Teacher-Coach Partnerships in Further Education for GCSE Mathematics Re-sit Students

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

Acknowledgements

Thanks must go to the whole action research group, their dedication and belief in the project has been inspiring. All of you have gone above and beyond this year and it has been very much appreciated.

Special mention must go to Georgina Norris and Sarah Stokes (CRC Student Engagement Coaches), their commitment, enthusiasm, creativity, and professionalism developed the direction of the project and brought out the best in our students and staff. I have learnt so much from you both that I will use for many years to come. Thank you.

In addition, thanks must go to all maths teachers from both CRC and our network partners. You have all embraced the CfEM ethos this year: joining us for CPD, supporting each other and collaborating in a way that I did not expect. Long may it continue.

"Alone we can do so little; together we can do so much." – Helen Keller

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About CfEM

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

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

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Summary

Research shows that approximately 21% of GCSE mathematics re-sit students achieve a grade 4, post-16, lagging behind the secondary school achievement rates of approximately 60%. The introduction of compulsory re-sits for those sixteen to nineteen-year-olds who have not yet achieved a grade 4 in mathematics, has led to disengaged, demotivated and anxious students who struggle to overcome their barriers to learning. Thus, highlighting the need to equip these students with the strategies to build mathematical resilience. This action research project was funded by the Centre for Excellence in Mathematics focusing on Engagement and Motivation of post-sixteen mathematics students to ultimately improve attainment. (Savage & Norris, 2021)

The aim of the project was to determine whether attendance, motivation and engagement is improved for construction and motor vehicle students taking post 16 GCSE maths resit by employing student engagement coaches to work full-time with maths teachers. This would enable planning and delivering to whole groups in partnership to ensure students' barriers to learning are addressed. Creating the right environment to ensure students were in an 'adult-state' was a key element, also to determine whether creating a safe space for students would put them in a growth mind-set for learning maths. The aim was for teachers to focus on teaching for mastery through contextualisation and evidenced based approaches. The coach providing a more holistic approach to building resilience and supporting maths anxious students. This model was employed at our Cambridge Campus with a smaller model running at Tresham College (part of the Bedford College Group). Thematic analysis was carried out on qualitative data from teacher and coach focus discussions. Qualitative and quantitative data was also sourced from student pre and post intervention questionnaires.

Key findings

Addressing the psychological barriers to learning mathematics is key in addressing the low attainment of post-sixteen resit cohorts. Giving students the strategies and support to identify and address their mathematical mindsets has been found to improve their motivation, engagement and ultimately lead to more successful outcomes. The specialism of Student Engagement Coaches in educating and supporting students to become mathematically resilient is crucial in preparing students, not only for examinations but also for the mathematics they will encounter in daily life.

Student confidence and engagement improved post-intervention. Towards the end of the year many students were more willing to both publicly ask for support and accept that errors were part of learning. For example, 68% of students who completed the post intervention questionnaire said that they now felt comfortable asking their maths teacher for help compared to 36% pre intervention. In addition, 84% stated that working with a coach improved how they felt about their maths ability and 88% said having a coach during the exam period had a positive impact on their experience. Students explained that this was because of specific exam teaching and coaching strategies, and that they were more willing to move out of their comfort zone and tackle the longer exam questions. During exam sittings, it was noted that exam anxiety was much reduced in these students compared to non-intervention students. In addition to reduced exam anxiety, improved student agency was cited by some participants; students were more prepared to proactively take control of their learning.

Background

Introduction

In 2017, the Department for Education commissioned the Education and Training Foundation to set up an educational project to deliver sustained improvements in mathematics for sixteen-to-nineteen-year-olds, in post-16 settings. The program involved setting up Centres for Excellence in maths in twenty-one different post 16 settings. The aim was to try to close the gap between the secondary school achievement rates of approximately 60%and the post sixteen resit program for GCSE mathematics:

In the English mathematics education system, emphases on reactive approaches are associated with a wide attainment spread and a long tail of under-achievement. Almost 180,000 students had to re-sit GCSE mathematics in 2019. Of these, only 22.3% achieved a standard pass (grade 4) or above. (Ofsted 2021)

Cambridge Regional College (CRC) is a further and higher education provider, offering vocational courses for school leavers, professional training, qualifications, and community courses including English and Mathematics. As one of the Centres for Excellence in Mathematics, the college has had the opportunity to explore ways, through action research, of improving student motivation, engagement and ultimately achievement. This was undertaken through the professional development of teachers, hosting good quality professional development and the sharing of best practice, with a view to drive innovation and improvement not only in our environment but also those within our network partner colleges and, as discussed in this report, addressing students' barriers to learning. As noted by Noyes and Dalby:

Teaching and learning approaches that address the specific contexts, constraints and affective issues in FE need to be researched, developed, and widely disseminated across the sector. ….. Mathematics teachers in FE need ongoing support and professional development to develop rich pedagogical toolkits that enable them to adapt teaching and learning to meet diverse students' needs. (Noyes & Dalby, 2020)

College Goals / Our Students

At Cambridge Regional College, we aim to enable students to adopt a positive mindset, build resilience, self-efficacy and to realise their full potential. CRC will help to identify barriers to learning by working with stakeholders, including vocational tutors, and learning support staff. In order to create and sustain an improvement in the quality of teaching, a programme of mathematics teachers' professional development is key. Fostering a culture of collaborative learning, teachers will be encouraged to trial new pedagogical approaches, reflect on their impact, and embrace change.

The overall aim of the Centres for Excellence in Mathematics (CfEM) project is to raise the attainment of GCSE Mathematics resit students. Our research focuses on the key CfEM themes of Motivation and Engagement. This aligns to the findings reported in Mathematics in Further Education Colleges (MiFEC) (October 2020):

Without personal motivation and a change of attitude to mathematics, colleges find that enforced attendance is unlikely to lead to learning….. previous failure in mathematics examinations is identified as a factor that reinforces low confidence and poor self-efficacy; students are even more convinced that they do not have the ability and will never succeed with the subject. Students with low levels of confidence are often afraid to make mistakes and fear being seen as stupid by their peers. They may be reluctant to try a question or

quickly give up because they have no confidence that they can succeed. This lack of self-efficacy and low resilience leads to reduced effort and disengagement.'

The action research project was guided by key research studies such as MiFEC.

Research rationale

Building on from last year's successful coaching project, where students were very positive about their experiences.

"In terms of whether a having a coach present has made a difference to how they feel about their mathematics ability. 87.5% identified that it helped them realise that when they put the effort in, they are better at some mathematics topics than they initially thought. 62.5% reported that it has given them more confidence in their ability……returning to the initial question of how the thought of mathematics made them feel at the start of the year, they were asked how the thought of mathematics made them feel now, 81% of students went from feeling 'stressed/worried' to 'hopeful/excited'" (Savage & Norris, 2021)

We worked with students on a 1 to 1 basis, either in or out of class depending on individual needs, using a variety of strategies, we wanted to establish exactly why coaches had made such a positive impact and could this be adapted to improve teacher practice and delivery. It was decided to create teacher-coach partnerships where teachers and coaches would work in tandem to plan, implement, reflect, and refine practice. This would allow teachers and coaches to learn from each other, create a supportive environment for students to enable positive mind-sets and to support a higher volume of students by working primarily with whole groups. In addition, enough time would be given for coaches to trial more effective coaching strategies in 1 to 1 or whole group settings to gain a deeper understanding of effectiveness.

