

OUTSTANDING TEACHING, LEARNING AND ASSESSMENT

**FINAL REPORT ON THE OTLA PHASE 7 (ENGLISH) PROJECT –
CURRICULUM APPROACHES TO IMPROVE ENGAGEMENT IN
GCSE MATHEMATICS**

South Essex College

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For further information regarding the OTLA Phase 7 (English) programme and this project go to <https://ccpathways.co.uk/practitioner-research/otla-7/>.

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Contents

Final report - Curriculum approaches to improve engagement in GCSE Mathematics	2
Appendix 1 – The Project Team	8
Appendix 2 – Studies completed by paired practitioners	9
Appendix 3 – Learner work	31

Final report - Curriculum approaches to improve engagement in GCSE Mathematics

South Essex College

How many times have maths teachers identified that the low literacy levels of their students prevents them from being able to understand the questions and 'do' the maths? This action research project adopted an 'umbrella' approach which involved 5 GCSE English teachers and 5 GCSE Maths teachers to work together in pairs in response to the overarching theme of the project. It was designed to improve GCSE maths outcomes for learners, by exploring how to expand English skills within the maths curriculum. The focus was on creating a culture of collaboration and evaluation among students and staff; as part of the impact on the students, with the objective that this would remove barriers to learning and help develop resilience and confidence.

Summary

South Essex College of Further and Higher Education is a large general further education college with approximately 16,000 full time equivalent students. It consists of 5 campuses across the South Essex Region. There are currently over 3400 learners enrolled onto GCSE Maths and English

The objective of the project was to increase GCSE maths attainment, by developing English skills, particularly around problem-solving questions, which require reading and comprehension of language. The rationale for the project is based upon evidence from assessments and observations, highlighting that our students struggle with longer questions, particularly where there is a lot of complicated text or several steps. Learners who are re-sitting Maths are in most cases also taking English. Learners may know the math calculations; however, they struggle to identify what they are being asked to do.

Rationale

The demands of mathematical English are higher than those of everyday English and students need to develop the necessary proficiency. We have seen an increase in worded problem-solving questions. The aim was to create a culture where tutors developed small activities that developed English skills in maths: short starters, or plenaries or considering different approaches to delivery that are not always observed in maths - for example, discussions and group work. Alongside developing English to support understanding of maths questions, the rationale was that these small curriculum changes would help students start to build resilience particularly around the fear of getting a question wrong.

The focus of the projects was to develop a community in the classroom where collaboration and problem-solving are encouraged. It was felt that this would lead to better attendance, particularly if the environment was found to be more inclusive and

engaging. We wanted maths and English teachers to learn from each other's practice and develop a community of evaluation and collaboration, building a culture of sharing common findings and challenges through evaluation of their teaching and learning and using the outcomes from learner voice to find different activities. In the long term, we want the experiences of the team involved in the project to change the culture of maths lessons and become a driver for change, impact and skills to embedded into the implementation of curriculum delivery.

Approach

We sought expressions of interest at the start of the project to ensure that all participant teachers were committed to our goal. We were fortunate to have a good balance of English and Maths tutors across the campuses come forward which enabled the approach of partnerships to be formed and individual projects to be undertaken in response to the overall theme. These were as follows:

- Giving meaning of key words to our learners when answering worded exam style questions.
- Building the maths vocabulary of the students by discussing the meaning of key words and linking? to how the topic is used in their course/real life
- Creating a bank of words which will be displayed in the classroom and used in future lessons.
- Employing Reciprocal Teaching techniques in maths lessons and? Guided Reading techniques to strengthen foundational reading skills
- Creating a visual word wall in the classroom using maths terminology and imagery created by the students which would be a focus throughout the year and built upon.

The intention was for maths tutors to research their own teaching and learning strategies, test out theories and gain feedback from their learners; then to adopt teaching and learning strategies that could be introduced within starters or plenaries.

The aim was to develop one or two strategies during the project period, and the encouragement of peer collaboration. Activities could focus on vocabulary and technical terms being introduced to the class, chunking down questions and encouraging discussion in class to share and encourage dialogic teaching. Every week English terminology and vocabulary were encouraged in lessons alongside mathematical language; this naturally developed and was in response to learners' and group needs.

The utilisation of English tutors to share practice and work with maths teachers on strategies particularly around reading, discussions, and vocabulary expansions was a successful strand. Partnerships were formed within the OTLA project group with a pair of Maths and English teachers working directly together. They held regular meetings and discussed the curriculum and teaching and learning. English teachers shared practice around the delivery and planning of their subject specialism and both practitioners looked at what aspects of delivery could be duplicated to embed skills further with learner. An example of this was where an English teacher highlighted maths terminology as it came up in English lessons – For example:

greater, adjacent, opposite, descent. This shared practice led to a natural change in some maths teaching, with simple changes that had a strong impact. An example was more exploration of group and paired work in the classroom, to support discussions and problem solving in teams.

Feedback from learners helped teachers to evaluate and reflect critically on their own practice and its impact on learners and the learning experience. Tutors observed confidence building among learners and a classroom with shared expectations and collaborative learning led to a more inclusive environment where attendance improvements were observed alongside engagement in learning.

