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SHAPING SUCCESS ACTION RESEARCH PROJECTS

FINAL REPORT ON THE SHAPING SUCCESS AR PROJECT – USING ONLINE DELIVERY TO SUPPORT LEARNING AND ENGAGEMENT IN MATHS

College of West Anglia

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College of West Anglia

This project started with an aim to develop our team's ability to deliver remote learning for 16-18 year olds studying Maths. As the project progressed our research aims evolved, and we report on our research into maths anxiety and misconceptions here.

Summary

The College of West Anglia is a Further Education (FE) college in the East of England, spread across five campuses in Norfolk and Cambridgeshire. The Maths department primarily delivers GCSE Resit and Functional Skills lessons, but also teaches Adults in 1 year and half year courses, along with a pilot programme this year for Level 3 Core Maths.

We commenced this project with the aim of adapting our maths delivery to something we could deliver online. We had no experience in doing this at the start of the project, but found we quickly grew in confidence due to our amazing team. We therefore narrowed the focus of this project to investigate common issues learners have with their maths development – maths anxiety (Aga's focus) and misconceptions (Carl's focus).

Carl developed low-stakes quizzes on each topic he taught this year, which were generally used at the start and end of a topic. In the initial focus, this was a method to capture learner progress in online lessons. We overestimated how complex this task would be, and our project very quickly turned in to a case study on maths misconceptions when we decided to investigate our learners' thought processes. The quizzes were made with questions from DiagnosticQuestions.com, which was initially chosen as a way of reducing preparation complexity. All the questions have carefully chosen incorrect multiple-choice answers to expose misconceptions and detect how learners think about a problem. This choice of questions generated data that prompted the shift of focus upon the misconceptions that arose.

One key finding was that there are two types of misconception – Direct and Emergent – that depend on the concepts involved, and that the 'emergent' type can be much harder to tackle – this was found to be the case in our research (example in Appendix 2).

While Carl focused on specific mathematics pedagogy and subject specific development, Aga focused on underpinning emotional connections to the subject itself.

Maths Anxiety is a key issue that has been described as affecting a large proportion of learners, and it has been stated that retaking GCSE maths could cause maths anxiety (Pearson, 2019) especially those resitting GCSE. Considering this, and the

fact that we found a considerable variety of well-established misconceptions, we decided to use action research to ascertain if there is a link between the two.

Aga devised a questionnaire (Appendix 3) which was distributed to Carl's and Aga's learners. Forty-one learners took part in it and four of those learners were then invited for an interview - one learner agreed to take part. (Appendix 4). We were hoping to have a higher uptake to have better picture of what learners' views on the matter are but, unfortunately, due to GCSE sessions finishing early this year and remote delivery we were unable to. We will continue this part of our research once we are back to face-to-face delivery.

Questionnaire analysis showed that only half of learners asked said they knew what the term 'maths anxiety' means (Appendix 3) and only sixteen learners were able to name possible signs related to maths anxiety (Appendix 3).

We were unable to determine if there is a direct connection between misconception and maths anxiety with our learners, though there is evidence from other research that the two can be linked (Sokolowski and Ansari, 2017). There was insufficient evidence to make an evidence-informed link due to the limited number of learners involved in this part of the research and the type of delivery we used this year. Our findings were inconclusive, but we would like to continue this research once we are back to face-to-face teaching to be able to maximise learner success.

Rationale

This year has been challenging – in addition to the regular challenges of teaching GCSE resits (from those who sat an exam), this year has been compounded by having learners who have not formally sat GCSEs due to the Centre Assessed Grades (CAGs) in 2020. We therefore decided to shift our focus away from the initial proposed intention of the work to investigate techniques of online pedagogy.

Engagement of learners has been something we wanted to address from the start of the project. Learner engagement has been a problem for both GCSE and Functional Skills lessons, which is one of the common issues we have in the FE environment.

One key aspect of our project initially was to investigate how learners might effectively communicate answers to us. Once we started using our new lesson plans (created prior to this year and adapted from the 5Rs by Julia Smith (2020)), we considered engagement alongside effective assessment.

We also investigated how, what (and why) our learners think about maths and learning of maths, along with effective assessment for learning that can be delivered remotely. Literature indicates there are two possible consequences when learners fail their maths – increased perseverance which helps improve the learner's performance, or fear of failure which leads to a decline in performance and anxiety (Johnston-Wilder, et al., 2015).

Every year, around one thousand learners must study maths at The College of West Anglia. Around half of these learners, because of the Government's condition of funding policy, are required to continue studying towards GCSE maths (Education and Skills Funding Agency, 2014). The current national GCSE pass rate in FE is

around 20% (Linford, 2019), which means approximately one hundred learners will achieve grade 4 or above.

The focus in this action research was developed via Cambridge Maths Hub's (Cambridge Maths Hub, 2021) Post16 workshops, particularly their session on maths anxiety. Our learners often say they cannot do maths and that it makes them anxious. We wanted to understand what learners meant by this statement, what their understanding of maths anxiety is, how it manifests in our classrooms and finally if there is correlation between misconceptions (that are so very common in FE maths re-sitters) and maths anxiety.

Approach

1. Initial Planning phase – identifying how we can adapt to the online learning environment.
    a. Adapting lesson resources from traditional style into 5Rs (Smith, 2020) and accommodating Variation Theory (Barton, 2020).
    b. Finding online technologies that can be used for effective Assessment for Learning.

2. Focusing on Learner Engagement – how can we maximise it?
    a. Different variation sequences and questioning
    b. Trying multiple digital methods to engage and assess learners: What to use apart from our own VLE? Are there any technologies that learners refuse to use?
    c. Which systems are best to use, and are there any learners who cannot access lessons due to digital poverty?
    d. Can we ensure learners are present – ideas from behavioural science. Investigating how we enforce attendance and engagement within lessons – how do we keep those less motivated?
    e. Additional challenge – second large scale lockdown January – March 2021.