The coaches and teachers looked into creating a classroom that would challenge student mind-sets, it had been noticed then when students were working in a vocational area, that was set up as a workspace, they were in a much more adult mind-set, however when in a maths classroom they tended to revert back to a more child state and behave as they would in school. It was decided to create a more adult space that was more maths anxiety and coaching friendly. Tables and chairs that would encourage collaborative working and peer support while being more adult in style, motivational posters, and plants to create a calmer environment. To give space for those who were maths anxious, sofas would be sourced to give a space away from peers at the back of the room and maths resources would be kept to a minimum on walls and decorative surfaces.

Literature Review

The introduction of compulsory re-sits for mathematics for 16 to 18-year-old students who do not have a grade 4 – 9 GCSE qualification has had a significant impact on Further Education (FE) Colleges. As exam entries have increased, the number of students achieving a Grade 4 or above has declined (Smith, 2017). In his review of post-16 mathematics, Professor Adrian Smith (2017) discusses how challenges are most likely to be experienced in FE colleges. These challenges consider two crucial factors. Firstly, FE colleges take students with lower average grades than school sixth forms or sixth form colleges and, secondly, they have also seen the largest increase in numbers of students studying mathematics. According to Rodeiro (2018), this forced re-sit regularly leads to disengaged, demotivated and anxious students who struggle to overcome their barriers to learning. In addition, this demotivation is exacerbated by the fact that many students continue a 'resit-cycle' over their three consecutive years at college as 60% of mathematics students do not improve their grade when they re-sit the exam (Rodeiro, 2018).

Although we appear to be in a period of change, it is arguable that the UK still lags behind many of its developing world contemporaries in terms of mathematics achievement. Indeed, it is evident we have made progress; according to achievement results from the *National Foundation for Educational Research*, the UK is now 18th in the world for mathematics achievement, compared to 27th place in 2015, (Programme for International Student Assessment, 2018). However, whilst showing a clear improvement, this is still a concerning figure. As discussed by Smith (2017) and Cherry & Vignoles (2020) qualification levels have risen in the UK. Nevertheless, the proportion of the adult workforce with very low numeracy and literacy has not reduced substantially in recent decades. For example, in 2017, it was identified that around nine million working age adults in England (more than a quarter of adults aged 16-65) had low levels of numeracy and/or literacy. Cambridge Regional College can be classified as very typical in terms of our GCSE maths resit results in comparison to other FE colleges in the UK.

At a more local level, we know that there are some issues specific to CRC that may affect student attainment. For example, the college's geographic location in Cambridge can also impact student engagement and motivation. Professor Adrian Smith (2017) explains that an area that is renowned for academic achievement, like Cambridge, could affect student motivation, engagement, or anxiety when they believe that they do not meet the expected standard. In addition, due to the structure of the maths team at CRC, students are not streamed. This often means that entry level students are placed in mixed-ability GCSE maths classes, which can negatively affect student confidence and self-esteem, which may differ from other colleges. In addition, many groups are shared between teachers which also means students can become disengaged if they feel they have not got the stability and support they require.

This literature review will expand on the reasons behind this challenging situation and provide a possible means of overcoming some of the difficulties our students face. As part of this, the review will provide a rationale for the research and a justification of the methodological processes. Drawing on the literature, the barriers to students' motivation and engagement are reviewed. From these foundations, the affordances and constraints of students resitting their GCSE at CRC are considered. Following on from this, a research-based intervention consisting of learning environment, collaborative planning, and implementation, as well as group and one to one coaching is discussed. As the overriding aim of the research is to evaluate how we can improve student engagement and subsequent attainment, the research on attendance and engagement is explored first.

Attendance

Although there is an undeniable relationship between attendance, engagement, and subsequent learning, as discussed by Sammons et al (2014) who found that students' attendance as rated by Ofsted inspectors was a statistically significant predictor of academic attainment in Year 11, this is however by no means the only indication of maths anxiety or demotivation. Maths anxious or demotivated students can have excellent attendance as their conscience tells them they must attend even if it is inexplicably hard for them. Likewise, students can have poor attendance for many reasons but as Parish, et al (2020) discuss in the Children missing education report "*wider societal factors have meant that children are arriving in schools with a combination of needs, often linked to disruption in their family lives"* and unfortunately many of them have gaps in knowledge and understanding due to poor prior attendance, which can in turn cause anxiety and demotivation.

"The negative implications can include slower progress in learning, worse prospects for future employment, poorer mental health and emotional wellbeing" (Parish, et al., 2020)

Engagement

Issues and solutions surrounding the engagement of students has been a significant focus of educational research within a variety of subject domains, including mathematics. Indeed, on a fundamental level, it is commonly understood that engagement is a prerequisite for effective learning (Finn and Zimmer, 2012). Data from Hume et al's (2018) qualitative research identified a range of barriers to engaging in GCSE Mathematics and English resits, though common themes arose. After conducting *"in-depth interviews with 103 students and 20 members of staff at 11 different colleges across England"*, four barriers to engagement were identified as holding particular significance:

1. *"Not viewing Mathematics and English as relevant to one's future*
2. *Having a fixed mindset (i.e., believing that their abilities are fixed and cannot be improved upon)*
3. *Being afraid of looking stupid in front of their tutor and peers*
4. *Lacking social support for one's learning" (Hume et al, 2018, p.18)*

Not only does this evidence the wide range of barriers that exist, but it also highlights how students differ substantially in terms of their experiences of Mathematics and English. Thus, the need to be flexible regarding approaches and intervention to combat issues of engagement is imperative. However, in order to understand how to improve student engagement, it is first necessary to recognise the different types and the way in which they can be displayed through student behaviour.

Different Types of Student Engagement

As part of an investigation into the relationship between mathematical self-efficacy and student engagement in the mathematics classroom, Warwick (2008) distinguishes between three different types of engagement: behavioural, cognitive, and motivational. Related to the more traditional understanding of the concept, Warwick (2008) defines behavioural engagement as "the attendance, effort and persistence shown by students and their willingness to seek help" (2008, p.32). Evidence of behavioural engagement can be students "following the rules and adhering to classroom norms", "as well as the absence of disruptive behaviours" (Fredricks et al, 2014, p.62). Cognitive engagement, on the other hand, refers to the psychological investment students make towards learning. This is often achieved

through memorisation and "the use of self-regulatory strategies to facilitate deep understanding" (Barlow et al, 2020, p.2). Warwick (2008) highlights that, whilst a student may appear to be working on a mathematics problem, this is "not necessarily indicative of the student fully engaging mental faculties in trying to complete it" (2008, p.32). The third type of engagement relates to the aforementioned concept of intrinsic motivation, whereby:

"a student may not particularly enjoy mathematics but appreciates the usefulness of the skills being learned and that these skills will be required within their chosen profession and so is motivated to engage in learning" (Warwick, 2008, p.32).