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

- All teachers involved challenged themselves to try new approaches
- Tutors have made simple changes e.g., displaying English vocabulary in the maths classroom, adopting an approach of underlining key terms and discussing the meaning of words
- Students have been encouraged to deconstruct the long questions to determine what is being asked of them
- Discussion has been included in lessons to encourage shared knowledge and deeper learning
- There has been an increased awareness of the importance of vocabulary in maths and a realisation that changing the delivery approach can have a positive impact
- Key words have been extracted from the maths questions which has enabled students to complete the questions more accurately and when approaching reciprocal reading there has been more focus on breaking down these key words and skills which has gradually improved learners grasp on long-worded maths questions.

Evidence of improved collaboration and changes in organisational practices.

One of the main areas for exploration in the project was to encourage shared practice between Maths and English tutors. It was felt that English lessons naturally have more discussions, collaboration, and active learning taking place. The strongest part of the project was that we had enough interest early on to be able to establish partnerships of English and Maths tutors working together. This opportunity to work as a team and to collaborate with colleagues has provided a great opportunity to learn from each other's practice and consequently self-review and self-evaluate.

One of the English teachers wrote in response to the project:

“As an English teacher supporting this project I found it very easy to embed some of the ideas and terminology that myself and my maths colleague introduced as part of our OTLA experiment. It didn’t take long to produce resources for a connect activity that included maths, and I found that this small contribution of maths in my English lesson really had an impact on the results.”

The campuses at South Essex are in a range of different socio-economic contexts which meant that the teachers involved in the project represented a range of students. Collaboration led to teachers having a greater insight into the variety of provision the college offers.

Some of the projects have further evolved to include collaboration with vocational specialists, for example, the involvement of motor vehicle teachers in sharing maths context and vocabulary in practical workshop lessons.

The project has grown to now include dissemination of the strategies applied across the department through CPD with the practitioners involved in the project sharing their findings and leading further research initiatives.

Further development is starting to be undertaken by looking at how further enhancements can be made to the maths curriculum to support learners with SEND who struggle with the complex content in written English in maths. Collaboration is currently being undertaken with the Additional Learning Support (ALS) team around further research and training around SEND and neurodiversity linked to the project.

Evidence of improvement in learners' achievements, retention, and progression

Across all projects, tutors tracked the progress of two learners and evaluated the distance that they made in relation to progress and attendance. An example of success was progress in mock scores which was partly attributed to confidence. All tutors saw an increase in engagement for the groups involved in the projects.

They all noted a developing trend of growing confidence and engagement in maths as students overcome barriers with English. One student has been able to now feel confident to ask questions because the tutor has enabled him to break down the barriers around reading and not understanding, by exploring this far more in lessons. Students struggling with English can now attempt some worded questions. The students developed the practice read questions twice and underline key facts before answering. Before the intervention, they just answered worded questions by applying any mathematical operation without any reason.

In response to the evidence of improvement seen one maths tutor wrote:

“I have realised that it’s not all about ‘hammering’ on mathematical terms but to introduce and discuss terms as they are used in daily life and in the students’ main Vocational Course”

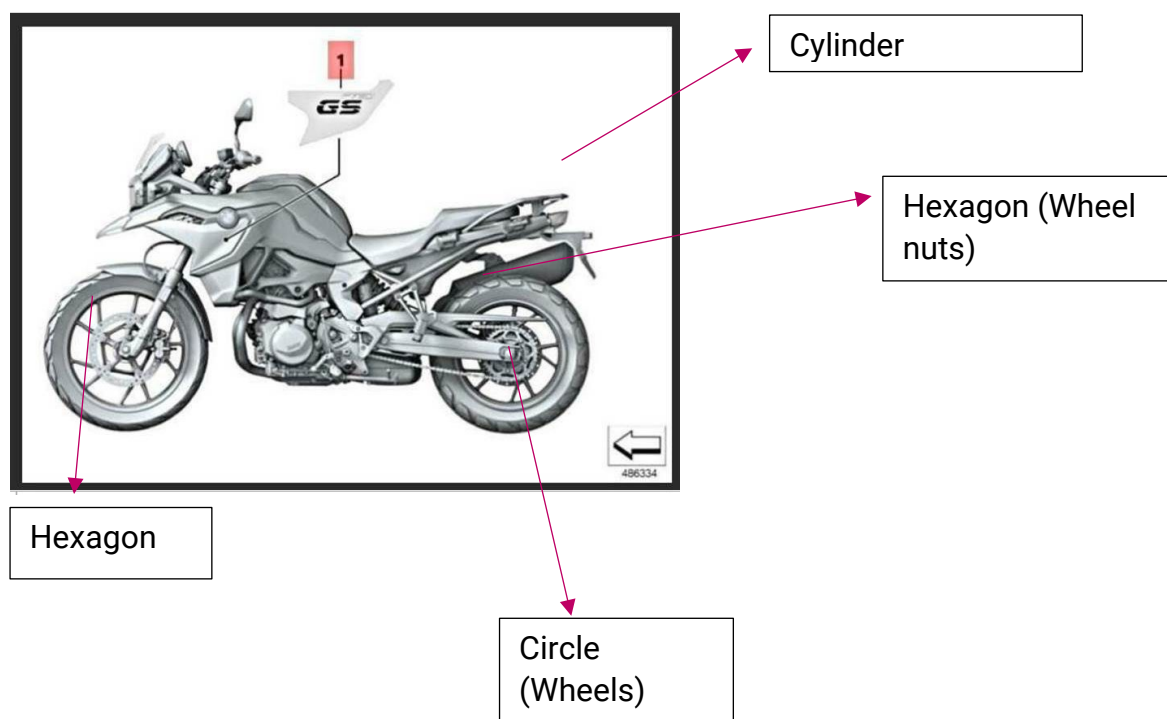
All tutors involved in the project noted that learners appeared better equipped for questions and understanding problem-solving in maths through the application of being taught better reading projects – particularly evident in the reciprocal teaching project. This is captured in some of the strategies that have been developed including the Teams Quiz template to support Reciprocal reading utilised as part of Group 4 (Appendix 2).