3. Identifying maths anxiety and misconceptions – now we have engagement, what can we find out?
    a. Assessment for learning throughout the year with Diagnostic Questions (Barton, 2018). Use of this questioning approach gave inspiration for the misconception investigation.
    b. Direct misconception buster sessions delivered in March and April with ~50 learners. Evidence of improvement across the session and one week after evident.
    c. Surveys completed on maths anxiety.
    d. Two learners chosen for interview on maths anxiety.

4. Synthesis of findings to a conclusion

Professional learning: Evidence of changes in teaching, learning and assessment practices

Previously the maths department had used a 'Top 15' (Grimsby Institute C4ME team, 2020) approach to delivery of GCSE resit maths. 'Top 15' is a focus on the 15 most common topics that appear in exams. This allowed us to reduce the scope of the GCSE specification delivered as we only have nine months to deliver two years of teaching and learning.

This approach had been successful in the previous academic year as it allowed the maths department to transition from teaching the full curriculum (in a very short period) to teaching the most important skills needed to be successful in GCSE examination, as well as everyday maths.

This transition made us realise our learners are not able to connect different topics and apply their skills in different scenarios, for example 'translating' a worded problem into a solvable algebraic equation (Appendix 5). Our teaching approach had to change to give learners the opportunity to develop this skillset. We started a transition to 5Rs based lesson plans (still using the Top 15) when lockdown started.

The 5R model focuses on five elements: "Routine, Recall, Revise, Repeat and Exam Ready?". It was first introduced to us in 2017, at the same time as the 'Top 15' approach. At the time, 'Top 15' seemed more important to implement into our delivery, and implementation of the 5R model across our team was inconsistent. Since then, we have modified Julia's 5R model to suit our learners and delivery methods and we re-designed our lesson structure around it.

The new sessions also incorporated variation theory to encourage learners to think about the mathematical methods and processes they would be manipulating in their lessons. Variation theory relies upon question sequences where a crucial aspect changes while others stay the same – such that learners should discern the crucial part (Barton, 2020). Full usage of this theory requires learners to reflect upon and consider how their answers change, and stronger learners may be able to explain 'why'. We decided to integrate this into our delivery as these allowed learners to draw connections between topics, that at first might seem disconnected, but are all interlinked (Appendix 6).

At the start of our research project we had already put the above systems in place, though the variation sequences had only been used in a simple way, and as a source of useful questions. One modification to our session design in the project was to use the 'Rule' type of question set (Barton, 2020), where typically only 3 answer options would be available. This reduction in plausible answers helped to facilitate engagement with learners, and creative use of this style of question was useful for developing engaging activities for learners on more challenging topics such as identifying 'reverse percentage' questions (Appendix 7).

We quickly established that misconceptions have a clear impact upon learner outcomes. Carl was studying his PGCE this year and researched the theories of misconceptions as a key part of his subject specialism. In turn, these theoretical findings were applied within our action research and put into practice.

> *"Maths, more than any other subject, has the power to crush children's confidence and to deter them from learning important methods and tools for many years to come"*
>
> (Boaler, 2015)

The majority, if not all, of our maths learners come to us with negative emotional baggage surrounding maths. Research into maths anxiety shed an interesting light on the importance of learner perception of maths and their willingness to keep trying – 'maths resilience'. Although we were not able to fully investigate how anxiety or resilience manifests within our classroom due to remote lesson delivery, we were able to collate some learners' views on the matter and will be looking at continuing this research next academic year. As a team, we are very keen to ensure learners' previous experience in learning mathematics is not a barrier to learning it with us.

Evidence of improved collaboration and changes in organisational practices

One of the biggest changes in our delivery this year was remote working and live online lessons as well as our new lesson structure, which, having been developed for face-to-face delivery, had to be adapted.

In September 2020, after very careful planning of our resources with variation theory and prior learning at the heart of everything, we found ourselves adapting resources to allow online delivery. Most of our resources were produced with the assumption that learners will have access to teaching and learning tools such as whiteboards, books, and maths equipment.

Due to the nature of online delivery and the fact that we were not in our usual classroom environment, unable to provide physical learning aides, we had to research and trial online software that would replicate them virtually.

One barrier to effective teaching and assessment has been a lack of verbal learner communication via Zoom. This has been due to technological issues (such as digital poverty or use of mobile phones to access online lessons) as well as some learners being uncomfortable with it. Most learners were also not using their cameras, for the same reasons. This meant we were not able to rely on body language which could indicate they need assistance and restricted our methods for assessing their learning.

The maths team researched a range of different software applications that would enable us to effectively assess learning. Our preferred tools were Whiteboard.fi, DrFrost Maths, OneNote and Microsoft Forms. As a team, we put together several training sessions to present and try those out before we used them in lessons. Successful tools were in turn communicated to the rest of the college in Continued Professional Development (CPD) events. None of those were as effective as physical tools, partly because we did not have a single approach as a team but also, it relied on learners being able to switch between different tools on their devices, at times more than two in a lesson.

As mentioned above, we found out it was difficult to gauge learners' understanding at first. Carl developed his quizzes to help understand what learners have learnt after the lesson, which then turned into prior learning check and 'what have you learnt this lesson?' tasks. This allowed us to a) understand learners' starting point and b) see in-lesson progression. Those quizzes were available to the team to use as they see fit. Some members of the team used Carl's approach and produced quizzes of their own, which they then shared with others.