Affect Issues

There is a plethora of research available which examines the impact different factors can have on improving engagement in mathematics. Whilst the progress in this area is substantial, the variance of factors which have been found to be effective, highlights that one size does not fit all. What engages one student might lack impact for another. The overlapping and interdependent affective components that align closely for many students with engagement issues are outlined. These include student self-efficacy, maths anxiety, mindset, and state of mind.

Self-efficacy

A factor which has been found to be closely linked with engagement is a student's level of self-efficacy, that is their personal "judgement of their capabilities to organise and execute courses of action required to attain designated performance" (Bandura, 1997 cited in: Warwick, 2008, p.31). For example, as part of a four-month experimental program, Breso et al (2010) found that students who participated in self-efficacy interventions displayed significant increases in their engagement and academic performance in comparison to two other control groups.

Furthermore, self-efficacy is particularly significant due to it being identified as a catalyst for behavioural, cognitive, and motivational engagement. In the face of difficulty, such as a student being presented with a mathematics task they cannot immediately do, students with high levels of self-efficacy are more likely to persevere than their counterparts (Warwick, 2008). Lower levels of self-efficacy, on the other hand, are more likely to "lead to feelings of helplessness and perhaps a premature admission of defeat" (Warwick, 2008, p.32) when presented with the same task. Lower levels of self-efficacy have also been linked with higher levels of stress, anxiety, and fatigue in students (Breso et al, 2010), thus highlighting the potential positive impact self-efficacy interventions could have on the behavioural engagement and wellbeing of anxious students. For as Breso et al (2010) highlights:

"When students experience negative thoughts and anxiety with regards to their capabilities, these negative affective reactions can themselves further lower perceptions of capability and activate a stress-generating mechanism that reinforces the probability of the inadequate performance they fear" (2010, p.340)

With regards to the relationship between self-efficacy and motivational engagement, research findings have indicated that self-efficacy is "positively related to adaptive motivational beliefs, like interest, value, and utility, and to positive affective reactions" (Linnenbrink and Pintrich, 2003, p.132) – beliefs which can encourage engagement on mathematics tasks. For example, Linnenbrink and Pintrich (2003) note how some "students first like some task or topic area and are then drawn to the activity due to their personal interest in this topic" (2003, p.132). Indeed, there are evidenced links between students' self-efficacy and motivational engagement. However, there exists debate about the causal ordering of the variables:

"In other words, do strong self-efficacy beliefs induce greater motivational engagement or is it the motivational engagement and consequent learning that generates stronger self-efficacy beliefs? In reality there is likely to be affect in both directions" (Warwick, 2008, p.32).

Maths Anxiety

Many mathematics students in FE are also facing challenges with maths anxiety and how it negatively impacts working memory. As described by Marshal and Johnston-Wilder (2017), maths anxiety is "an acquired fear of mathematical situations or subjects which stops the brain being able to process mathematics effectively or even at all" (2017, p.1). Whilst researchers often speculate on the causes of this situation-specific anxiety, Marshal and Johnston-Wilder (2017) argue that it often occurs as a result of previous negative experiences with mathematics and lack of confidence in their ability.

Maths anxiety manifests itself in number of ways and can cause a range of physical and psychological symptoms such as sweating, nausea, increased heart rate and feelings of helplessness. Lyons and Beilock (2012) also highlighted that the anticipation of doing maths activates regions of the brain associated with pain, although the physical act of engaging in a maths task does not, thus highlighting that maths anxiety is a conditioned anticipatory fear of mathematics. It is therefore unsurprising that the most common behavioural symptom of maths anxiety is maths avoidance (Ashcraft and Krausse, 2007).

The finding that a significant proportion of the UK's population suffer from mathematics anxiety was confirmed by Almehrz, et al. (2016), and is a significant contributor to mathematics underachievement. Emerging research into mathematics anxiety highlights the need to teach students to be resilient. Marshal and Johnston-Wilder (2017), for example, confirmed that students need guidance in overcoming anxiety:

"A few participants described themselves as previously "attempting to remove ... mathematics anxiety but without a sort of strategic plan of how to do so". For other participants, helplessness manifested as a 'that's life' acceptance that mathematics anxiety is a problem but not knowing what to do about it." (Marshall & Johnston-Wilder, 2017).

Mindset

A second issue which can significantly affect student engagement and subsequent attainment relates to student mindset. Dweck (2012) discusses how students' mindsets generally fall into one of two categories: a fixed mindset or a growth mindset. Which of these two mindsets a student possesses can have a substantial impact on their learning, as well as affecting how they respond to challenges, effort, feedback, and failure. Students with a fixed mindset tend to believe that intelligence and ability are fixed traits, and nothing can be done to change them. Students with fixed mindsets are also more likely to avoid challenges which risk failure, set themselves lower expectations and are discouraged to continue learning due to mistakes and failure (Leung, 2018). Conversely, students with a growth mindset believe that intelligence isn't fixed, rather it can be cultivated through effort. They tend to adopt the belief that although everyone has different initial abilities, aptitudes and temperaments, change and growth occur for everyone through application and experience. In addition, students with a growth mindset tend to seek critical feedback in order to learn from mistakes and failures, as well as displaying resilience and perseverance when faced with challenges or setbacks (Dweck, 2006).

States of Mind

In addition to mindset, students different 'states' of mind (Gold, 2018) can impact engagement and motivation. This area of research is pertinent to CRC students as they transition from child to adult state. Transactional analysis tells us that there are three ego states: Parent, Child, and Adult. To enable learning to take place, students need to move from a child state to an adult state. In a child state, a student may behave, feel, and think similarly to how they did as a child. The Child is the expression of feelings, thoughts and emotions that are replayed from childhood. In terms of the FE environment, students may regress to how they felt as a child in mathematics classes in school and respond negatively, for example by getting angry or displaying negative behaviour. This conjecture was confirmed by Dalby (2015):

"…students entered college with existing attitudes that influenced their approach to learning mathematics in college, affected their social behaviour in the classroom and impacted on their learning process (Dalby, 2015)

Adult State describes our ability to think and determine action for ourselves based upon the 'here and now'. It draws on our understanding and analysis of our external and internal environment. Students are often in adult state in their vocational environment, where they have no prior emotional response to this situation and view it as a new experience.

Motivation

Motivation and resilience are key factors in switching to and maintaining an adult state and for improving engagement.