Learners have also adopted new skills starting to automatically develop the approach of underlining key words to questions they did not understand and finding out the meaning instead of simply ignoring the question or giving up and this is leading to a noticeable improvement in their confidence. (Appendix 3)

The processes being developed also encouraged students to naturally identify gaps within their own learning and the extraction of key words from questions enabled learners to make better noticeable progress as they were observed answering the questions more accurately.

Learning from this project

Although the project approach was to have umbrella groups, everyone responded to the objective and all involved demonstrated an increase in development of 'familiarisation of terminology'. This success led to the idea that we can continue to produce collectively designed resources. Posters and resources have been displayed around the campuses to expose learners to key vocabulary and terminology in mathematics. For example a motorbike labelled with the shapes used in mathematics that can be visually displayed in the Motor Vehicle workshops.



The engagement and positivity of teachers in the project was apparent and it is felt this is because they had been selected to take part and they have been positive with concern to engagement. It is easy to see how we can evolve and move the project forward by sharing good practice. The effective teamwork and collaboration between English and maths practitioners learning from each other has been a particular strength. This has enabled some evaluation of practice and maths teachers starting to adopt approaches observed more within English lessons like discussion work and group-based activities. A wealth of practice has been developed through the research being undertaken by practitioners with different subject specialisms.

There has been a common conclusion that small, simple changes to practice can be pivotal in engagement of learners. This has been a strength of the project. Tutors developed a strong awareness that they were breaking down barriers to learning by establishing an understanding that the poor confidence from learners was linked to a lack of English skills not necessarily maths.

The reflective and evaluative teaching methods undertaken have meant that the project has taken different directions with more resources and ideas being developed given further scope for more progression of the project.

The unforeseen circumstances of this academic year and the global pandemic Covid-19 meant that we have been able to be adaptable with our approach to the project. Tutors have been able to develop strategies and resources that work both in the classroom and online for remote learning. There is further scope to take the project in the direction of online learning development to support and underpin face-face delivery.

We intend to disseminate the project within the organisation and work collaboratively with other providers. Throughout the project, considerable interest from other providers has been evident and we are in the process of exploring ideas around reciprocal reading to help support our SEND learners and promote further inclusivity.

There are opportunities for collaboration with the vocational departments; this was a strand of development starting to emerge from one of the groups who had started to adopt this approach with the engineering and construction department.

Appendix 1 – The Project Team

Project Role	Name	Job Role
Project Lead	Joanne Styles	Head of English, Maths and Education
Project team	Tom Sammarco	Cross College Manager English and Maths
	Andre Rudder	Cross College English Manager
	Lahija Usher	Cross College English Manager
	Jack Bryant	Cross College Maths Manager
	Dave Bibbey	Maths Lecturer
	Dani Mortimer	English Lecturer
	Karolyn Shaw	Maths Lecturer
	Jane Perrin	English Lecturer
	Tamilla Shedden	Maths Lecturer
	Nuzma Badat	English Lecturer
	Natheaniel Machino	Maths Lecturer
	Kerry Nash	English Lecturer
	Meire Gransauil	Maths Lecturer
	Jade Riley	English Lecturer
Project Mentor	Catherine Gray (consultancy)	
Research Group Lead	Claire Callow (consultancy)	

Appendix 2 – Studies completed by paired practitioners

This appendix contains the 5 studies completed by the paired practitioners who carried out the research across the course of the project. It illustrates the classroom experiments that they carried out and how this has impacted on their practice and teaching, learning and assessment. Each of these provides more detail and discusses findings alongside the next steps for the projects and future.

GROUP 1

Background situation

This cohort consists of mixed ability male students. They are attending level 1 classes and started with very low confidence regarding maths. Most of them would not ask questions during the lesson or try to do more challenging questions in class.

Making a change in my teaching

I used the plan for learning to develop a display with maths vocabulary in the classroom. I developed power points to introduce the topics using key words for each lesson. At the start of the lesson, we discussed the meaning of the words, the students would take turns explaining to the others. They would write the words in their exercise book with an example. At the end of the lesson, we worked on an exam style questions using the vocabulary/key words. Discussing how to break down the question, how to answer and meaning of words. I also used tarsia puzzles to get the students to work in groups and discuss maths, share knowledge, use mathematical terminology, and enjoy completing the tasks in different topics. Some of them started asking “can we do another puzzle?”.

Findings from the OTLA project

- Both students I was following showed greater confidence in their maths.
- Both students have demonstrated improvement in their assessment grades.
- One student has improved attendance to lessons.

Next steps

- To use strategies with other groups.
- To develop more resources with maths vocabulary
- To collaborate with other teachers and share good practice

Research Evidence

- Attendance has improved
- The students' engagement and participation during the lessons was much better.
- Students were not afraid to ask questions and get it wrong.
- Better engagement with Century.

Group 2

Background situation

The objective of the project will be to increase GCSE maths attainment and improve outcomes for learners, by exploring how to expand English skills, particularly around problem-solving questions, which require reading and comprehension of language.

