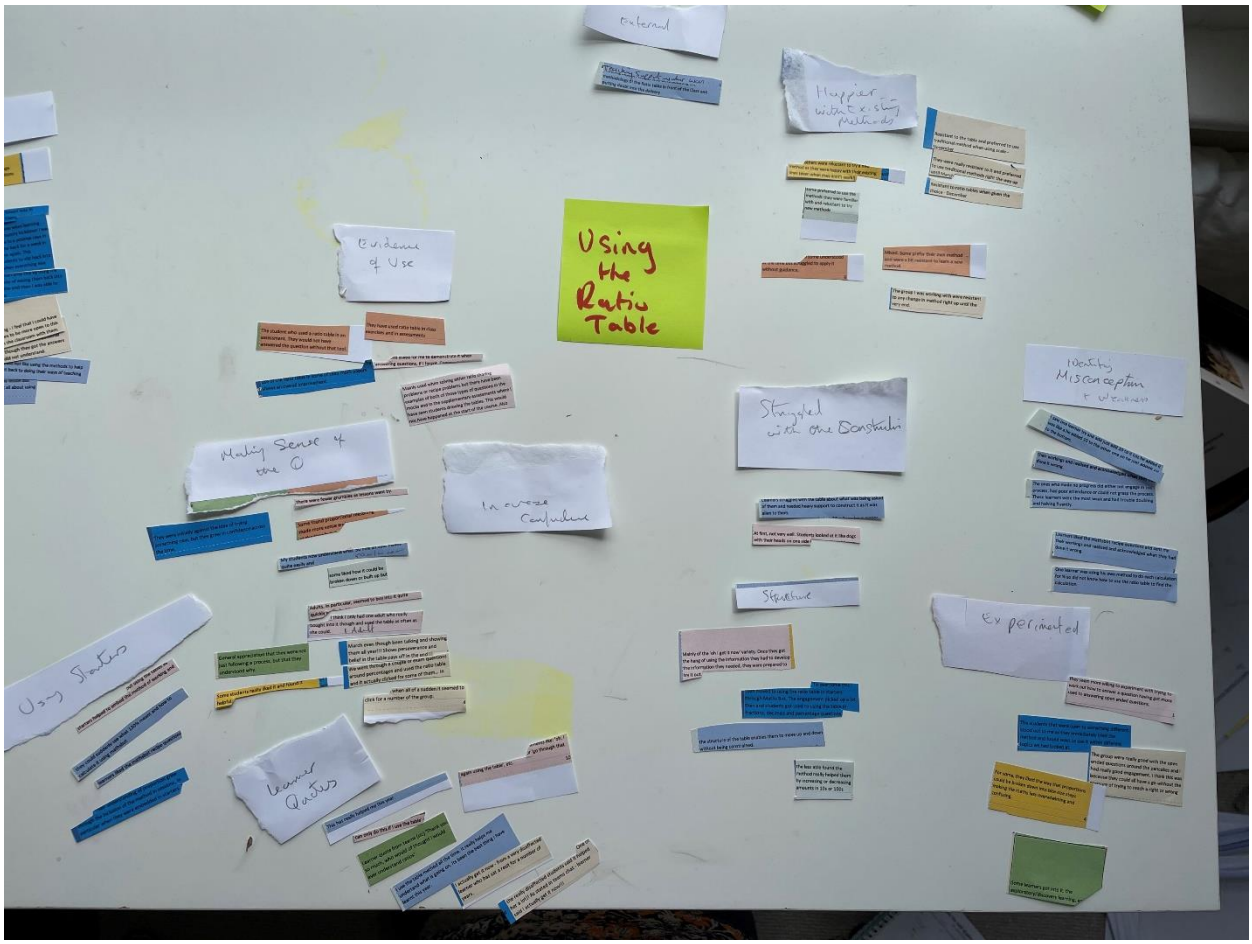
Pedagogy

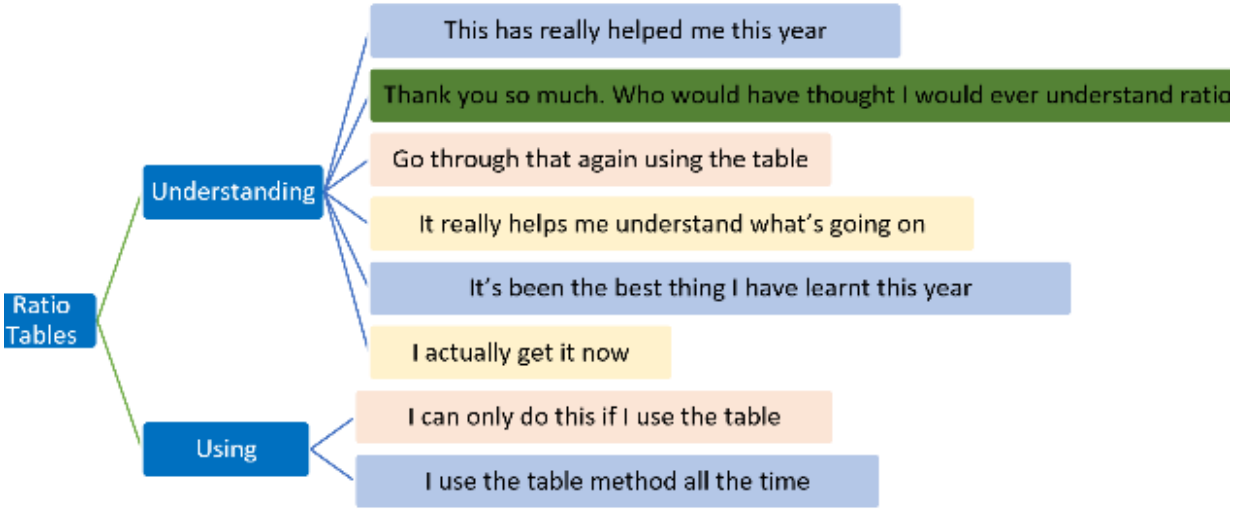


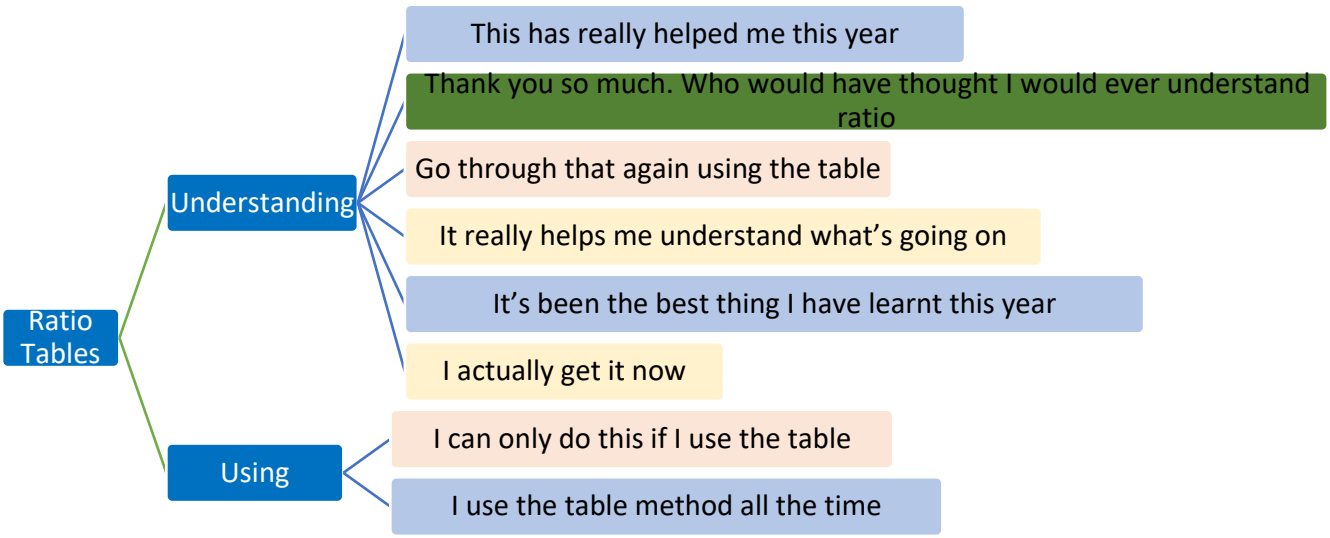
The Context



Using the Ratio tables






Ratio Tables
Understanding
This has really helped me this year
Thank you so much. Who would have thought I would ever understand ratio
Go through that again using the table
It really helps me understand what's going on
It's been the best thing I have learnt this year
I actually get it now
Using
I can only do this if I use the table
I use the table method all the time

Appendix H

		Q1 Pre-test		Q1 Post-test		Pre-test		Post-test		Pre-test		Post-test		Pre-test		Post-test		Pre-test		Post-test		Pre-test		Post-test		Pre-test		Post-test	
	Student	Q1 Used F	Correct?	Q1 Used RT	Correct?	Q2 Used F	Correct?	Q2 Used F	Correct?	Q3 Used F	Correct?	Q3 Used F	Correct?	Q4 Used F	Correct?	Q4 Used F	Correct?	Q5 Used F	Correct?	Q5 Used F	Correct?	Q6 Used F	Correct?	Q6 Used F	Correct?	Q7 Used F	Correct?	Used RT	Correct