"*In Self-Determination Theory (Deci & Ryan, 1985) we distinguish between different types of motivation based on the different reasons or goals that give rise to an action. The most basic distinction is between intrinsic motivation, which refers to doing something because it is inherently interesting or enjoyable, and extrinsic motivation, which refers to doing something that leads to a separable outcome……. Students can perform extrinsically motivated actions with resentment, resistance, and disinterest or, alternatively, with an attitude of willingness that reflects an inner acceptance of the value or utility of a task*" (Deci & Ryan, 2000)

There is no doubt that students' prior experiences of learning mathematics taint their motivation in resitting mathematics in FE colleges, as well as the examination outcome and career aspirations. Archer, et al. (2017) discuss how those students that have not yet managed to achieve the accepted standard of a Grade 4 feel that they have failed, leading to various levels of motivation to re-engage with the subject. A few students although disappointed with their grade can still find the motivation to improve, most though will continue to become more and more demotivated in ever increasing cycles of continuing 'failure' driven by their own lack of confidence or how they have been labelled previously. Once at this point, it can be difficult for students to find the resilience and motivation to try again without support from others.

Strategies for increasing student engagement and attainment

Learning environment vs learning space

Research has shown that the learning environment can have a significant impact on student engagement. It is important to note at this stage that research in this area can often present conflicting definitions of the learning environment. For example, whilst some researchers include the physical setting as part of the learning environment, others refer to it distinctly as the perceived cultural context in which learning takes place. In this literature review we adopt Lorsbach and Tobin's (1995) definition of the learning environment, who describe it as "a construction of the individuals in a given social setting; an individual's socially mediated

beliefs about the opportunities to learn and the extent to which the social and physical milieu constrains learning" (1995, p.431). In contrast, the physical setting, such as the traditional classroom, will be referred to as the 'learning space'.

The creation of a positive learning environment, the way in which it can be maintained and the effects this can have on student motivation and engagement have been the focal point of a number of research studies. Having a sense of belonging and feeling valued by the educational institution of which they reside has been found to be positively correlated with students' expectancies for academic success and intrinsic value for education – two common indicators of motivation (Goodenow, 1993; Skinner & Belmont, 1993). In addition, results from Ryan, Gheen and Midgley's (1998) research study found that students of teachers who reported that they attend to students' social needs as well as their academic needs reported higher levels of help seeking behaviour – a self-regulated learning strategy which is often recognised as a key indicator of engagement (Dong, 2020, p.2). This emphasis on meeting students' psychological/holistic needs was also highlighted in a study which looked at the profiles of 'effective' and 'ineffective' classroom environments (Cheng, 2010); correlational analysis of classroom environment measures and the affective performance of students highlighted the importance of the teacher-student relationship and how this can impact a student's motivation and engagement in class. Cheng's (2010) findings led them to conclude that 'effective' classrooms were those in which the teacher did not "use force or punishment" but, rather, were able to create "a good classroom climate with their professional knowledge, personal morality and personality" (2010, p. 221). It is possible to infer from these findings that the non-physical aspects of a classroom environment can help ensure that the psychological/holistic needs of the students are being met which, in turn, is likely to help them achieve their academic goals. For as Graetz (2006) highlights, "environments that elicit positive emotional responses may not only lead to enhanced learning but also to a powerful, emotional attachment to that space" (2006, p.62).

In addition, the impact that physical learning space can have on student behaviour has also been a subject of some interest within educational literature. Students are awash with environmental information when sitting in a classroom. Graetz (2006) highlights how the "sights and sounds of instruction" (2006, p.62) only make up a small fraction of this information and that other physical characteristics can play a significant role in the learning process. Findings from Nelson, March and Martella's (2003) research highlighted the social and behavioural benefits of a well-organised classroom, arguing that good organisation can help permit positive interactions between teachers and children and reduce the presence of challenging behaviours.

Creating a relaxed environment

Research has also shown that creating a more relaxed environment can also benefit students and their learning. Millard, A (2018) discusses the impact of whether more relaxed rules around clothing, food, and fidget toys had an influence on achievement. She goes on to challenge that:

"what an observer may consider to be 'learning' may not actually look like that. A student could be learning just as much when they are fiddling, eating, drinking, and wearing a coat as when they are adhering to strict classroom standards. The findings suggest that students are actually learning less when they are adhering to these strict standards…… Our goal as teachers is to produce students who are passionate about their subject, keen to learn the next thing, content and confident. Students need to feel respected and listened to. They need to know that their deep concerns are considered and that they are cared for whilst they are in our institutions. The findings suggest that students will not do well when they feel belittled, disliked and are just a statistic." (Millard, A2018, p.17)

Collaborative Learning

Student collaboration

The physical learning space can not only help to improve students' behaviour but can also encourage collaborative learning. Moveable seats, chalk boards placed around the room and smaller group tables that can easily be reconfigured have been described by Bruffee as 'the ideal classroom for collaborative learning'. Collaborative learning between peers has been found to have a number of social, psychological, and academic benefits (Johnson and Johnson, 2009). These include, but are not limited to, helping to "establish a positive atmosphere for modelling and practicing cooperation" (2009, p.487), increasing self-esteem and helping students take a more active role in their learning. However, whilst this research highlights the impact that both the learning environment and the learning space can have on motivation and engagement, there is a considerable lack of research on how these factors can impact motivation and engagement within a further education setting.

Teacher- Coach collaboration

There have been numerous studies into how when teachers collaborate, students benefit.

DuFour (2011) defined collaboration as:

"a systematic process in which teachers work together interdependently to analyze and impact professional practice [and] improve results for [their] students, [their] team, and [their] school" (p. 10). A teacher collaboration model may include the following characteristics: valuing individual contributions equally; having a shared goal; sharing responsibility; possessing shared accountability for whatever results that might occur; building upon shared resources; and believing in the importance of shared decision making, trust, and respect (Sevier County Special Education, 2009),

However, there has been little research published into the collaboration of pastoral support, such as coaching, and the academic teacher in a classroom. This report will aim to explore this, however as Jackson and Davis (2000) discuss when positive relationships exist in a group, learning is bound to become more meaningful.

Coaching

Definition of coaching

Coaching within educational contexts has been recognised as a powerful tool for the academic, professional, and personal development of students, teachers, and senior leaders. Whilst coaching takes various forms, the concept is commonly conceived as a means of facilitating "learning using active listening and inquiry and providing appropriate challenge and support" (Devine et al, 2013, p.2). A plethora of research exists in support of the benefits coaching can provide across the board of education; this includes academia-based improvements, such as improved GCSE examination results (Passmore and Brown, 2009), as well as developing skills "that go beyond the traditional academic subjects to enhance wellbeing" (Devine et al, 2013, p.2) such as 'cognitive hardiness' (Green et al, 2007), mental resilience (Campbell and Gardner, 2005) and the use of coping strategies (Seligman et al, 2009). However, as discussed earlier, there is little in the way of coaching in Further Education Colleges.

