Mastery in GCSE maths resits: should we teach fewer topics in greater depth?

Abstract

Building on the work of John Cooper (2016) this research aims to address the continuing challenge of motivation and engagement in GCSE maths re-sit classes and answer the question “why do so many students in Further Education have a negative attitude towards GCSE maths?”

Previous research and observations suggest that the extensive GCSE maths curriculum plays a part in learners feeling overwhelmed and anxious about re-sitting, whilst also reinforcing the pre-conception that they will be repeating a curriculum that they have experienced at school. This project will investigate how a slimmed down curriculum design and focus on mastery can address these issues and improve classroom attitudes and performance

John Cooper (2016) has devised an “Essential 8” approach, focusing on 8 topics that award the most marks in the GCSE maths exam. These 8 topics were used as the starting point for my research and curriculum design.

This research is carried out by 3 practitioners in a large urban Further Education college in the South West. It involves a sample of 16-18 year olds currently studying on a GCSE maths course. A focus group with other FE institutions in the South West to discuss the outcomes of the results, which is supported by the NCETM (National Centre for the Excellence in Teaching Mathematics) was held.

The 8 topics were taught to the sample group over a 10-week period, and their progress recorded on a tracker. These topics were repeated in every lesson for the duration. Students had opportunities to give feedback and analyse the effectiveness of this change to the curriculum.

Introduction

This research project aims to answer the question

"Why do so many students in Further Education have a negative attitude towards GCSE maths?"

My own research demonstrated that GCSE maths re-sit students find the curriculum overwhelming and not relevant to their day-to-day lives. These attitudes have been particularly apparent since the introduction of the reformed qualification to FE in 2017 Much of the content does not enable learners' main vocational programme or career aspirations to be embedded and omits more engaging functional maths skills. The pass rate for GCSE maths re-sit students across the country remains low (30% of students aged 16+ achieved a grade 4-9 in 2017 according to the Times Education Supplement), and engagement continues to be a challenge. Students frequently comment negatively on their experience of studying GCSE maths in college and question its relevance to their futures.

This small-scale trial within 3 GCSE maths re-sit groups in a South West FE college, will focus on developing an understanding of whether:

1) a more streamlined and functional curriculum will improve student satisfaction, engagement and results.
2) repetition of key topics, which are relevant to everyday life and important for the GCSE exam, will improve motivation, behaviour and attendance
3) a streamlined curriculum will reduce lecturer workload, leaving more time for intervention and building relationships with learners
4) allowing students more time and autonomy to track their own progress will lead to more enthusiasm and better performance.

Some of these research topics pose wider questions:

1) How beneficial is the re-sit policy to the career prospects of 16-19 year olds, and how useful is the qualification?
2) What is the impact of GCSE re-sits on the most venerable and academically weak learners?

3) How are cross-college interventions implemented for mandated courses, with varying levels of support for the qualification?

These questions are too extensive to address in this small-scale study, but by undertaking this project I hope to examine these questions in further work.

Literature review

Anna Bellamy's research poses challenging questions on the impact of mandatory GCSE maths resits and their effect on learners. In her article "Forced GCSE resits in Further Education: Students' voices" (Bellamy, 2017) she reports that GCSE resits were doing more harm than good and sent a message to learners that they were worthless unless they gained their GCSEs. Bellamy questioned whether we are teaching students to gain the skills they need or using the qualification as a "gatekeeper for social mobility". The question, whether the qualification is an appropriate one for these learners is central to this research project. Dalby (2014) found that motivation improved in learners where there was a link to their personal life, and the maths could be applied outside the classroom rather than just to pass the examination. This suggests that selecting topics for a more streamlined curriculum needs to be based on what will motivate the students and benefit them in their later life.

"75% of students said that, if given a choice, they would have not studied mathematics that year"

Bellamy, A. (2017, p29)

Bellamy's work focused around student voice, and asked students to analyse their experience of maths at college and maths at school. One finding was that students reported a "chaotic school life and inconsistency of staffing". This research project will therefore consider how previous experiences affect learners' ability to engage with the programme. Dalby (2014) found that students' attitudes to learning maths at college was strongly linked to their experience in school classrooms. Furthermore, research conducted by Cresses, Lister and Mallows (2015, p13) postulated that "more of the same is unlikely to produce different results" and that teachers have emphasised that the teaching must be different to that experienced at school. My own experience is consistent with these findings, mand students begin the course

with negative attitudes based on their time at school. One student told me that a history teacher took over their year 11 set 4 GCSE, because their qualified maths teacher was re-allocated to set 1 when the set 1 teacher went onto maternity leave. Apparently, the school felt it was more important for the qualified maths teacher to be assigned to the higher attaining group rather than the set 4 group of struggling learners. These experiences appear to be common and serve to reinforce students' sense of not being good enough and even that they are undeserving of qualified teachers.