Carl and Aga had regular meetings to discuss findings and decide on next steps. This time was also designated to discuss any changes needed to our approach, such as use of quizzes as a prior learning check as well as lesson plenary. We also looked at other possible interesting avenues in mathematics education such as comprehensive reading and understanding questions, confidence levels in answering questions, and formal and informal methods of concept delivery. While we did not investigate these aspects in this project, we could do so in the future – a focus on reading and understanding questions could be very beneficial to our learners.

Our team is very fortunate to have been allocated weekly teaching, learning and assessment sessions. The maths team meets Friday afternoon as part of CPD. We use that time to collaborate on resources and new ideas, take part in maths specific professional training, and team discussions on teaching and learning approaches. We also use that time to share good practice with one another.

Evidence of improvement in learners' achievements, retention and progression

We initially identified two learners in the same group for a case study. One of these learners entered the GCSE November 2020 series and passed with a grade 5. Her feedback (Appendix 8) was that learning synchronously over Zoom was beneficial as it reduced the noise in her learning environment and helped her to understand concepts. Utilising the Zoom messaging system was described as beneficial as it meant that explanations could be read multiple times.

An early piece of assessment – before and after teaching fractions – demonstrated the two misconception types well and can be seen in Appendix 2. The results demonstrated that learners progressed better where errors came from reading the question accurately, rather than those where the process itself was poorly understood prior to the topic being covered. We concluded that learners expect that mathematical operations with addition should be straightforward. Since the addition of fractions is not simple, it seemed that learners treated it as if it were, and despite learning the correct process, did not tend to retrieve this knowledge when tested. It seems likely that our learners were able to apply the skill when taught it (procedural understanding), but unable to correctly identify when to use the skill (conceptual understanding (Rittle-Johnson, et al., 2016)).

In the later stages of the project, we investigated algebraic misconceptions – specifically, erroneous simplification, for example:

$$2x^2 + x^3 = 3x^5$$

For this task, a diagnostic quiz was used to determine which misconceptions a group had, before tackling the misconception with Frayer models (Quigley, 2018). The correct answer to this first algebraic simplification was 'Does not simplify' – it seemed that learners may be reluctant to select this option. A follow up short low-stakes quiz at the end of the session was used to determine if learners had progressed in the short term. The following week an additional quiz was used that used modified versions of the original questions, and another quiz was to be used after a month to test retention. In general, after a week, more correct answers were given, and some errors were almost eliminated. A detailed breakdown of the results we were able to gather can be seen in Appendix 9.

As mentioned previously, we also wanted to investigate how our case study learners feel about maths as a subject and what emotions maths education brings as well as if there is correlation between misconceptions.

Johnston-Wilder et al., (2019) describe maths anxiety as:

> *"a negative emotional reaction to mathematics that acts as an 'emotional handbrake' and holds up progress in maths."*

Aga found that from 41 learners who answered a questionnaire on maths and maths anxiety, 20 learners had either not heard about it or had no idea what it was. (Appendix 3). Other answers varied between "Nervous to do maths", "When you get stressed and worry about maths" or "When people hate maths, but they are forced to do it".

Although learners often say 'maths makes me anxious', responses in the questionnaire did not support this claim amongst those asked. One key question used was "What do you understand by "maths anxiety"?" - an example response given was "I assume its where it gives you anxiety, like what I have". This learner was invited to an interview in which she admitted she didn't know 'maths anxiety was a thing'. (Appendix 4). When asked to elaborate on this statement, the learner said:

> *"I wouldn't say the whole thing in general (maths), but some parts of maths make me anxious, I just want to completely shut off and I just get worked up about it".*

Johnstone-Wilder et al talk about the brain-hand model (Johnston-Wilder, 2021); Siegel (Siegel, 2012) introduced this method as a way of explaining what happens in our brains when faced with a threatening situation, in our case, learners' fear of failure.

In our survey, we asked "What were the signs/ changes in their behaviour? (of people experiencing maths anxiety)", only 16 learners were able to answer this question. Some responses were "Get angry and loose the temper and keep worrying", "They Go quiet", "not want to do it as they think there not good at it", "get quieter and

stressed". This is a typical 'fight, flight, freeze' response. There are a number of possible ways to address this and help build their maths resilience to minimise occurrence of feeling helpless:

1) ensuring teachers are aware of the emotions surrounding a particular task
2) recognising when emotional stress is overtaking and
3) working on relaxation response.

This year, due to online lesson delivery, the only possible way of knowing if learners are experiencing emotional distress was for them to communicate it directly with us via their preferred communication method and, so, this part of the research was not successful. We were not able to introduce relaxation methods either as we have not been aware of possible emotional difficulties.

The survey also asked learners if they think "maths anxiety relates to reading and understanding exam questions?" (Appendix 3) and if so, how. Twenty-four learners answered this question and some of their responses were "You don't read the question right and rush through questions and get them wrong", "You feel a big amount of pressure, you get flustered, which overall creates a negative mindset. no one will do well in exams with this mind set", "makes you nervous which blocks of your whole understanding and makes you think you're doing things wrong".

Learning from this project

Two of the misconceptions we have identified (Appendices 2 & 10) are of a non-standard usage of the plus sign. As addition is one of the simplest parts of maths, learners often 'Just Add' numbers. Identifying ways this can be addressed to ensure that learners use the correct procedures would be something to investigate in the future.

The use of diagnostic quizzes online has been straightforward as learners could be sent the links required directly in the Zoom chat. Embedding these into face-to-face sessions may be more challenging due to the requirement of digital devices in the classroom, and the opportunity for disruption these provide. This may be addressed with different approaches to facilitating such quizzes and meeting this need will be a good challenge early in the next year.