Recent progressions in the adoption of coaching within these contexts, according to Griffiths (2005), has influenced a shift in the traditional teacher role "from that of instructor to one of facilitator" where combined coaching strategies such as "self-regulation, the use of questioning, problem-solving opportunities and feedback" (2005, p.3) are utilised. Indeed, in theory, this emphasis on learning techniques, in addition to the teaching of content, can create a unique opportunity to further develop the teacher-student relationship. However, it is important to acknowledge the difficulty relating to the maintenance of these relationships when students are persisting with disengaged and disruptive behaviour in the classroom – a common issue faced by FE teachers in Mathematics GCSE resit classes.

Sheffield,D. and Hunt, T (2006) explore how for students who have maths anxiety it is necessary to alleviate this, not by working through maths problems but by focusing on alleviating the emotional responses first:

"Interventions should attempt to alleviate the anxiety experienced rather than focus on a student's intellectual or cognitive abilities" environments that elicit positive emotional responses may lead not only to enhanced learning but also to a powerful, emotional attachment to that space. It may become a place where students love to learn, a place they seek out when they wish to learn, and a place they remember fondly when they reflect on their learning experiences." (Sheffield, D. and Hunt, T. (2006, p.22)

Cognitive-behavioural and other blends of coaching techniques have been found to be effective in the personal and academic development of students. Based on the premise that our reactions to negative experiences are a result of the way we perceive an event/situation as opposed to the event/situation itself, cognitive-behavioural coaching focuses on "examining and re- evaluating some of our less helpful views [so that] we can develop and try out alternative viewpoints and behaviours that may be more effective in aiding problem-solving" (Neenan and Palmer, 2001, p.1). Cognitive behavioural coaching was found to have a positive impact on senior high school students in Australia as part of Green et al's (2007) research study into the effects of evidence-based life coaching. Teachers were trained in coaching techniques before delivering them to students via ten individual face-to-face coaching sessions. Not only did this form of coaching help develop the "students' coping skills and resilience", it also highlighted "increased wellbeing, […], decreased levels of depression, the development of study skills and personal learning goals which contributed to enhance performance" (Devine et al, 2013, p.1386). Another key finding was an increase in 'cognitive hardiness', i.e., the ability to recognise opportunity for adaptation and change in

the face of stressful situations (Kobasa and Maddi, 1977) – a key component of resilience (Bonanno, 2004).

Group Coaching

Brown and Grant (2010) discuss how the benefits of group of team coaching are extensive following the research of: Anderson et al., 2008; Ascentia, 2005; Kets de Vries, 2005; Ward, 2008 on understanding of and self-regulation of acceptable group behaviours and the development of greater insight into the psychodynamic process of the group. The benefits they discuss include:

- *improved likelihood of durable changes in behaviour*
- *development of trust and support within the group*
- *improved listening and communication*
- *constructive conflict resolution*
- *appreciation and alignment of individual goals, strengths, and values*
- *greater commitment and accountability*
- *development of coaching skills*
- *increased emotional intelligence*
- *leadership development*
- *improved systemic awareness of the organisation*
- *prevention of organisational silo formation*
- *knowledge transfer and management*
- *improved group energy levels*
- *creation of high-performance teams*
- *better organisational results* (Brown & Grant, 2010, p.9)

There is also an argument that coaching needs time to embed and develop. Coaching practice takes time to evolve and the more experienced a coach, the bigger the impact on the students. Passmore and Broen (2009) ran a 3 year, large-scaled coaching study of over 500 students taking GCSEs. The results showed a year-on-year growth:

"*These results of year-on-year growth suggests that coaches in the programme drew from past experiences and used this to enhance their methods and approach." (*Passmore and Broen, 2009, p.58)

However, this research area appears to often be limited to primary and higher education sample pools and online learning which means that the findings might not be representative of further education settings, thus highlighting a need for research in this context.

Summary

It is widely acknowledged in the research that students resitting their GCSE are often disengaged. This can be evidenced through several distinguishing patterns of behaviour, including poor attendance in class, anxious and demotivated students. These factors can be directly attributed to the subsequent poor attainment of resit students. As outlined above, the situation has been exacerbated by the pandemic. One-to-one coaching is a promising solution to this situation. The general consensus in the literature on coaching literature is that combining approaches in order to be flexible and cater to the needs of the individual is usually most effective (Devine et al, 2013). There is, however, an absence of research relating to how coaching techniques can be applied to post-16 students. This action research aims to help fill the gap.

Methodology

The aim of this study was to develop on previous research findings by testing whether teacher-coach partnerships could impact the motivation and engagement levels of GCSE Maths resit students. Maths Teachers and Student Engagement Coaches (SECs) were paired to plan and implement maths sessions together, as well as reflect and refine strategies to improve student engagement. SECs focused primarily on addressing the emotional and psychological needs of the student within a mathematical context, whilst the Maths Teachers addressed the academic needs. However, as the partnerships developed and staff members gained knowledge from each other, this naturally began to overlap. The Action Research Group (ARG) consisted of staff from both Cambridge Regional College and Tresham College, with a total of three Maths Teachers and three SECs who took part.

	Cambridge Regional College	Tresham College
Maths Teachers	2	1
Student Engagement Coaches	2	1

In contrast to last year's methodology, whereby individual students were referred to the SECs by their Maths Teachers, this year students were coached collectively as a class after being identified as having low engagement levels. Students who presented as particularly disengaged, demotivated or maths-anxious, however, were also supported in a 1-1 coaching capacity. This allowed the SEC to gain a deeper understanding of the barriers faced by the individual and provided an opportunity to work together in a space separate to the maths classroom.

Coaching strategies trialled and subsequently refined included, but were not limited to:

Coaching strategies

Observing Behaviour

- Body Language
- Identifying barriers to engagement
- Potential trigger points/topics
- Response to maths teacher/coach
- Attendance to lessons

Relationship Building

- Getting to know the student
- Active listening (previous maths/school experiences)
- Acting on their preferences
- Modelling positive relationships
- Relationship building exercises (non-maths related games and activities)

Intervention

- 1:1 support sessions
- In class coaching
- Confidence building techniques
- Challenging negative self-talk
- Encouraging a safe classroom culture
- Modelling help seeking behaviour
- Diffusing tension
- Exam anxiety techniques (RAG rating, graded exposure, box breathing)

Reflection

- Reflecting on student behaviour and reactions
- Raising concerns
- Reflecting on effectiveness of interventions
- Offering new ideas
- Recognising successes

Additional strategies were implemented both prior to and during the exam period to help manage student experiences of exam anxiety. These included RAG rating, graded exposure to exam papers and the teaching of box breathing exercises. Graded exposure is a technique which was used to help students who were particularly maths or exam-anxious get used to mathematical content. The main premise is to gradually expose yourself to a feared situation over time in a way that allows you to control your fear at each step. Exam papers can be a particular trigger for students with maths anxiety, so becoming more familiar with exam papers and exam style questions in a safe environment is a technique which can help students prepare themselves so that they feel more confident in managing any unwanted feelings during the exam.