	1	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	0	0	1	1	0	0	0	1	0	1	0	1	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0
	6	0	0	0	1	0	0	0	1	0	0	1	0							0	0			0	0	0	0	0	0
alc	7	0	0	0	0	0	0	1	0			0	1			0	1			0	0			0	1	0	0	0	0
	8	0	0	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	1	1	1	0	1	1		0	0	0
	9	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	1	0	0				0	0	0	0	0	0	1	0	1	0	0			0	1	1	1	0	0	0	0
	11	0	1	1	1	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0
	12	0	0	1	1	1	1	0	1	0	1	0	1	0	1	0	1	1	1	0	0	1	1	0	0	0	0	0	0
	13	0	0	0	0	1	1	0	0	0	1	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
	14	0	1	1	0	1	1	0	1	0	1	0	0	0	1	0	1	1	1	0	1	1	1	0	1	0	0	0	0
	15	0	0	0	1	1	0	0	0	0	0	0	0	1	1	0	0	1	1	1	1	0	0	1	1	1	1	0	0
	16	1	1	1	1	1	1	1	0	0	0	0	0	0	1	0	1	1	1	1	1	0		0	1	0	0	0	0
	17	1	1	1	1	0	1	1	1	0	1	0	1	0	1	0	1	0	0	0	0	1	1	1	1	0	0	0	0
	18	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19	0	0							0	0	0	1	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0
	20	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	21	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1
	22	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	0	1	0	1	0	0	0	0
	23	0	1	0	1	0	1	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	24	0	0	1	1	1	1	1	1	0	1	0	1	0	1	0	1	0	0	1	1	1	1	1	1	0	0	0	0
	25	1	1	1	1	1	1	1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0		
		4	11	13	14	8	9	13	16	0	7	1	9	1	10	2	13	5	6	6	9	6	7	5	11	1	1	1	1

Questions used for the pre and post test

Date: Current Grade: Name:

Action Research Pre-Test

College: **Current Grade:**

Time of starting test: **Time of finishing test:**

1) It takes a photocopier 18 seconds to produce 12 copies. How long would it take at the same speed to produce 30 copies?

2) Pat and Julie share £140 in the ratio 2 : 5. How much money does Julie get?