The misconceptions identification quiz gave useful data, identifying key misconceptions to address in the session in the short term. The next week's recall quiz showed good progression but unfortunately timing prevented a 4-week check of learner retention of the correct methods with the algebra case study. This could be improved with changing question styles. The infrequency of the correct answer being 'none of the above' may have reduced learner willingness to select this option.

It would also be useful to now bring in some real-world approaches to maths to help to address misconceptions. A 'Concrete, Pictorial, Abstract' process, using real items that can be physically manipulated ('Concrete'), or drawn visually ('Pictorial') and finally shown in a mathematical sense ('Abstract') could be used to debunk misconceptions.

The fully online teaching allowed learners to be quite passive. I would like to investigate the difference between misconceptions being identified by the teacher vs being identified through peer assessment, and if learners find the latter more motivating and if it benefits retention.

Research into maths anxiety has given us a lot to think about. It has outlined the importance of learners' prior maths experiences, their emotional connection to the subject (very often negative) and the need for inclusive environment for learners to thrive in. Although our research in this area was inconclusive, our aim is to continue this on a larger scale, across both GCSE and Functional Skills qualifications.

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Appendix 1: The project team

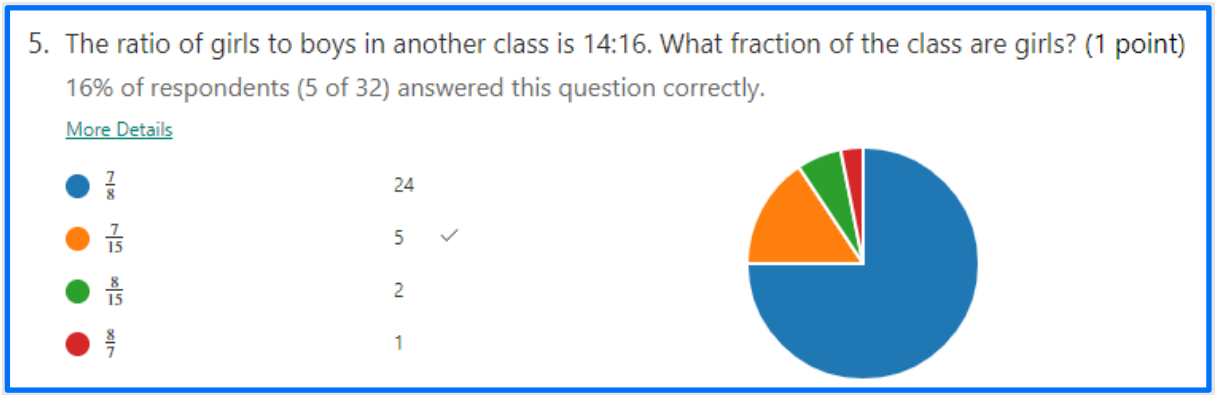
Project Role	Name	Job Role
Project Lead	Aga Heisig	Maths Co-ordinator
Deputy Lead	Carl Bramham	Maths Lecturer
Project team	Gillian Hesling	Maths Lecturer
	Louise Frost	Maths Lecturer
	Karen Vickers	Maths Lecturer
	Natalie Gooch	Maths Lecturer
Project Mentor	Lynne Taylerson (ccConsultancy)	
Research Group Lead	Gail Lydon (ccConsultancy)	

Appendix 2: Direct and Emergent Misconceptions

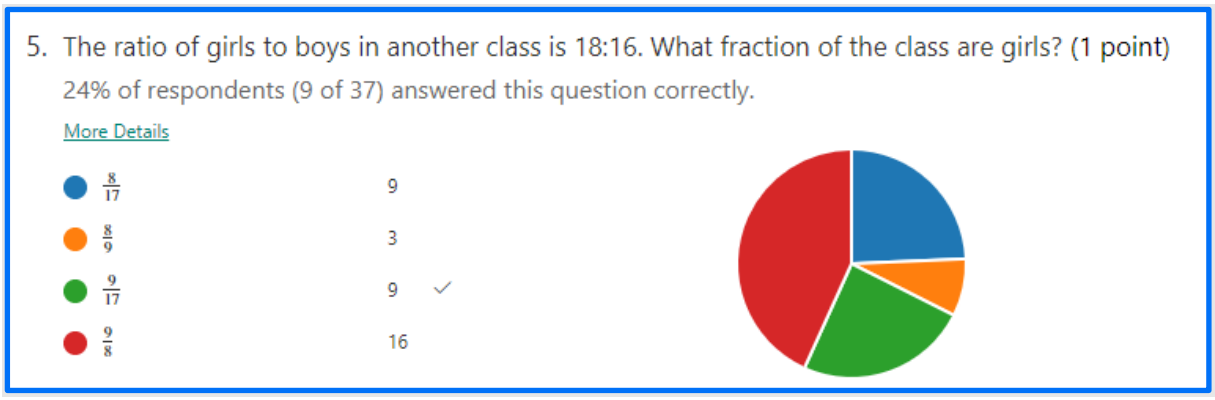
In a report on misconceptions in the sciences, Chi (2005) gives two types of misconceptions. Direct misconceptions arise where a process is straightforward and potentially entirely sequential – each step seems to logically follow the previous. In the example below, the first stage is to consider how the ratio adds together (to get the whole group) and then to use this as the denominator, with the correct part of the ratio as the numerator. The popular misconception here is to use both numbers in the ratio for the fraction.

The 'Emergent' misconception has a certain aspect of simultaneity. A correct approach to a fraction addition relies upon the process of finding a common denominator, and then adding the numerators. Finding the common denominator – and the new numerators – is the simultaneous part that must be completed prior to the addition. Learners typically do not do this, and 'just add' both numerators and denominators.