We based some of our coaching activities on graded exposure when focusing on revision. For example, students were asked to RAG rate an exam paper with support from a coach. This exercise involves students being given a red, amber, and green colour highlighter pen before being asked to go through an exam paper booklet and highlight which questions they feel more comfortable with (green), questions which might cause them a bit of stress but would be happy to seek support for (amber) and the questions which they do not know where to start with and could cause significant stress (red). This was used in both in-class and 1-1 settings in order to help students become more familiar with exam style questions and exam papers without actually having to do any maths. This allowed the student to get used to the paper without the pressure of performing any mathematical skills and, by the time they had got to the end of the paper, signs of anxiety had subsided. This also informed planning, delivery and support from the SECs and Maths Teachers as it enabled them to gain a clear insight into which topics individuals and groups found particularly triggering.

Students who presented signs of overwhelm during the exam period were offered the chance to learn the box breathing technique in a 1-1 coaching session. This is a simple breathing technique which involves counting the breath for 4 seconds – (breath in, hold, breath out, hold) – and can be effective in helping students manage their anxiety whilst sitting the exam as it calms their nervous system and distracts their focus from the anxiety, they are experiencing to something more productive.

The research design stage was very much a collaborative process between teachers and coaches, with teacher and coach partnerships developing in-class coaching strategies, and coaches collaborating to trial, implement and refine strategies used in 1-1 sessions. Due to the difference in behaviours exhibited in 1-1's in comparison to class sessions, it became paramount that staff were open to trialling and amending strategies throughout the year so that they would meet the ongoing needs of our students. Using an iterative cycle approach was invaluable in trialling interventions, reviewing in pairs to modify and trial again. Regular partnership meetings played a pivotal role in ensuring that the strategies were regularly evaluated and refined, using different perspectives of participants.

Data collection methods

In order to understand both what was happening in the intervention and why, the research adopted a mixed methods approach, incorporating a combination of qualitative and quantitative data collection methods. Pre-intervention, both quantitative and qualitative data was collected in the form of a student survey. The first part of the survey sought to find out more about the learners' current attitudes towards maths and their previous experiences of maths at school, which included a combination of open and closed questions. The second part of the questionnaire was a summarised version of The Abbreviated Maths Anxiety Scale (Hopko et al, 2003) which had been adapted to suit the needs of our learners. Students were presented with a short list of hypothetical situations within a mathematical context and were then asked to rank how they would feel from 0 (extremely worried) to 10 (very comfortable).

For example, “being told you have a maths test coming up” and “being asked a maths question in front of your peers”. Not only did this help establish stating points for learners who completed the survey, it also allowed the maths teacher and SEC to gain a quick insight into how learners might feel in particular scenarios. For example, if student ‘x’ reported a ‘2’ when asked how they would feel if they were asked a question in front of their peers, this would indicate to staff that this would be likely to cause stress for the learner which could impact both their feelings but also their ability to retrieve mathematical information if that situation was to arise. Staff were then able to adapt their approach, moving forward in a supportive manner. A post-intervention questionnaire was also given to students to identify any similarities/changes in their attitudes towards maths, their self-confidence, self-efficacy, as well as to find out whether their exam experience was affected by working with a SEC. This survey also consisted of a combination of open and closed questions.

A second source of qualitative data was obtained from post-intervention staff focus groups which took place towards the end of the academic year. In order to reduce bias, the focus group discussions were planned and partaken in collaboration with Dr Sheila Evans. Having someone who was independent of the Action Research Project allowed for increased objectivity throughout in both the planning side (designing focus group questions) and the direction of the discussion itself. Focus groups were audio recorded and transcribed using Microsoft Teams, before being checked for errors and amended appropriately.

Qualitative Data Analysis

Qualitative data collected throughout the project was analysed using thematic analysis. Thematic analysis is a method of systematically identifying and interpreting patterns in the data (Clarke and Braun, 2014). Using a grounded approach, the data was interrogated through the generation of codes. These carefully designed codes formed the building blocks for the emergent themes (see Appendix E for an example). This rigorous analysis provided a robust framework to organise and identify meaningful patterns within the data set.

Ethical Considerations

In order to comply with ethical research regulations, a number of procedures were employed to ensure learner safety and confidentiality. This included creating a participant information sheet for the pre and post-intervention questionnaire, gaining written informed consent from learners who took part in the video interview for the AR presentation, anonymising learner names when analysing and presenting data from the staff focus groups and student questionnaires.

Results and Discussion

As discussed previously, at CRC, we worked with approximately 130 students, 80 of these students received intensive support from coaches. Due to timetabling constraints, achieving reliable quantitative data becomes challenging as students may not only have an action research teacher but may have some of their lessons with a teacher who is not part of the project. Therefore, the results will center on case studies and on a focused feedback discussion held with the action research group.

Case Studies

Case study 1

In the early stages of supporting this class, the maths teacher expressed their concerns to the Student Engagement Coach around this student's negative attitude towards maths. This was evidenced by their very low attendance to maths classes. Having a SEC in class allowed for a trusting relationship to be built between SEC and student which meant that barriers to engagement could be identified. It became evident after working with this student for a few sessions that they had extremely low self-esteem and did not think that it would be possible for them to progress in maths. After being supported by a SEC, this student has excelled in both their maths attainment and in terms of their work ethic. Their attendance to maths lessons has significantly improved, as well as their relationship with their maths teacher. Once they believed they were capable, their engagement levels increased significantly. Achieved a Grade 5 in their most recent skills check.

Case study 2

This student arrived with no qualifications, having been out of education for a number of years. They had extremely low self-esteem when it came to maths and constantly used self-depreciating language. They were reluctant to engage with staff members and peers in class and avoided putting pen to paper. They have received intensive coaching both inside and outside the maths classroom and their attitude has been transformative. They are on track for, and is working hard to achieve, a grade 4. This is demonstrated, not only by their work in college, but also by the scale of their independent learning at home. They have developed a genuine passion for maths.

Case study 3

This student came to college with a good understanding of maths however they presented as weaker than their ability showed, and their body language was very shut down. They didn't want to talk with teachers and, whilst very polite when spoken to, they were not actively engaged. They regularly relied on their peer to converse with staff members and to complete the tasks. After receiving in-class coaching, this student's self-confidence significantly increased and, after this, it became clear that their ability was much higher than initially observed. They were also supported in a 1-1 setting with the SEC on a number of occasions where external barriers to engagement were identified and they were signposted to appropriate support sources. They achieved a Grade 4 in the November resit.

Case study 4
This student was initially referred to a SEC last year after they were identified by their maths teacher as presenting as extremely maths anxious – they had low attendance to maths sessions, only attended occasionally to online lessons, had a very pale face upon entering the maths class and became overwhelmed by maths content very quickly. After working with the SEC both on Teams during online learning and then face-to-face in the classroom, the signs of anxiety began to subside. This then followed into 21/22 where they had been exposed to in-class coaching and has continued to make tremendous progress, both academically and in terms of their self-confidence. They now demonstrate a solid understanding of mathematical concepts and appears to enjoy their maths classes. They achieved a grade 4 in this year's mock exam and is currently on track to achieve a Grade 4 in the upcoming exams.