"Mathematics was often associated with boring methods and a lack of stimulation"

Dalby, D. (2014, p184)

Bellamy (2017) found that GCSE resit students struggle to retain information, an issue identified by myself and colleagues. The reformed curriculum has increased the number of topics some of which students must learn by rote by not apply contextuality. For example, foundation tier learners must learn trigonometric ratios but are rarely asked to apply this knowledge to a real-world situation. Research conducted by Robey and Jones' (2015) noted that tutors must move through material quickly and therefore learners are unable to spend enough time to practice more difficult topics. A shorter and more focused course was preferred by the learners interviewed in their research.

This research project will consider how the issues identified above are addressed.

Students resitting their GCSE maths often come to lessons with frequently reinforced misconceptions. For example, Dalby (2014) found that students believed maths was a system of rules that produces one correct answer. Teaching the full curriculum in a year leaves little time to address these issues. Repeating key topics might expose students to different types of questions and develop more advanced questioning skills. Creese, Lister and Mallows (2015, p14) state that "approaches which identify the weaknesses in the cohort and, in maths particularly, concentrate on uncovering misconceptions, have been shown to be more effective". They also recommend that teaching approaches should be more creative and imaginative and give learners opportunities and support to take control and have an input into the way the lesson is

designed. Therefore, it is important that students are encouraged to become autonomous learners and able to track their own progress and assess their work. In other words be active in their learning rather than passive recipients.

"This cohort of learners include many who to not wish to study English or maths, but specifically have already "failed" these subjects at GCSE and have no confidence in their ability to do any better this time round. Motivation is a huge problem"

Creese, B., Litster, J & Mallows, D. (2015, p12)

From the above discussion several conclusions can be drawn:

1) There are benefits to learning outcomes where curriculum content and structure is not only associated to the examination but also to real life relatable contexts.
2) The starting conditions and previous experience of learners is highly influential to their approach and ultimate achievement
3) Retention of information is a challenge to many students which negatively impacts their performance
4) Students need the opportunity to consolidate their learning before moving on to the next stage.

Methodology

The study took place in a large South West FE college. The focus groups were comprised of 3 GCSE maths re-sit classes. All students had achieved a grade 3 previously and were targeted to achieve a grade 4. These students were enrolled on an Engineering programme, an Automotive programme and a Childcare programme.

Before the intervention took place, a streamlined curriculum was decided upon. John Cooper's (2018) "The Essential 8" was used as a starting point for selecting the topics that would be the most relevant or award the most marks in the GCSE examination:

- Ratio and proportion
- Transformations

- Algebra
- Angles
- Area and perimeter
- Fractions, decimals and percentages
- Straight line graphs
- Probability

Students were given questions on these 8 topics every lesson over a 10-week period and tracked their results on a personal tracker grid (see table 2).

To understand how students perceived their GCSE maths course at college, I reviewed the previous academic years cross-college student survey. The survey measured how valuable learners felt the GCSE maths course was to their aspirations in later life, and how engaging they found the programme. I then spent a 4-week period implementing the Essential 8 in the classroom, as laid out by John Cooper. A further 4 weeks were spent adapting the structure based on how the work was being perceived by the learners. At this point learners were asked to review the Essential 8 in the form of a group questionnaire (see figure 3) (discussed later in this report). Based on their feedback, changes were implemented, and the students were asked to review these changes.

Throughout the research project I was leading a workgroup consisting of lecturers from 4 FE colleges. This workgroup, funded by the National Centre for Excellence in Teaching Mathematics (NCETM), was set up to research ways to improve the delivery and outcomes for GCSE maths re-sit students. The lecturers involved in the workgroup also used the Essential 8 and reported their observations back to me. Feedback from the group of lecturers informed the subsequent curriculum design.

The anecdotal data from lecturers and students on the effectiveness of this intervention was compared with a review of student attendance data and a comparison of examination results before and after the 10-week intervention period.