Research question: What is the impact of giving meaning of key words on answering worded exam style questions.

Method

1. Identify two students who are struggling with answering worded questions
2. Give the class (where students are in) an exercise with worded questions and record the responses of the two targeted students
3. Teach the class where the identified are in using the **strategy** and weekly record the students' responses.

Strategy: Teacher introduces every lesson by making students write key words in exercise books. Class discusses the key words by making students define the words and use them in sentences. Teacher to regularly refer to the key words emphasising their mathematical and real-life usage. The student to keep a glossary of the KEY words in their maths notebooks.

4. a) After three weeks, give the class an exercise with worded questions and evaluate progress (or not) of the targeted students.
b) Have an interview with the target students about how they understand questions because of key words.
5. Repeat the cycle.

Making a change in my teaching

The most significant change in my teaching is the awareness of the importance of vocabulary in mathematics. I have realised that it's not all about 'hammering' on mathematical terms but to introduce and discuss terms as they are used in daily life and in the students' main Vocational Course. Mathematical terminology must be introduced while connected to everyday use and/or vocational area of study.

Findings from the OTLA project

Students improve in their mathematics engagement in lessons and overall performance if they are confident on the mathematical terminology and connect this to real life and/or vocational course.

Next steps

- Keep on introducing terminology
- Share the research experience with colleagues

Research Evidence

- Better/improved participation in lessons. Improved performance in mathematics exercises like assessment tests and century nuggets.

Ideas for developing across college

Incorporate the research findings in CPD. Researcher teachers to run CPD sessions.

Group 3

Background situation

The cohort for this course consists of both male and female students (all 16+) who have come from various educational establishments. Some are from mainstream, some from alternative provisions and some were school refusers. They have all come straight onto the level 1 course and have various starting points with respect to GCSE maths. I felt that it was of paramount importance to allow the students to find their comfort zone within the course and use this as the starting point. I also used their quals on entry and an initial assessment to clarify a target grade. By allowing them to establish their own starting point it enabled me to determine their learning requirements for their assessments. As students who have just come from a variety of learning establishments, I was aware that for them to achieve I would have to think outside of the box and make lessons more fun rather than school-based learning. This would allow for the more kinaesthetic learners to achieve through doing rather than just writing stuff down.

Making a change in my teaching

Using the plan for learning I developed lessons for each week that incorporated fun activities that had lots of learning opportunities. With my project partner we created word games to incorporate the terminology, we encouraged the students to design posters to explain the terminology, we used word walls in English and Maths to support that week's topics as starters. This allowed for English and Maths to be incorporated into both lessons and it also allowed for the students to practice what they had learnt and often show off their new skills. We would often incorporate a wordsearch as a starter using that week's terminology for example, multiply, times, more, subtract, take away, minus. The students would then come to my lesson and I would give them two/three words such as multiply, subtract and ask them to give me some other words that meant the same using Padlet. This reinforced their learning and allowed for them to use technology in lesson. The results from all these activities allowed for me to create SMART targets and individualise their work to their specific learning needs.

Findings from the OTLA project

- Both students we were following showed greater confidence in their maths and English work
- One of the students has shown a bigger improvement in their English as opposed to their maths
- Both students enjoyed creating pictures to run alongside the terminology as it helped them to understand better. In fact, one of them drew pictures on their assessment as it helped with their understanding of the question
- Both attempted question that before starting here they would never have done
- Both have shown an improvement in their grades
- Both students have said they are enjoying maths as it is "fun and interesting not like school"

Next steps

- To continue using pictures to explain terminology
- Consult with the students after their assessments to get feedback on what has changed this year (what went well, what could have been better)
- As this is the first year of using the OTLA project in lessons I would like to open it up to all classes and see the impact it has on all students not just selected ones.