Focus Group Feedback

A thematic analysis of staff focused group discussions revealed 2 **main** themes, which were then broken down into sub-themes:

- **Impact of the intervention**
  - Student Impact
  - Staff Impact
  - Classroom Culture Impact

- **Reasons for Impact**
  - Participant's roles
  - Intervention Strategies

Throughout this discussion a number of direct quotes will be examined to provide context and to support any claims made. In addition, quantitative data obtained from student pre, and post intervention questionnaires will be discussed, within the thematic context.

Context of the Intervention

In this section, the data on the context of the intervention is explicated.

Teachers reported that maths anxiety appeared to be a common trait of students this year. This manifested itself in students in several ways:

- disruptive in class and exhibiting attention-seeking behaviour
- withdrawn, would not engage with staff or peers
- low attendance
- poor punctuality

The open environment of the classroom was a barrier to learning for many students and they found it difficult to ask for help and to accept any offered support. One teacher commented that the exhibited behaviour of the students was grounded in the fact that they had not received the 'respect they deserved' at school which other members of the action research group agreed with. Indeed, it was suggested that, because of negative school experiences, several students started the year with entrenched feelings of distrust towards maths staff and nurturing their trust was an ongoing, but necessary challenge.

Impact of the intervention

The impact of the intervention on students, staff and the classroom culture are summarised in this section.

Student Impact

Action research participants evidenced several constructive ways the intervention impacted student's attitude and behaviour. In general student confidence improved, this revealed itself in several ways: for example, a coach reported that a student's fear of making mistakes diminished. Towards the end of the year many students were more willing to both publicly ask for support and accept that errors were part of learning, with 68% saying in a post intervention questionnaire that they now felt comfortable asking their maths teacher for help compared to 36% pre intervention, interestingly, 88% said that they felt comfortable asking a coach for help in class.

Furthermore, because of specific exam teaching and coaching strategies, students were more willing to move out of their comfort zone and tackle the longer exam questions. Indeed, reduced exam anxiety was aptly surmised by a teacher:

"I think our students were definitely more confident going into the exam. [compared to students not in the intervention]. They were not having panic attacks and meltdowns. …. some students were so distressed from other departments. On the whole, our students were much better prepared psychologically for the exam than other departments were, … Our quality manager was saying 'get me a coach, get me a coach, get me another one' because there were so many issues."

Such a quote, by a member of staff outside the intervention, helps validate participants observations of change in students' attitude. This was also backed up in the post intervention questionnaire with 88% saying having a coach during the exam period had a positive impact on their experience.

In addition to reduced exam anxiety, improved student agency was cited by some participants. Students were more prepared to proactively take control of their learning. A teacher commented, for example, that in one of his classes the students, independent of him or the coach, took positive steps to minimise a fellow student's disruptive behaviour. Student agency was also evidenced in how students were more able, as the year progressed, to appropriately decide on their own learning needs. By the end of the year, one teacher reported that instead of them handing out differentiated worksheets, students took the opportunity to decide for themselves what problems they would tackle in the lesson. Such behaviour not only suggests that students were taking responsibility for their own learning, but that they were also developing an awareness of their own strengths and weaknesses. This again is supported by post intervention responses that reported that 84% of students said that working with a coach improved how they felt about their maths ability.

All action research group (ARG) participants agreed that student engagement improved as the year progressed. This was highlighted by a teacher who compared student behaviour at the start and end of the year:

"…. frequently they did things like throwing sweets at each other, coming in with fizzy drinks and food and just leaving the packets on the floor and then there was the sitting on the tables, including some really inappropriate graffiti …. but actually, that group has gone from being one of the most disruptive and hardest to manage groups to one of the warmest."

Moreover, another participant explained that there was a 'domino effect', in that when students witnessed one student engaging, others followed. It became 'cool' rather than 'uncool' to show an interest in the maths.

Another coach commented that changes in how the students viewed the coach also supported engagement. Initially students assumed a coach would not be able to help with the maths and it took some time for them to trust and seek support from the coach. This viewpoint was supported by another coach who explained that one of her students was initially very reluctant to engage in one-to-one support. As the year progressed trust was established:

"…. at the end of the year, he asked if he could continue his one to ones after the exams were over, and I think it was just for him. It was about making him feel comfortable and valued and that we weren't going to judge him if he wasn't able to do the maths. And then, I think he started enjoying it over time." – student engagement coach

The positive impact of trust-building was key, all participants concurred to improved student engagement. Such improvement was clearly evidenced in students' increased attendance and better punctuality:

"…. *we had a laugh and a joke, and it just felt so relaxed, and a lot of students said they enjoyed coming because it was relaxed, and it encourages them to come. Before they would think I'm just going to clear off at lunchtime and not go to maths but now they come to the lesson because they enjoy coming."* - maths teacher

The impact of developing such a safe classroom, was further exemplified in one coach's comment:

"I had a student the other day that hugged me because he wasn't going to have me again, I've never had a student hug me before in 18 years, I didn't really know what to do."

Staff Impact

All staff in the ARG reported that they had learned much from their colleagues throughout the intervention: both in the classroom and when planning a lesson together. It was agreed that this learning was born of mutual respect and a recognition of specific skills in the teacher and coach roles.

A teacher mentioned how they had assimilated the language coaches used, so instead of simply focusing on the maths they were more able to also support student's emotional needs. This often entailed slowing down any intended mathematical progress in order to support student's affective needs. Indeed, it was commented that the way the coaches modelled behaviours such as 'help seeking' was beneficial not only for the students, but also for the teacher. One teacher explained how now, having witnessed the coach publicly struggling with the maths, she was more prepared to open up to students about her own dyslexia and realised how this could help build trust between teacher and student.

Similarly, coaches commented on how they had learned both maths and pedagogical approaches from the teacher. This was achieved through observations, listening, and frequent communication. One coach reported on how much they had also learned from students. In recognition of the complexities of learning and the desire to truly meet the individual needs of students she often asked for feedback from students. Such ways of working also helped teachers to recognise the importance of understanding individual students and adapting pedagogies as the needs arose. It also helped students to feel their opinions were valued.

Both coaches and teachers agreed that they had, through continual communication learned more about the students: their gaps in mathematical knowledge, their anxieties, and reasons for them, as well as their personal background. This acquired knowledge helped them to attend more closely to, and develop students' engagement, and mathematical understanding.

All participants reported that, as the year progressed, they had learned to listen and act on student's comments. This is aptly evidenced in a coach's comment:

"I think most of us have learnt that a lot of the problems come from not listening to the students and not taking what they say at face value. You know, if they say I don't want to do this right now, I'm not in the mood for it and you're like, OK, alright, I get that. But let's just do a little bit of (x, y, z). They're telling you: No, I don't want to do this right now. That's definitely something I've learned this year. It's like, if you're saying you need to respect them, then treat them like adults. You need to listen to what they're saying at all times. And it doesn't matter whether they're a student or an adult or a teacher. You have to respect that people know themselves better than you know them."