Table 1 is a summary of contributing participants and the research methods they used:

Contributing participants	Research method used
All GCSE learners	Feedback reviewed from the 2017/18 cross-college survey
Tutors	3x workgroup meetings with other SW colleges. Discussions surrounding the success of the Essential 8. 2x research tasks decided on by the group to implement in between meetings.
Managers	Discussion with manager about how this intervention should be implemented. Management decide on a selection of lecturer appropriate to be involved in the trial
Tutors	Team meeting/sharing ideas/creating resources
GCSE Maths learners	Questionnaire for learners within the focus group.

Table 1 Participants and Research methods

The intervention

The intervention timeline is depicted in Figure 1:

Figure 1 Intervention timeline

Ethical considerations

In accordance with BERA Ethical Guidelines for Educational Research (2018) consent was obtained from all learners and practitioners involved in the research project. I ensured that all participants were given the opportunity to withdraw their consent should they wish to do so. The use of participants data will be made transparent, with all participants being made aware of how the data will be used, shared and with whom. Data collected will be anonymised. Exeter College's own ethical and safeguarding procedures were adhered to whilst completing this research. Part of this research has been funded by the NCETM (National Centre for Excellence in Teaching Mathematics), to allow for teacher time and cover; all participants will be made aware of this. The research complies with the legal requirements stated in the General Data Protection Regulation (GDPR) (2018) and that of Exeter College. All data is kept secure, using secure computer networks and password protection.

Analysis and Results

Based on my previous research and feedback from learners I hoped that a more streamlined curriculum would see motivation and engagement improve. I have first-hand experience of how students feel frustrated as to the relevance of the course, and the amount of content that they need to cover. This anecdotal evidence suggests there may be limited value from studying the whole GCSE maths specification when students only need to achieve 55% of the marks to be awarded a pass grade. I hoped that students would show an increased level of attendance and progress based on the intervention.

The primary research showed that learners often felt that they did not know how well they were doing. Although lecturers commented that they often shared the level of the work they were setting, and that they allocated clear targets in every lesson, learners still fed back in the learner survey that they wanted more structure to their feedback. Robey and Jones (2015) advise that learners need to be "clear on the way in which they will be assessed". Every learner participating in the research project

was given a tracker sheet to record how well the answered the Essential 8 questions each week (see table 2).

Analysis of the trackers showed that students were improving their key skills. The students felt that the tracking was valuable and liked seeing how they were doing week on week. The following comment is typical of some of the feedback received:

"I find it useful to see how I am doing week by week. It's best to practice the topics at the beginning of the lesson because it gets us into the zone!"

GCSE re-sit student

The students within the focus group were enthusiastic about tracking their progress and began asking to track every activity we did in the lesson. This exposed to me an opportunity that I had been missing, when students can see they are making progress by reminding them of what they achieved in previous lessons, motivation and engagement seems to improve. This was also reflected in the student survey, with fewer students commenting that they didn't know how well they were doing. Students made suggestions as to how tracking could be improved:

"Have lower marked questions at the start of the year then increase throughout the year"

"It would be better if we were using smiley faces instead of ticks and crosses so it makes you feel better about not getting it correct"

GCSE re-sit students

Staff also enjoyed the tracking element commenting that:

"it can give meaningful feedback to students about their areas for improvement and helps promote metacognition".

"I am also finding that my expectations of the students is rising while they improve."

GCSE maths lecturers

The implementation of a more streamlined curriculum that repeats key topics appeared to please and satisfy the learners in the focus group. Learners were able to clearly see what they needed to do to get a grade 4 in their exam. Around 20 minutes was spent each lesson on the key topics, and sometimes longer if learners

needed the extra time.

"There are too many topics in the GCSE, it's really tedious. Focusing on less topics jogs my memory and helps me with everyday knowledge"

"starting the lesson with the Essential 8 warms up my brain and refreshes my mind. I forget less stuff"

GCSE re-sit student

Lecturers implementing the essential 8 also commented that they felt the lessons were easier to plan with fewer topics to focus on and enabled them to plan the topics in greater depth. Students could all be working on the same topic regardless of level, but still have an appropriate level of challenge. The nature of the GCSE maths course in a large FE college means that lecturers must often move across multiple sites in a day. Having learners starting on the same thing every lesson means that learners know the immediate expectations. One member of staff commented that it "helps us as teachers have work for students to be working on when they come into a room"

This feedback is in line with the research of John Cooper and Nicola Tomlinson (2018) who states that "differentiating by depth rather than difficulty means learners can move forward collaboratively. It can transform the learning experience and even reduce maths-anxiety for some".