3) In 1976, the average yearly wage was close to £3300. On average people spent 17% of their average yearly wage on a family holiday. How much money is this?

Examples of online tool used on Mathsbot

Whole	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{3}{4}$	$\frac{1}{10}$	$\frac{1}{5}$	$\frac{1}{20}$	$\frac{1}{40}$	$\frac{7}{40}$	$\frac{1}{100}$
840 kg	420 kg	210 kg	630 kg	84 kg	168 kg	42 kg	21 kg	147 kg	8.4 kg
£1040	£520		£780						

100%	50%	25%	75%	10%	20%	5%	2.5%	17.5%	1%
160 g	80 g	40 g	120 g	16 g	32 g	8 g	4 g	28 g	1.6 g
1560 cm	780 cm		1170 cm						

Serves 4	Serves 8	Serves 12	Serves 2	Serves 1	Serves 3	Serves 10	Serves 20
312 g butter	624 g	936 g	156 g	78 g	234 g	780 g	1560 g
304 ml milk	608 ml		152 ml				

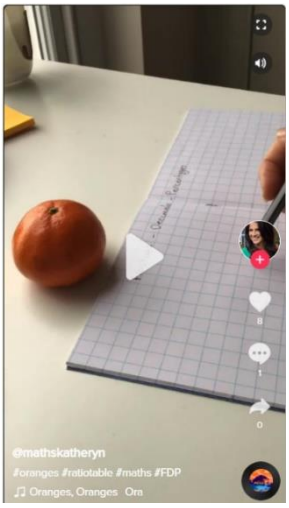
What could I buy for £280?

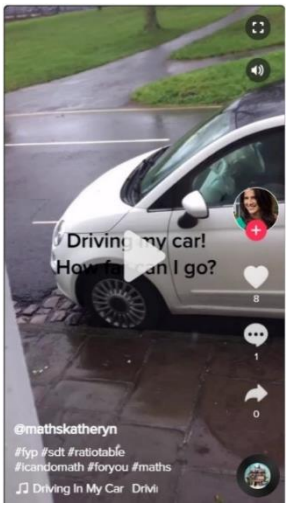
Which town is 680 km from Weston?

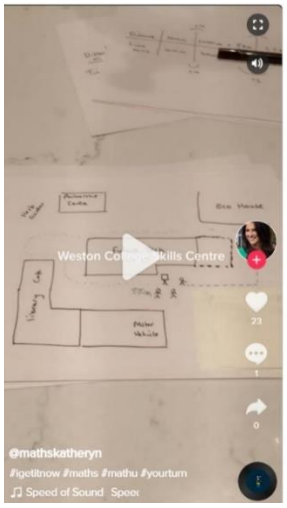
Copy Ctrl+C

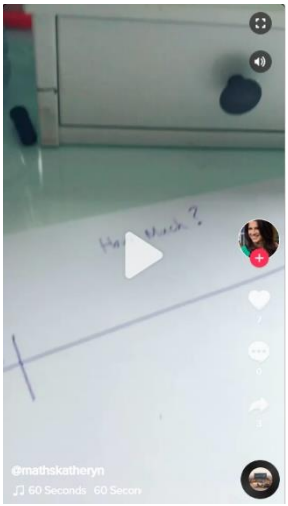
100%	50%	25%	75%	10%	20%	5%	2.5%	17.5%
£280								
	680 km							