Direct misconception (and reading based) before:



After:



Emergent, Process Based Misconception before:

9. Calculate: (1 point)

$\frac{3}{8} + \frac{1}{4}$

32% of respondents (8 of 25) answered this question correctly.

More Details

$\frac{2.5}{4}$	2
$\frac{5}{8}$	8 ✓
$\frac{4}{8}$	3
$\frac{4}{12}$	12

After:

9. Calculate: (1 point)

$\frac{3}{8} + \frac{1}{4}$

36% of respondents (10 of 28) answered this question correctly.

More Details

$\frac{2.5}{4}$	2
$\frac{5}{8}$	10 ✓
$\frac{4}{8}$	5
$\frac{4}{12}$	11

Appendix 3: Maths anxiety questionnaire (Number: 41)

How does the word "maths" make you feel?

7 Learners did not identify that 'Maths' makes them nervous. 9 identified that it does make them feel nervous.

What do you understand by "maths anxiety"?

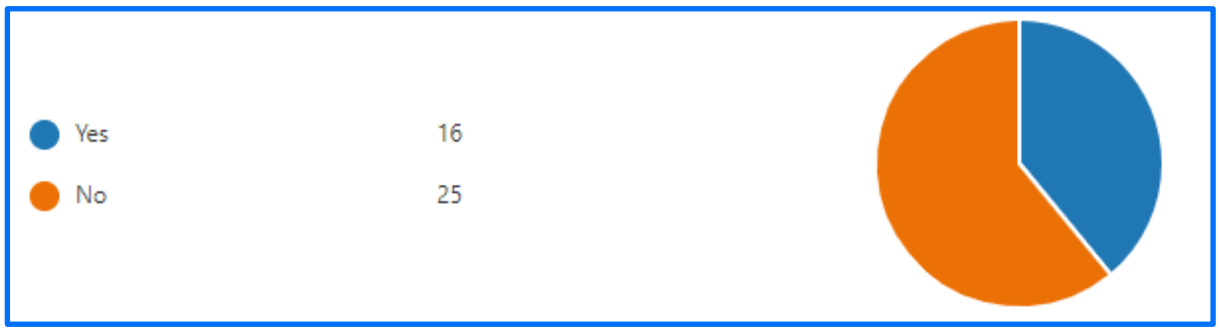
5 Learners described something that might be maths anxiety, rather than trying to find their own meaning. Of these learners, responses were:

- "Struggling to do maths when everyone else can do it easily" - unsure on their view of others, they were online so wouldn't be able to perceive this – perhaps memory of school.
- Very worried and scared of doing maths – two learners said this.
- Assuming you can't do maths or a lack of confidence – the other two learners described this.

Of those learners who did not describe maths anxiety, other responses included:

- "When people hate maths but they are forced to do it"
- "I can't do maths so it makes me scared"
- "I don't know. Why would you have anxiety in maths?"

Do you know anyone who has ever been anxious about maths?



What were the signs/ changes in their behaviour?

Useful responses included:

- "Get angry and lose their temper, and keep worrying"
- "Frustration"
- "Go quiet"
- "Very stressed about maths and the future"
- "They didn't want to do maths and bad behaviour"

Though it was not maths anxiety specifically, two learners possibly described a more normal definition of anxiety in relation to maths, with responses of "Anxiety, scared, shaking" and "The usual anxiety traits" - this learner described maths anxiety as "Gives you anxiety, like what I have"

How do you think maths anxiety relates to reading and understanding exam questions?

Many learners stated that they were unsure of how this might relate or described their feelings in a generic ‘stressed’ way. Specific answers included:

- “You don’t read the question right and rush through questions and get them wrong”
- “It might make you feel anxious about that question so may not answer it properly or read it properly”
- “You feel a big amount of pressure, you get flustered, which overall creates a negative mindset. no one will do well in exams with this mind set”
- “makes you nervous which blocks of your whole understanding and makes you think your doing things wrong”

Appendix 4: Interview with learner on maths anxiety

This interview was with one of the learners identified by Questionnaire on maths anxiety.

Thank you for agreeing to meet with me.

That's ok, I didn't even know, maths anxiety was a thing.

What do you understand by maths anxiety?

Well, I would just assume that, it's when you get anxious about maths, it's just like, the whole thing about it. Makes people feel anxious- maybe.

In your questionnaire you've said you think you have maths anxiety, can you tell me a bit more about that.

So just like, I wouldn't say the whole thing in general, but some parts of maths make me anxious, like I think about and I just want to completely shut off and I just get worked up about it.

Do you think maths anxiety has anything to do with how you learn maths?

I don't know- I think maybe a little bit but not mostly. Like I think it can come from other things.

How do you think, people who have maths anxiety read and interpret questions?

I think one, for me, when I read questions and I get all flustered and everything like that, I just want to rush it, so I sometimes, won't even read the question properly. And I'll end up doing it wrong anyways. But I think it's like very fast-paced way of thinking so I can just move on to the next question because I don't want to deal with it.

What about understanding questions?