After initially following John Coopers' structure, different resources were developed around the Essential 8. This included laminated questions, Powerpoint presentations, card sorts and exam booklets in line with Creese, Lister and Mallows (2015) advice to be creative with resources and make it less 'school-like'. These resources were shared amongst the team. Students gave feedback as to how they would prefer questions to be posed and the new resources:

"*I want all the questions on one page so I can see everything that I have to try. If the questions are in a booklet, I feel like I have to do them in order and I will give up if I can't do one"*

"I don't like laminated/projected questions as I like to keep the questions"

"Do an Essential 8 Kahoot – keep it green!"

GCSE re-sit students

The most encouraging finding from the research was that students had higher expectations of themselves, and their confidence was boosted. This was reflected in the results of attendance and progress analysis for the students in the focus group. 58% of learners in the focus group made at least one grade of progress within the 10-week period and 19% made 2 grades of progress (this was based on the results of practice examinations in the winter and spring terms). This was an encouraging result as nationally only 5% of students made progress in a year (many stayed the same grade or achieved a grade lower). The attendance data from this institution was also encouraging, with average attendance for focus groups and GSCE maths classes at 82% and 77% respectively.

Although these outcomes are promising, it is important to acknowledge other mitigating circumstances that may affect the data. During the winter term I was experiencing the first stage of pregnancy and subsequently had to take time off. Having cover teachers always effects engagement and attendance and has probably inflated the success of the students in the spring term upon my return to work.

Key findings

Figure 2 shows the benefits and concerns raised in this small-scale trial:

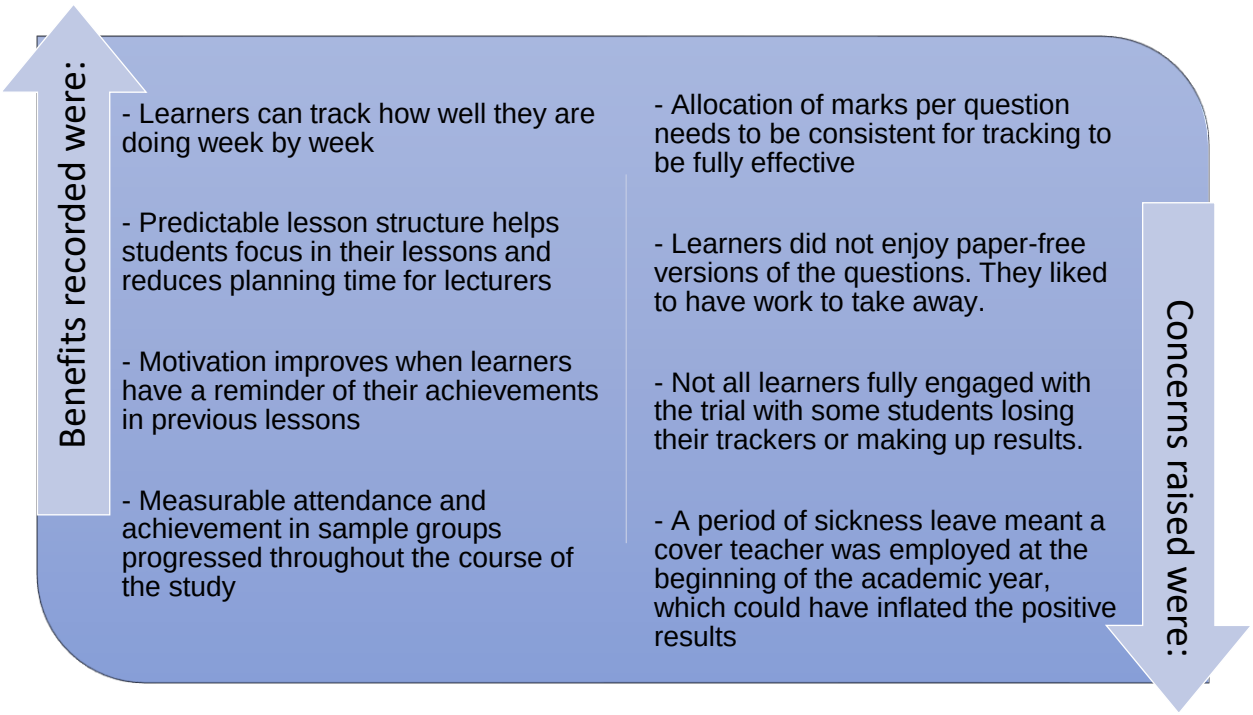

Figure 2 Benefits and concerns recorded in the trial

Findings from this study indicate that students received benefit from repeating key topics on a weekly basis. The feedback from the evaluations showed students found the curriculum more manageable. Retention of information was identified by the learners as a key barrier to progress and they felt this was addressed by the activities given to them in the trial. Students showed that they have more understanding of what strategies work for them than expected, and they were particularly enthusiastic about the tracking element of the trail. Valuable feedback was given indicating a preference towards questions being presented on an A3 sheet, which gave them confidence to attempt more. The sample size, scale and time constraints of this study potentially limit the influence it had. Therefore, in terms of having an impact on attainment and results, a longer more wide-reaching study is recommended.

Recommendations

The study highlights some key difficulties in the delivery of the extensive GCSE maths curriculum, and how this affects the student's ability to retain this information.

Potential strategies for overcoming some of these problems are discussed in the following work:

1. Bellamy (2017) questions the usefulness of the GCSE maths curriculum to 16-18 year-old learners, and what impact it is having to the most venerable and academically weak of the cohort.
2. Cresses, Lister and Mallows (2015) believe the FE curriculum must be different to what learners have experienced at school
3. Dalby (2014) suggests that students must be given the opportunity to explore mathematical concepts in depth, and not rely on a system of rules to obtain the correct answers

By adapting the GCSE maths curriculum and reducing the content taught to re-sits students, I have found both opportunities and limitations. The challenge of teaching maths to learners who feel like failures and hate the subject is not going to go away, so it is essential a supportive and useful curriculum is developed. Moving on from this study I would recommend:

- A scheme of work is adapted early in the academic year to include the most essential exam topics. This maximises amount of time to practice these skills and will help to build confidence.
- Maintain a consistent format in delivering the key skills, this makes tracking progress more valuable and reduced teacher planning time.
- Find time for reflection and discussion on progress, students gained motivation in knowing what they needed to do to get to the next step and in seeing what progress they have already made.

Students showed that they are much more aware of their learning preferences and should be given more autonomy to make decisions about their progression. For students to feel confident in their mathematical ability, we have an obligation to take the focus away from tricks to gain marks in the exam and give students the maths skills they will need for life. This includes giving them the confidence to use, discuss and reflect on the maths that they have been using in the classroom. Space for depth of understanding seems to be more valuable than learning a breadth of skills.

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Annex

The students recorded their results every week for 10 weeks on the following tracker grid:

Date																					
Essential 8 number																					
FDP																					
Ratio and Proportion																					
Probability																					
Angles																					
Area and Perimeter																					
Algebra																					
Line Graphs																					
Transformations																					

Table 2 Student tracker

Students were given the following questions to review the study:

What do you think of the format the Essential 8 comes in?

You have answered questions from the board, completed questions independently and used laminated worksheets. What is your preferred format?

Any other suggestions?

What do you think of the Essential 8 questions?

Are they relevant?

Are they stretching?

What improvements can be made?

How useful do you find the tracker grid?

What improvements could be made?

How long do you think we should spend on the Essential 8?

At what point in the lesson should we do these questions?

Figure 3 student questions

Below are some of the student responses:

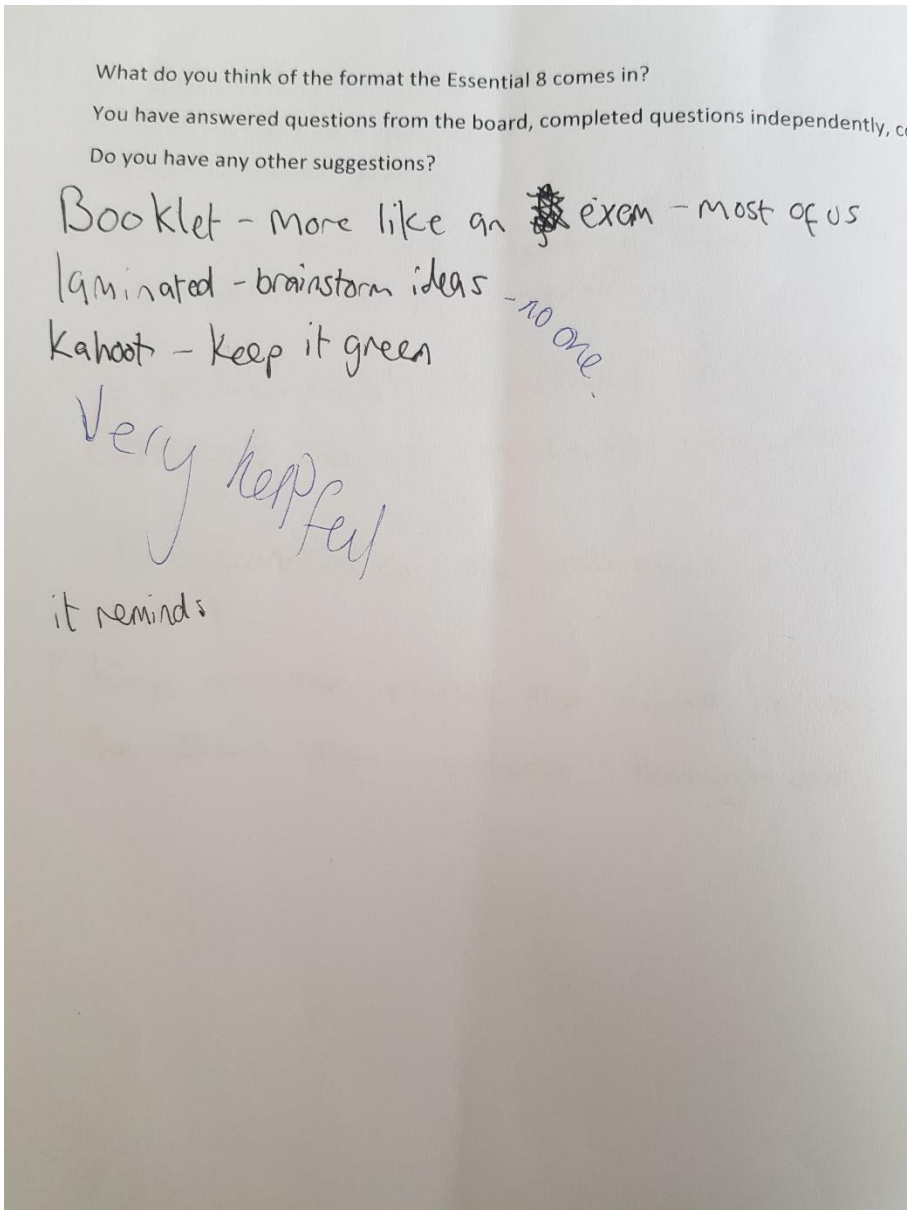


Figure 4 Student responses 1

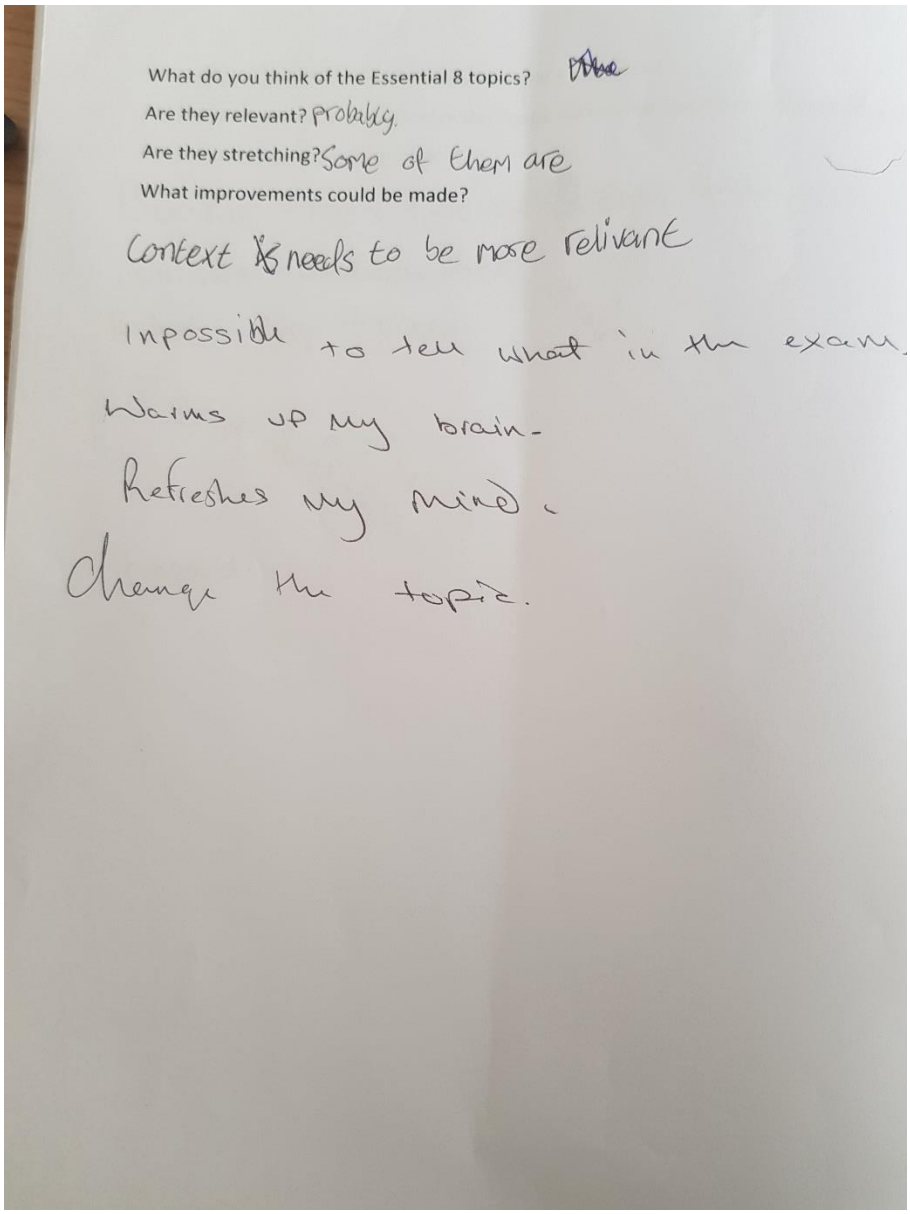


Figure 5 Student responses 2

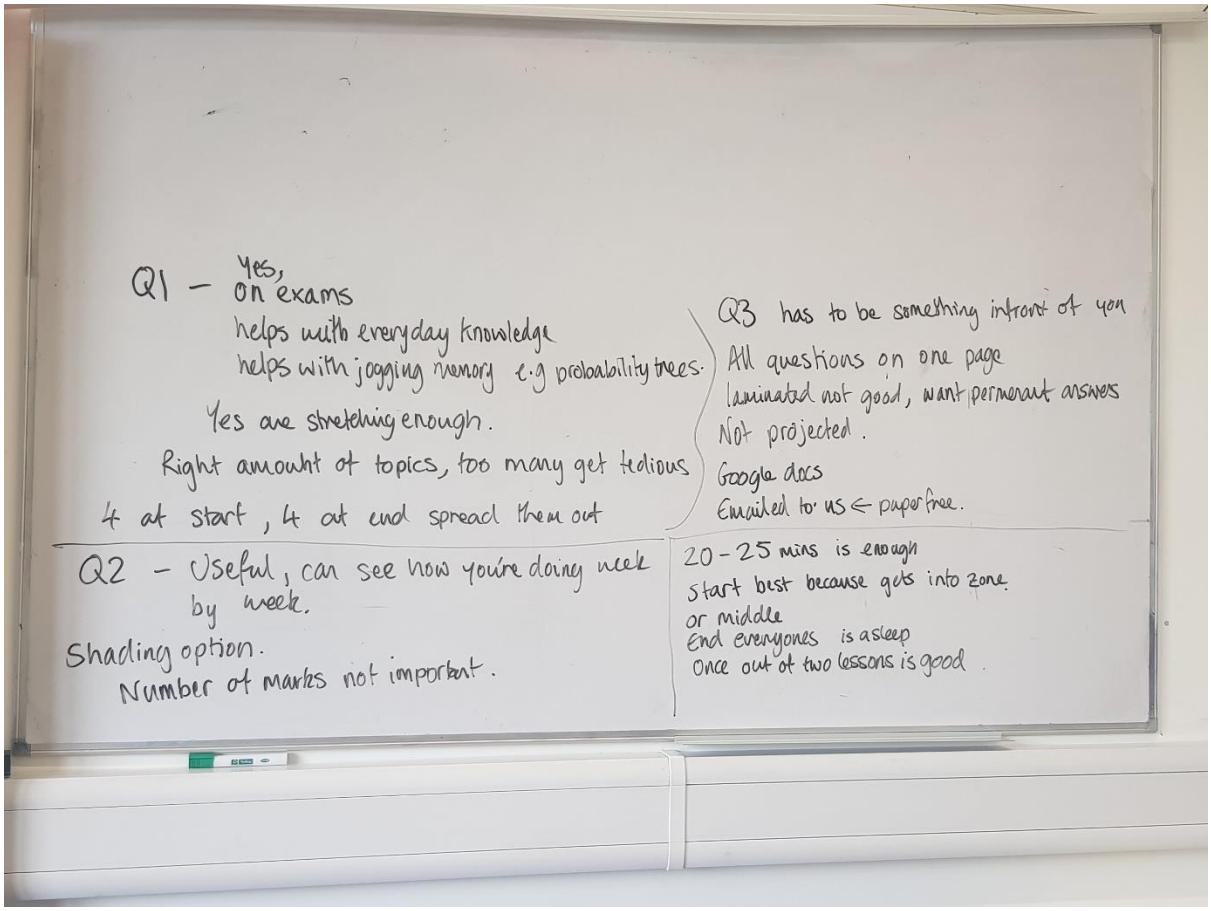


Figure 6 Student responses 3

Essential 8

Fractions, decimals and percentages

Molly's salary is £24000 per year. She is paid the same amount each month.
She is given a pay rise of 10%
Calculate her new **monthly** salary.

Solve **Algebra**

$4x + 5 = x + 2$

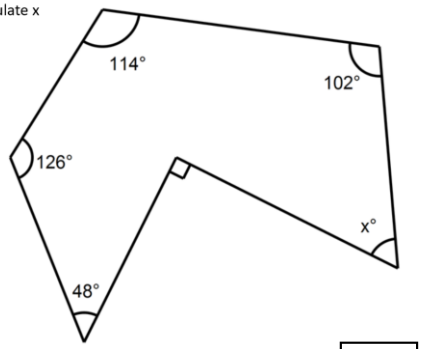