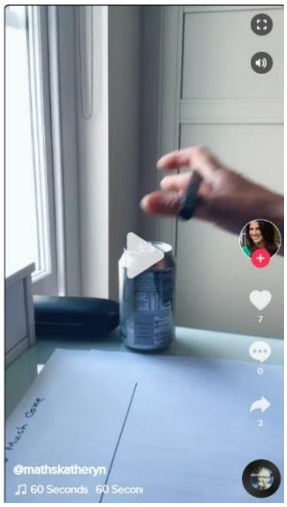
Tik Toks

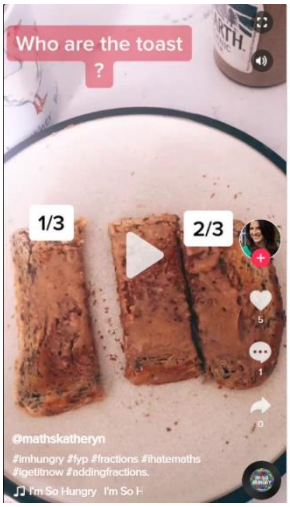


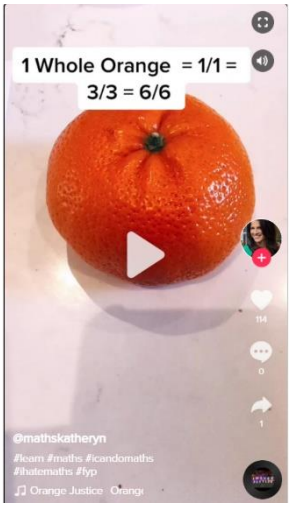












[Research on Multiplicative Reasoning Padlet]

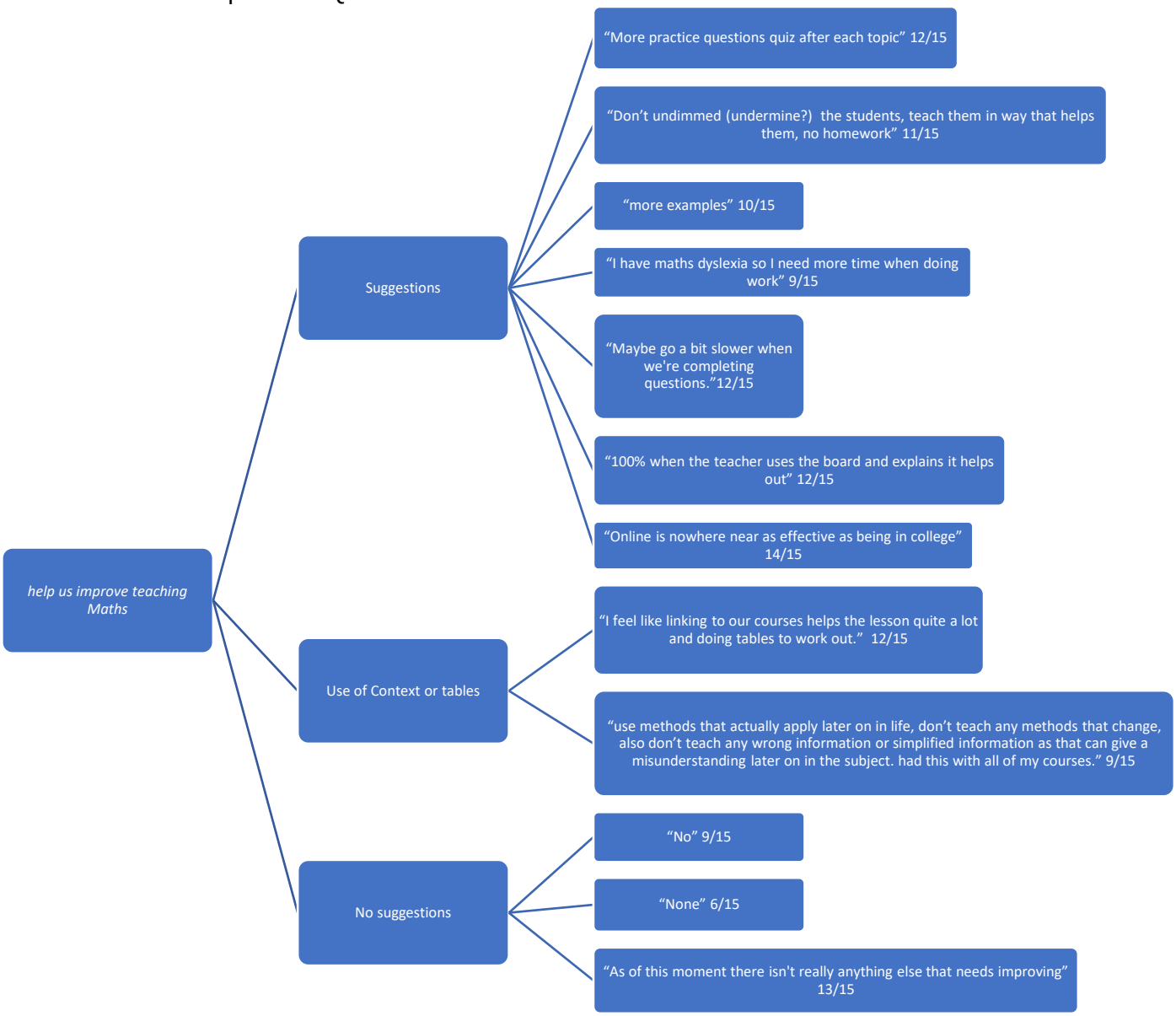
Sample of Teachers' Transcriptions from meetings