Research Evidence

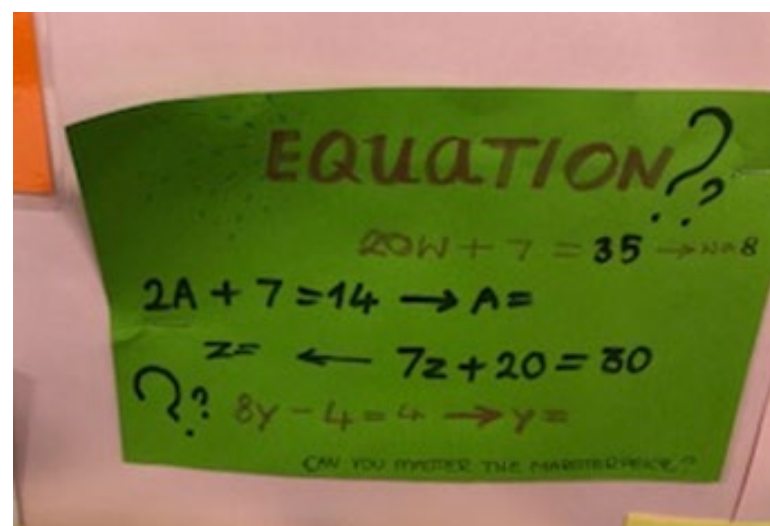
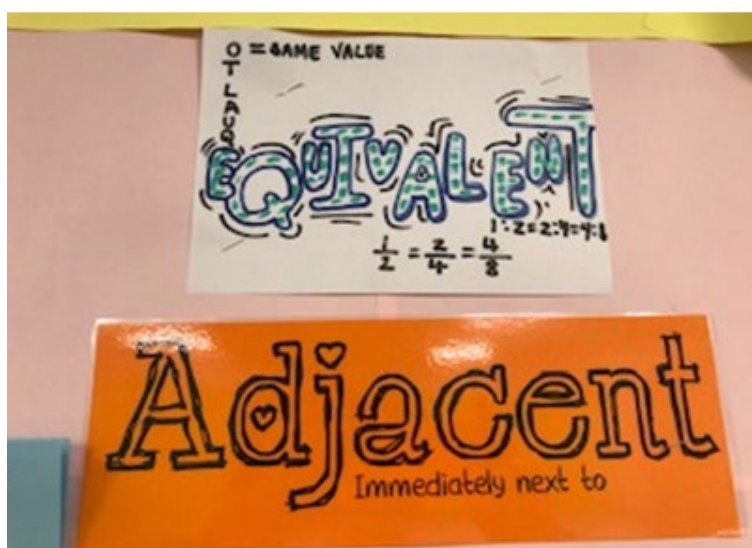
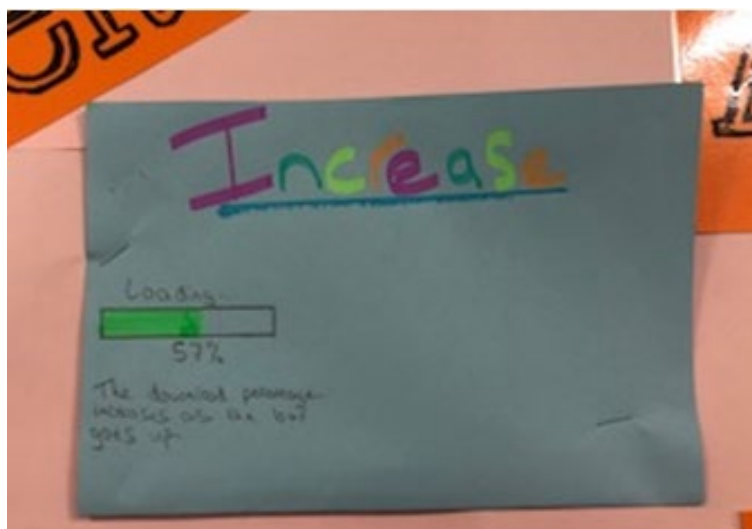
- Attendance has improved
- Student engagement and confidence has risen dramatically
- Grades are showing improvement

- All assessments have been attempted and they aren't afraid to make mistakes




Example of a classroom board created by learners and used as part of activities within the lessons including matching activities to recall and consolidate terminology

Examples of student work undertaken as part of exploration within the project: A selection of quick recall activities around maths terminology:



Examples of resources created to use everyday Maths terminology linked to vocational subjects, explored within Group 3.



Disc

Tyre for motorcycle

Clock

Wheel







Pizza

Circle

Scissors made from two rectangles and two circles



Example of terminology domino resource created within Group 3, as a mix and match task normally more evident in an English lesson. Encourages active learning and additionally development of maths vocabulary and terminology.

+	Multiply	x	Half
1/2	Descend		Ascend
	Ratio	1:5	Subtract
-	Share	÷	Squared
5 ²	Cubed	5 ³	Cube
	Sphere		Trapezium
	Divide	÷	Circle
	Less than	<	Equation
5x-2=28	Identity	x+x+x=3x	Expression
4x+y	Formula	V=lwh	Integer

A simple Word search created as a starter activity, designed to develop a crossover of both English and Maths skills – This was utilised by both English and Maths teachers. Designed to embed vocabulary and terminology alongside support a consolidation and continued learning checks.

N	O	I	T	I	T	E	P	E	R
O	J	Z	Y	N	O	R	I	A	C
U	E	T	A	M	I	T	S	E	O
N	L	S	I	M	P	L	I	F	Y
S	I	P	V	D	H	A	N	Q	T
Y	M	M	E	T	A	P	H	O	R
P	I	T	R	I	P	L	E	S	B
U	S	X	B	W	C	N	Y	Q	E

Find the words in the word search

Which are the odd ones out? Why?

Metaphor	Simile
Repetition	Estimate
Irony	Verb
Nouns	Simplify
Simplify	Triples

Now using the reverse of the paper give an example and the definition of each of the above.

GROUP 4

Background situation

One cohort for this course have learnt exclusively online during 2020-2021 (Level 3), while the other learnt solely in the classroom, until lockdown, then moved online. The cohorts consist of a wide variety of students in terms of age (16-18), prior educational achievements, and overall general knowledge and experience. They were also different Levels – some Level 3, some Level 1., as they were grouped by bubbles this year. Most students struggle to identify the maths skills being demanded by word-based questions that are difficult to break down into key words and skills. Reciprocal reading strategies of predicting, questioning, clarifying, and summarizing are being used to support learners in breaking down and identifying the nub of the maths question within the difficult language. However, identifying starting points, I feel, is crucial to avoid making assumptions and to help the students establish their own current knowledge and as such determine their learning requirements in preparation for assessment for learning. As such, the project begins with a baseline test on these types of question. It was necessary to make it easy to access independently, being online, so Microsoft Teams Forms were used, as Teams was the main teaching tool. However, in person, the aim is to replicate this structure on paper.