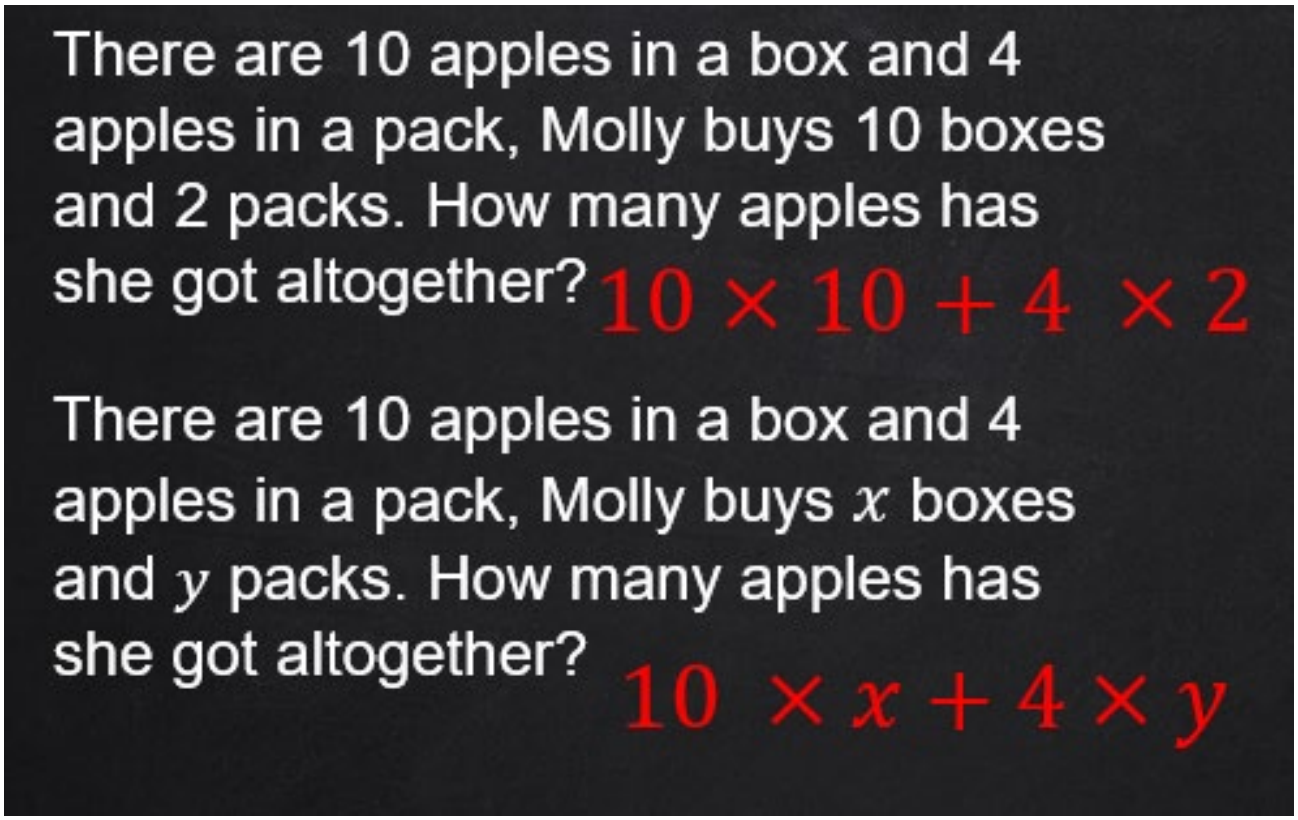
I don't think I read it properly or like, I am really thinking in my head, what is this question asking me, I just want to move past it as fast as I can.

Is that specific topics or just when you see a question you don't know what to do with?

When I see a question that I don't know what to do.

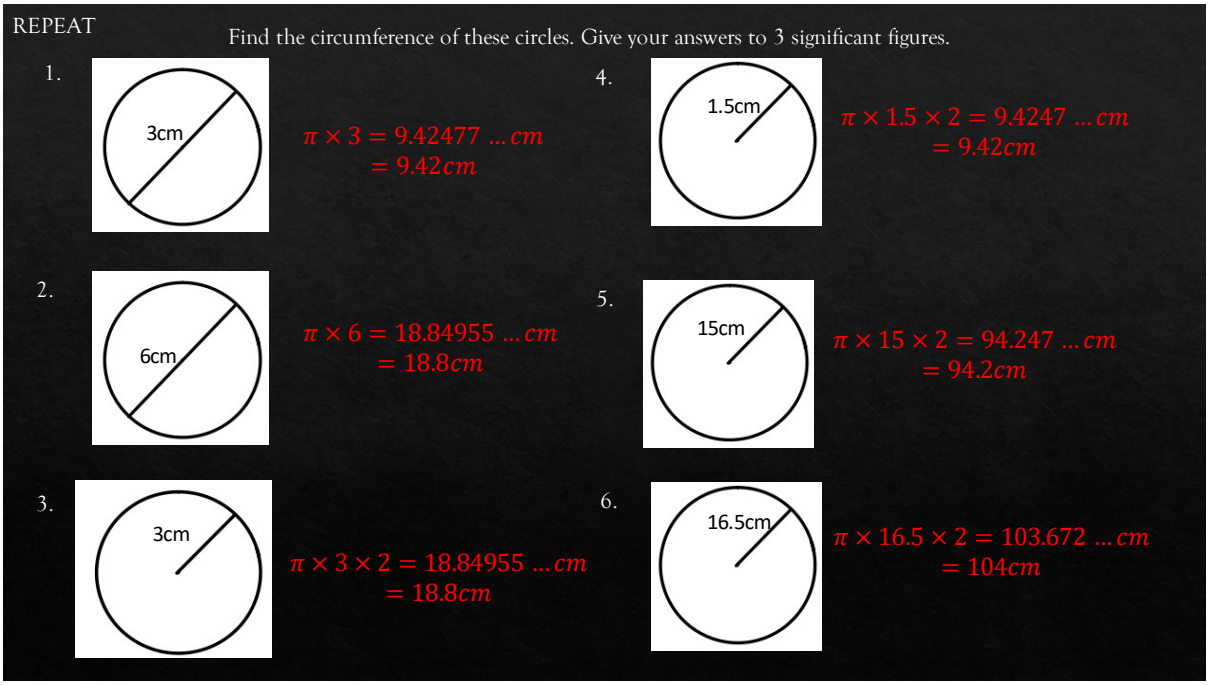
Appendix 5: Example of use of one skillset in different scenarios

This resource is used as an introduction to algebra – learners can quickly and easily solve the first question. The second part gives some difficulty as they may not be immediately comfortable with use of x or y as a quantity that can be multiplied.