6th Oct	20th October	24th Nov	8th 9th Dec	13th January	10th Feb	17th March
felt overwhelmed by the initial CPD event.	I'm being very positive I'm not tired I'm not confused and I'm not overwhelmed I know exactly what's going on	Left				
Confident	I'm quite excited when watching the I'm intrigued to see how we're going t	The context the adults really appreciate the fact t we then improve our answers and confidence on cracking on with it	Nothing as been doing 2 weeks of formal There is a fuel use and like the pancakes or the	I've started I've done the initial assessment I've done the pancakes session and the petrol session, and then since then a founder of opportunities to draw ratio tables in. When we've be **I use Nearpod and I don't have too many worrie** I know **groups have got through plenty of conten** **I'd be quite happy to try an integrated starter. b** is we just **get one lesson a week with most of our** **I'm happy to contribute if if there is a model starter**, we could sort of develop a bank quite quickly. **do a model of this starter, best practise, to emulate. same sort of structure, number of questions**	it's **been a miserable few months**, hasn't it? **January** Dark and cold and endle I'm worried that my learners just **regressed to their old ways of working thing** **on nearpod** and they need to draw tings out with tables and they're trying to do it **. I think our data is going to be strong and nothing is going to show su** proper qualitative data so I like it.
Confident	Feeling quite positive having done th	tools down and can't do it not many of them use ratio tables, isn't there norr what figures could we do now? What percentage is could we find now?	Used Scale showing them the methods Scale 4cm and 6m they prefer the tradit What questions are we using? What do you know, what do I need to find out. You need to be a Maths Detective.	Using Starter with hairdressers. Gave them a proforma. Some of them relying on Traditional methods. happy to carry on with mathsbot. Starters.		

- Don't put any data or results here, please – that should all go in the Results section. If you have too much data to present in the Results section, please get in touch with ETF's National Research Adviser, Cath, who'll be able to make some suggestions (cath.gladding@etfoundation.co.uk)

Data not used.

- **Student Quotes**
-
- Student Comments from this Question
- "*Thank you for taking part in this survey. Please make any other comments to help us improve teaching Maths*." Adding their total star score 1 Star = not at all. 5 Stars = A lot from the 3 previous Questions.



- From the 55 students who answered the survey, 12 were able to articulate a comment about how to improve their experience. 10 with long answers scored 9-14 stars out of a possible 15.
- 7 came up with helpful suggestions, 2 of which were indicating they required more support. 2 spoke about the use of context or ratio tables
- In hindsight the Question should have asked them to articulate their experience of the year. This would have been more impactful and although these comments are interesting but no conclusions can be drawn.