Making a change in my teaching

Using a Teams Quiz template, I then customised this according to the four aspects of Reciprocal Reading (predicting, questioning, clarifying, and summarizing) and the cohort – one online and one in class. Initially, the forms looked quite different, but the online one was more successful, and so was used as the basis for the classroom-based learning from week 4. The baseline tests were crucial to identifying the different starting levels against the difficulty of the questions. The results could then be used by me to determine starting points and by the student to set their own SMART targets for this unit.

Findings from my experiment

- All online students attempted the questions, whilst there was less engagement within the classroom setting
- Some students understood the format more than others and it helped to elevate their grades the most
- It helped some students identify gaps in their knowledge and helped them fill these gaps
- Some were unsure of the mathematical skills needed for this type of question and this process supported them in understanding how to identify which skill to use
- Key words being extracted from the questions enabled students to complete the questions more accurately

- Breaking down the key words and skills gradually improved their grasp of long-worded maths questions

Next steps

- Continue using the developed document with future students – [Please see example attached.](#)
- Develop to support with different question types, as found that the algebra questions were not achieved at such a high rate as the more difficultly worded questions
- Consider the feasibility of issuing the document ahead of the first session on the Unit/Learning Outcomes if time allows. This will help my planning for delivery of the unit and assessment for learning

Research Evidence

- Baseline tests, repeated three times
- Completed Initial Assessment documents
- Mini tests on Forms, completed regularly – Please see example attached/
- Student participation in sessions
- Feedback forms regarding their engagement with the process

Research consulted

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Ahmad, N. (n.d.). *Effects of Reciprocal Teaching Strategies on Reading Comprehension*. Reading. [online] Available at: https://www.academia.edu/2088877/Effects_of_Reciprocal_Teaching_Strategies_on_Reading_Comprehension [Accessed 1 Jul. 2021]

Example 1 - Teams Quiz template to support Reciprocal reading utilised as part of Group 4

Name.....

Question.

Five friends want to raise at least £200 altogether for charity.
The pictogram shows how much they each raise.

Key:  represents £10

Ahmed 

Beth 

Carly 

Donna 

Ethan 

Do they reach their target of £200?

What sort of maths question am I being asked?	
Which maths skills will I need to answer this question?	
For each line in the question, identify the key point from the line.	
First key point	
Second key point	
Third key point	
Remaining key points from the question	
Do you need any clarification of the question? Y / N	Details if yes.

Explain the nature of the final answer required.	Is it a numerical answer, a Yes/No solution, a name or similar, etc.?
Space for working.	
Now give your final answer.	

Example 2 - Teams Quiz template to support Reciprocal reading utilised as part of Group 4

Name.....

Question.

At a rugby match, the ratio of children to adults is 2 : 3

There are 80 children in the crowd.

Each adult ticket costs £8

Each child ticket costs a quarter of the adult ticket.

Work out the total money made from ticket sales.

What sort of maths question am I being asked?	
Which maths skills will I need to answer this question?	
For each line in the question, identify the key point from the line.	
First key point	
Second key point	
Third key point	
Remaining key points from the question	

<p>Do you need any clarification of the question? Y / N</p>	<p>Details if yes.</p>
<p>Explain the nature of the final answer required.</p>	<p>Is it a numerical answer, a Yes/No solution, a name or similar, etc.?</p>
<p>Space for working.</p>	
<p>Now give your final answer.</p>	

Example 3 – Teams Mini Test example – Exploring worded questions each week with learners with the intention that they are applying reciprocal reading techniques to respond.

3

Question 3

There are 14 rows of seats in a cinema.
There are 15 seats in each row.

A film was shown in the cinema on Saturday.
Each ticket for the film cost £6.50

The tickets that were sold cost a total of £1274

How many tickets were **not** sold?

A Feedback questionnaire created to obtain evidence from learners on how reciprocal reading activities may be helping learners to develop maths understanding.

6/17/2021

OTLA feedback (Edit) Microsoft Forms

Time to complete: 00:57

1. Please enter your name. 0 / 0 pts
Auto-graded

Jess
2. Please enter your previous (best) GCSE grade for maths. 0 / 0 pts
Auto-graded

3
3. Explain, briefly, why you agreed to take part in this exercise. 0 / 0 pts
Auto-graded

To help with information
4. Please explain your expectations from taking part in this exercise. 0 / 0 pts
Auto-graded

No answer provided.
5. How strongly do you agree that you completed all of the additional exercises sent to you? 0 / 0 pts
Auto-graded

★ ★ ★ ★ ☆
6. How well did taking part in the exercise meet your expectations. 0 / 0 pts
Auto-graded

★ ★ ★ ★ ☆
7. How strongly do you agree that taking part in this exercise improved your ability to interpret complicated maths questions? 0 / 0 pts
Auto-graded

★ ★ ★ ★ ★

GROUP 5

Background situation

The main aim of this project is to increase students' attainment in their GCSE Maths grades as well as to improve the outcomes for learners. The purpose of this project is to identify and describe some language difficulties which impact on their Maths attainment. Many students struggle with Maths because of poor English skills.

We have decided to use a case-study method as it will give us an opportunity to concentrate on the individual learners. We are planning to place the focus on two learners from year 10 who are taught twice a week. They were chosen because they often struggle with completing long worded maths problems for various reasons, one of them being reading for gist and detail.