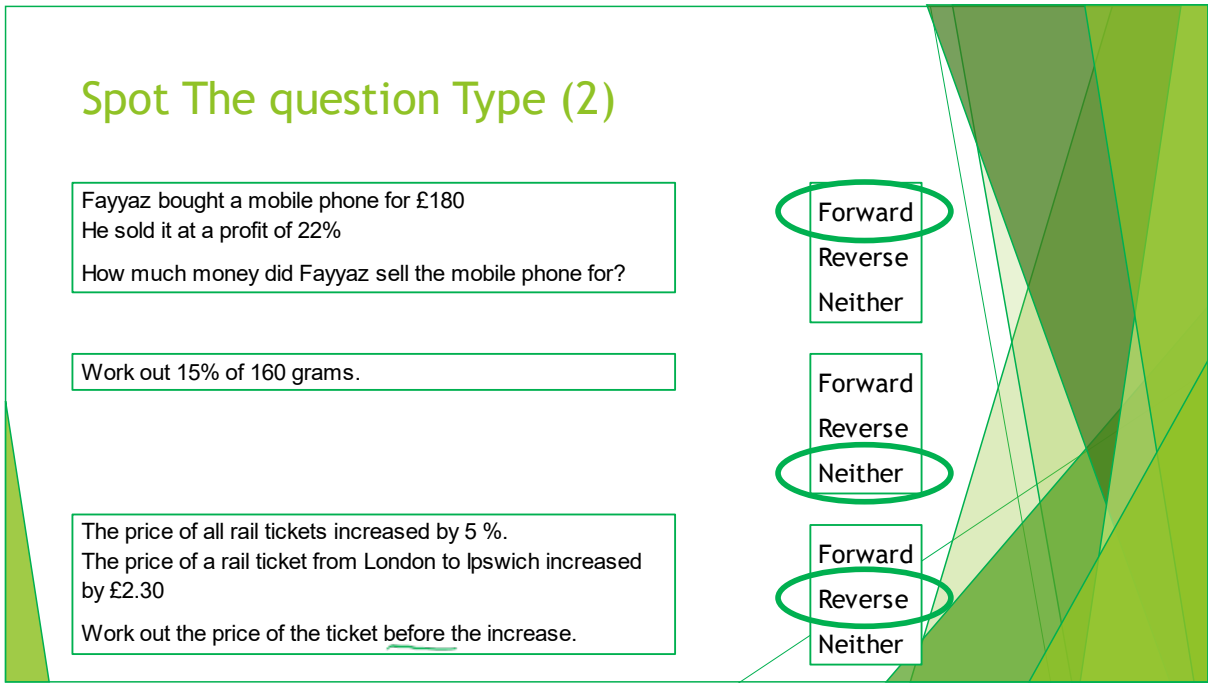
Appendix 6: Variation Theory questions example

The question set below explores finding the circumference of circles. In this sequence, all questions involve finding the circumference, rather than finding a diameter or radius from the circumference. For example, Q1 – Q2 doubles the diameter, and learners should find the circumference also doubles. Q4 – Q5, the radius increases by a factor of 10, as does the circumference. Learners can be asked to reflect on the differences between questions, state their expectations of how the answer will change because of this, and explain why after they have checked their answer against their expectations.



Appendix 7: Variation Theory 3 option reverse percentage question example

This was the second page of the adapted 'Rule' type questions. The three question types we aimed to develop recognition of are visible. The first question starts with a full percentage price which would require a reduction to solve it and is therefore a 'forward' question. The middle question is a basic 'find a percentage' type question. The final question is the reverse, and this question starts with a small percentage of an actual amount, and learners must find the full quantity – this is therefore a 'reverse percentage' question.



Appendix 8: Exit Interview

This interview was with one of the first learners identified for this project.

She entered the November exams and achieved a grade 5. My most surprising find of this interview was that she felt online learning was better than face to face. Somewhat unsurprisingly, the other key finding is that the learner identified that her own input effort was also key.

What did you enjoy most about maths this year?

The fact it was online – no-one was able to shout answers over anyone else, and the atmosphere was good for learning.

There were good, detailed explanations with lots of different calculation methods given.

What happened differently this time for you?

Mainly teaching style – didn't find past teachers (school or college) as easy to understand.

What did you do this exam entry?

Revised more than at school.

In the exam – wrote anything and everything, even if not sure it was relevant! Felt more prepared and calmer in the exam – partly due to feeling more able to interact in class due to remote delivery

What did you do on the other exam entries?

Previously didn't feel prepared enough, nor confident. Also, probably didn't revise enough!

To what do you owe your success?

A lot more revising and the differences in teaching style – e.g. if someone didn't understand, took time to explain again or did this via the zoom messages.

Do you have any tips for your fellow learners who are still studying to retake maths?

'Wing it' and give it everything you can!

Would you be willing to help them if it were possible?