Factorise Fully

$77y + 44y^2$

Ratio and proportion

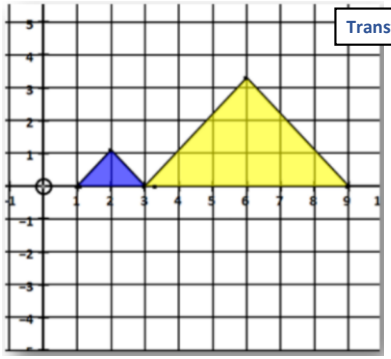
If 5 litres of paint cost £22, how much will 2 litres of paint cost?

Calculate x



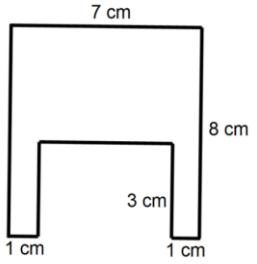
Angles

Describe fully the transformation that maps the yellow triangle to the blue triangle.



Transformations

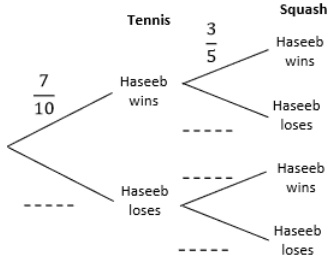
Calculate the area



Area and perimeter

Probability

Haseeb is going to play a tennis match and a squash match.
The probability he wins the tennis match is $\frac{7}{10}$.
The probability he wins the squash match is $\frac{3}{5}$.
Complete the probability tree diagram.



Calculate the probability that Haseeb will lose both matches.

Straight line graphs

a) Complete the of values for $y = 2x - 2$.

x	-2	-1	0	1	2	3
y		-4			2	

b) On the grid, draw the graph of $y = 2x - 2$

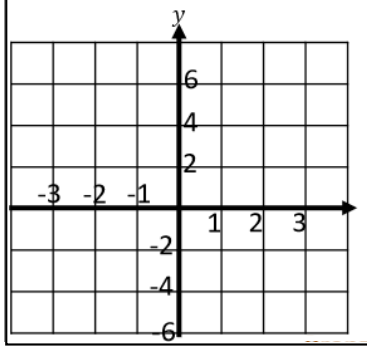


Figure 7 Essential 8 example