The research question is:

What teaching and learning strategies can be used to help my learners to overcome language difficulties in their maths lessons? I've observed the following difficulties:

Language problems

Students do not read long maths problems and, as a result, miss out on some information or do not answer the question correctly

Some maths words can have different meanings in maths context and everyday English and cause confusion, e.g., Prime, similar,

Students may not know some of the words at all, e.g., consecutive, ascending,

Students cannot imagine the context in which a word problem is set

Making a change in my teaching

I've attended a few training sessions which gave me some ideas. I found one of the apps Flipgrid interesting and used it during my online lesson. I asked the students to think loudly and record their talking while attempting one of the worded questions (4 marks). I told them not to worry if they get it? wrong. **Two learners** recorded and sent the audio response back to me. It was interesting for me to hear their thinking and how they interpret the information there. They missed the given information even reading it aloud. It got better when I was aiding them with questions. I put a few questions on the screen and asked them to answer them as they were reading the maths problem again. I could see that having the questions on the screen helped with their understanding. Questions were simple and helped to break down the information: what is this problem about? What

shapes are there? What part of the circle is 10cm? Is 4 cm showing a radius or a diameter of the small circle?

I think encouraging learners to answer at least one of those break down questions can raise some interest or motivation to attempt difficult questions in tests and exams. Such approach as asking yourself what is given, what needs to be found, making own notes on long worded questions can eventually improve their reading and understanding. I was able to see this positive change in the following lessons: the student's understanding has improved, and they have got more questions right in the test.

I started using apps in my teaching, such as Mentimeter, Nearpod, Padlet, Tricider for collaborative learning.

I read an article about viewing maths as a language but more consistent and regular than English - Numbers can be viewed as numbers and calculation symbols can be viewed as verbs. Encouraging learners to speak in full maths sentences can help with better understanding, e.g., instead of giving the answer 6, they say $3 \times 2 = 6$. These basic sentences can be expanded in long maths problems.

Memorising in full sentences

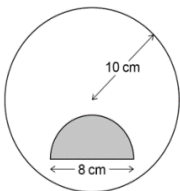
Many learners struggle with multiplication as they don't know times tables. When I was learning, I was advised to learn times tables in full sentences, by writing it or by saying it. Memorising this way helped Kiera with 3 times tables, she's got a better recall memory now, she needs to continue and regularly use it.

What do I already know?

I gave learners quite a challenging maths task which was broken down into steps.

They needed to fill in the gaps where words were missing to check their understanding of the maths problem and identify what they needed to find. For example:

25 A shaded semicircle is inside a circle as shown.



Not drawn accurately

The **radius** of the circle is 10 cm
The **diameter** of the semicircle is 8 cm

How many times bigger is the unshaded area than the shaded area?

[4 marks]

Task 1 The radius of the circle is
The diameter of the semicircle is ...
The question is

In Task 2 I broke the problem into many questions with the idea the learners would be led to the right answer. This was also designed to help to boost the learner's confidence as they were able to

answer at least some of the questions.

Task 2 Answer as many questions as you can:

1. Diameter is twice as long as radius True/False
2. What is the diameter of the white circle?
3. What is the radius of the shaded semicircle?

4. How many semicircles are there in a whole circle?
5. If the shaded circle was a whole circle, would the white circle be an enlargement of the shaded one? Yes/no
6. The white circle is the enlargement of the shaded circle and their diameters are proportional

True/False

7. The ratio of their diameters is a) 20cm: 8cm or b) 10cm: 8 cm
8. How many times bigger is the white circle than the shaded circle? Shaded semicircle?
9. How many times bigger is the unshaded area than the shaded area?

Task 2 was further developed into a Microsoft form where the wrong answers were bridged to the links from BBC bitesize allowing them to practise main concepts (radius, diameter, similar shapes)

I was able to see more students attempting this challenging problem (4 marks) rather than giving up on it. Breaking complicated questions into a series of smaller questions can help with understanding. Getting into a habit of writing what they know about a maths problem can help them to find the unknown.

In our college in my classroom, I have created a wall space with maths words. Each lesson learners are encouraged to pick a word from the wall that they know, and they explain it in their own words, or draw it, and they also pick a word they do not know, and they google it then? discuss it? always working in pairs. This activity has allowed the learners to remember the key words better over time and has improved their performance and ability to respond to questions.

Findings from the OTLA project

We as tutors face similar problems in maths classes, language difficulties are one of them. Students may have poor decoding (reading) skills or expressive or receptive language difficulties. These language-based problems stop them from effectively developing mathematical abilities. If these students are only provided with lecture or text-based instruction, they are limited by the teaching style in addition to their poor understanding of math concepts.

Maths can be viewed as language. Numbers represent nouns, while operational signs (+, -, x, /, =) serve as verbs. Students should be encouraged to speak in complete sentences, to deliver an entire thought. They should be encouraged to think loudly about? how they arrive at an answer.

Some students are unable to process rapid or complex speech. These students need to be exposed to discussion and take part. Modifying my presentation can help them effectively participate and benefit from them.

Some of the strategies I've used in my lessons:

How to overcome/Teaching strategies

Ask learners some questions to check their reading comprehension for the gist and for the detail, e.g. What is this maths problem about? What is the total in this question? Ask them to highlight the key words. Ask them to draw/write down the worded problem in their own words. Ask them to create similar worded problems on the same topic.

Display Key words on the board, go through them thoroughly, find out if they understand (Q&A, multichoice quiz, etc)

Same as above

Find out by asking if they are familiar with all the words in the maths problem

Pick familiar contexts

Next steps

- Use multi-sensory approach in my presentation to reinforce learning
- Continue to use the above apps in my lessons and learn about new ones
- Create opportunities for learners to discuss and explain their choices and answers
- Build the bank of key words
- Will try to use Thing link, I like the 3D feature on it which is quite appealing to use online and seems engaging.
- Share good practice with other tutors from my organisation and other colleges


Ideas for developing across college

To create a wall with math words in every maths classroom once I return to full-time face -face delivery.