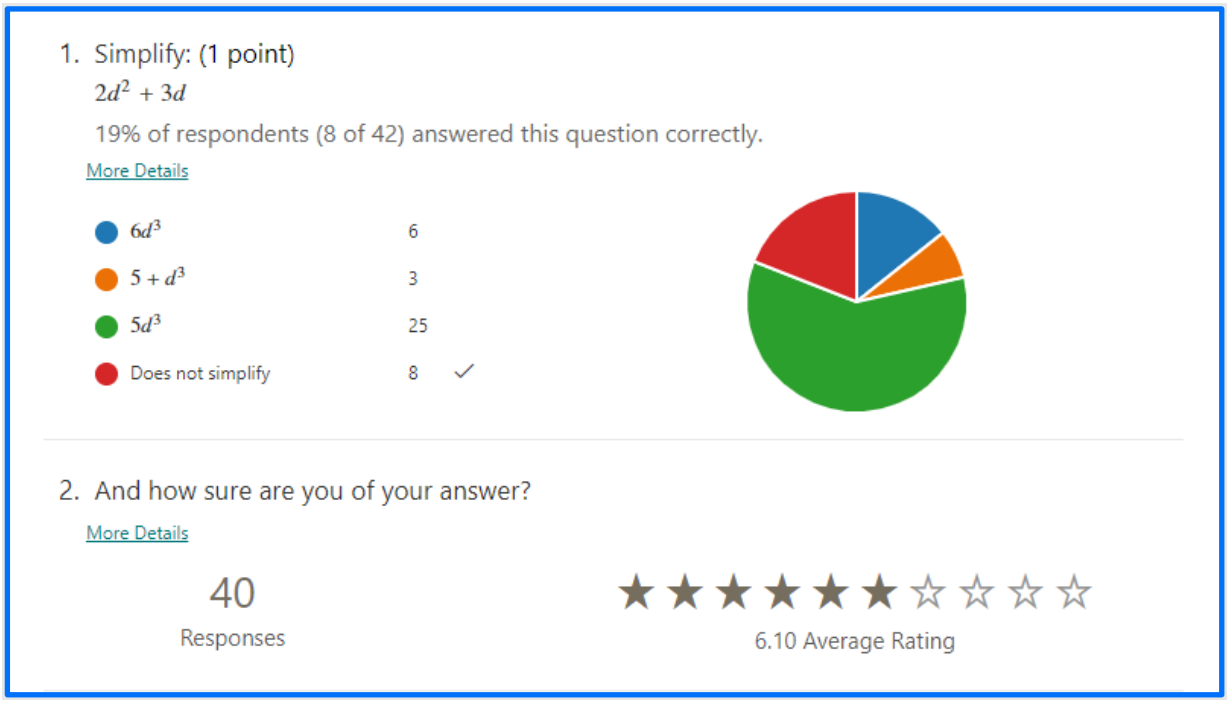
If yes, how would you be willing to help?

Yes, if 'still able to do maths' - sounds happy with in person or zoom!

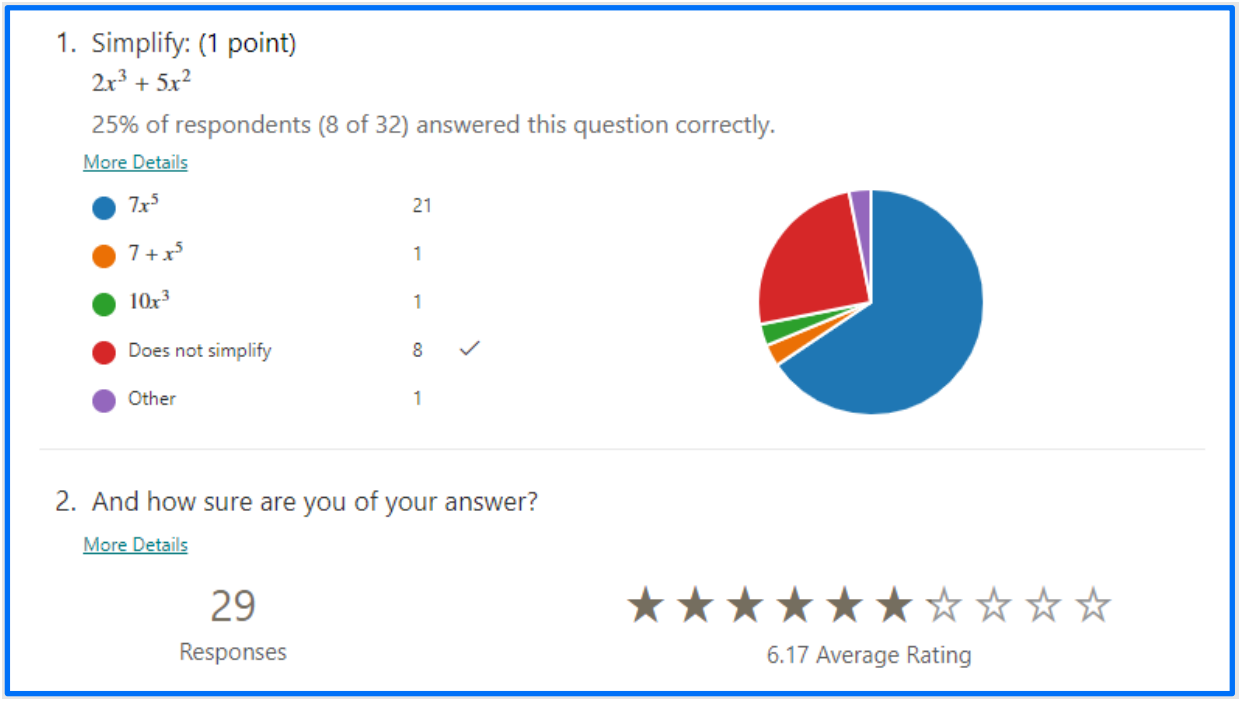
Appendix 9: Algebra misconceptions

Similarly to the fraction misconception, learners appear to have difficulty identifying when they cannot 'simply add' all terms together. The near elimination of other misconceptions is encouraging. There may be an additional issue that the correct answer is the 'Does not simplify' option – it is rare that this is the case and may prevent learners selecting this.

Before:



After:



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