Maths questions displayed around the college

Maths questions with QR codes around the college

Example Task developed into a Microsoft form where the wrong answers were bridged to the links from BBC bitesize allowing them to practise main concepts



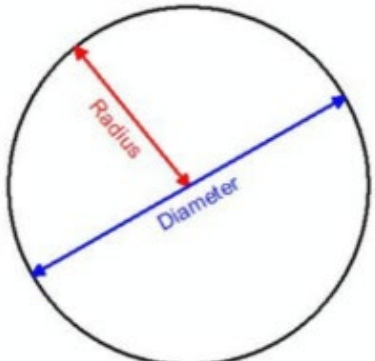
4 mark question (area, similar shapes)

This 4 mark question from an AQA paper is broken down into a few questions to guide you through to your final answer. Try to answer as many questions as you can. Use the [explanation links](#)

Hi Joanne, when you submit this form, the owner will be able to see your name and email address.

1

Radius is half of the length of the diameter



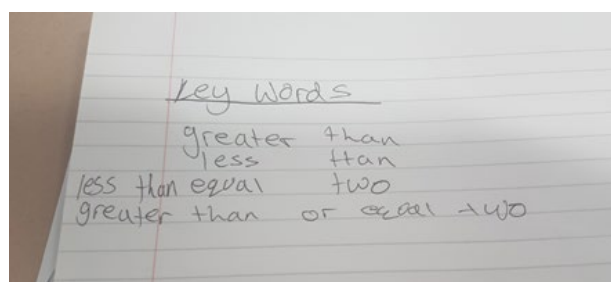
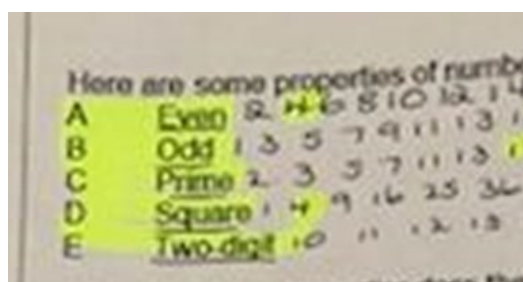
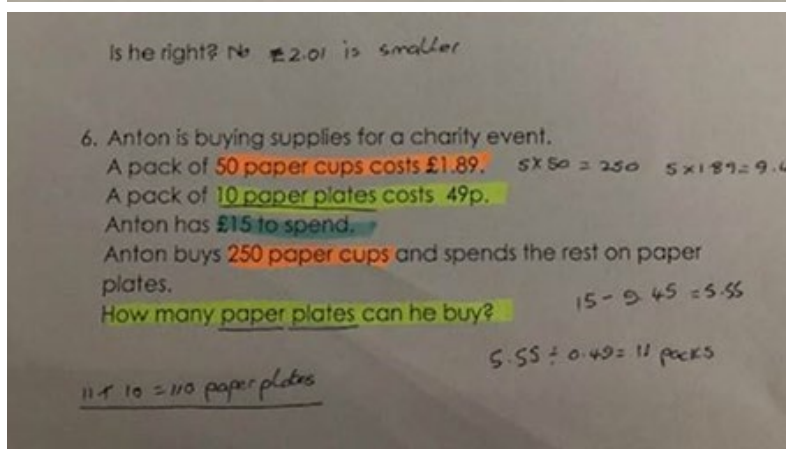
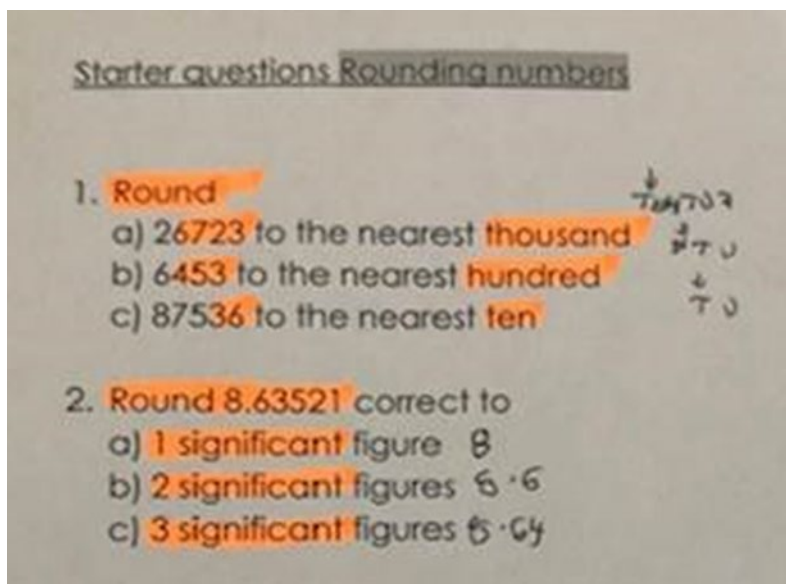
Select your answer

Submit

Appendix 3 – Learner work

Learner work which has been underlined showing an adapted approach students have developed with highlighting or underlining key facts before answering.

Prior to the intervention, they just answered worded questions by applying any mathematical operation without any rationale.



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