As well as gaining skills and knowledge, all participants concurred that the roles supported their own confidence and job satisfaction:

"I could not have predicted that I'd have such a fun time in lesson. I think a lot of the students would agree." -maths teacher

Participants enjoyment of the intervention, together with close working practices, also helped cement strong relationships between teachers and coaches:

"You know, there's layers to everyone and when you feel connected with someone, you want to do better, don't you? You want to put the time and you want to put the effort in because it's like a group dynamic and you kind of doing it for yourself, but also for the other people" – student engagement coach

The coaches reported that the teachers tended to be more relaxed in the classroom, which in turn moderated students stress-levels. Teachers were prepared to spend time discovering not only students' prior learning but also their personal background, teachers also shared a little about their own history. This sharing helped build relationships and trust: *"Sharing bits about yourself and becoming more relatable, I think can really help." – maths teacher*

Classroom Culture Impact

Classroom Culture is interrelated and dependent on Student Impact and Teacher Impact, however, for the sake of clarity it is briefly described here. Participants in the focus group, outlined a number of key features of classroom culture that developed over the course of the year. These features are briefly summarised below.

Participants were keen to stress how their classes had become safe environments for students to make mathematical mistakes without the risk of feeling stupid. Through strategies outlined in the next section, a culture in which students felt valued and respected was nurtured. An adult environment, possibly similar to what students experienced when attending their vocational cause was created. Integral to this culture was the build-up, over the year, of trust between coaches, teachers, and students. This in turn fostered a sense of equality and reduced anxiety levels.

Reasons for Impact

In this section, core factors of the intervention that brought about the impact outlined above are summarised. These factors, although considered separately, are generally interdependent.

Participant's roles
Participants explained that teacher and coach developed specific but overlapping roles. In the main the teacher focused on the learning of maths whereas the coach focused on encouraging students to engage. Often coaches achieved this goal through finding out about the students and building positive relationships with them. As a teacher reflected, such a relationship can help build other relationships:

"…. sometimes the coaches will have a better relationship with the students because they have the opportunity to build that better than I do in a classroom. I think that the coach's relationship with me helps the students' relationship with me." – maths teacher

Although at times, these roles were reversed, coaches, in general were able to discover any barriers to learning and feed these back to the teacher. A teacher admitted, such barriers were hard to discover when they were working without a coach.

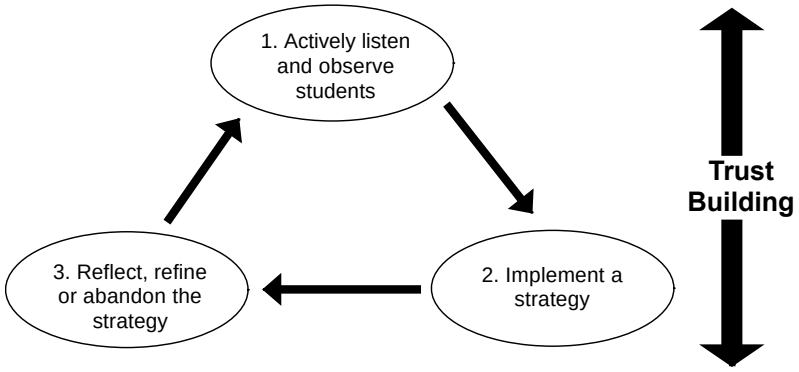
Participants also agreed that students benefitted, on occasions, of having two different approaches to solving a problem. This can help students understand more deeply the underlying concept. Moreover, having two people in the room meant there was space to listen to and observe students tackling a problem. This in turn deepened their own understanding of students thinking, including any misconceptions.

Intervention Strategies
Teacher and coaches implemented a wide variety of affective strategies. The most significant ones are outlined below.

First, the arrangement of the furniture, and the type of furniture in the classroom prompted students to positively change their attitude and behaviour. Students perceived that the adult environment created specifically for them, required a more mature approach to their own learning. The new organisation of the classroom also permitted staff to introduce new strategies. A coach, for example, explained that the arrangement of the furniture helped them to support students' preference of either working in collaboration with their peers or working alone. It also allowed staff to support more easily a wider 'cluster' of students at any one time. Additionally, participants reported, it was easier to allow students to take time out. Furthermore, there were tools available, such as exercise balls to reduce student stress and improve concentration.

Secondly, coaches explained an overarching strategy was their flexible, iterative approach to supporting student's attitude and engagement. The approach is illustrated in the diagram below:

Overview of 'Formative Assessment' Affective Strategies



As illustrated in the diagram, key to the 'formative assessment approach' was trust building. Coaches and teachers recognised that gaining trust was the gateway to student learning. Trust enabled students to feel validated as young adults, respected even when they made mistakes, reduced their anxiety levels, and promoted student agency and engagement. Such components were necessary for learning to take place. Integral to the cyclic approach outlined above, was the acknowledgement that a strategy may not work for a particular student at a particular time and should either be refined or abandoned.

1. Listening and Observing

As was outlined earlier in the report, active listening and observing could focus on a student's mathematical understanding. More often, however, coach's attention was on how students were feeling. Through careful and empathetic questioning, a coach, for example may show an interest in a student's home life or their past-times. Such information, one coach reported, helped explain a student's current behaviour and consequently guided them towards a particular coaching strategy. Alternatively, finding out about a student's previous experience of learning maths could help participants decide on a particular pedagogical approach to a maths topic.

One coach demonstrated this process by outlining how she had reacted to a student's comment about being "absolutely knackered" in a one to one. She let the student rest on a sofa for 20 minutes instead of tackling the planned Maths problems. Then in the next session he was very keen to do the maths:

"I think it's because he was listened to, and his needs were met because at the time he knew he was not in the right mind-set to do the maths and what are you going to get out of someone if you put pressure on them to do it. We all know what it's like when we're stressed or tired, we would never hesitate to give each other a rest would we? We would just say …. go and have a bit of fresh air, or you'd have a cup of tea or whatever it might be if you get to that point where you hit a wall. But I think we forget; we think that students have to be absolutely on it 60 minutes in an hour and sometimes they do need time to just take a deep breath." - SEC

Through the process of active listening, trust was built, and positive attitudes developed. Other participants agreed that they had learned, by "truly listening", to respect students wishes in the same way we would any adult.

2. Implement a strategy

Participants reported on a wide variety of strategies they employed. Some of these have already been outlined, others are explicated below.

Help-seeking Strategies

Coaches proactively normalised making Maths mistakes. In the course of a lesson, when they made a mistake, they used it as an opportunity to publicly acknowledge their error and seek help from either the teacher or a student. A coach explained although it exposed a personal lack of knowledge, it was worth doing so:

"I guess to a certain degree it's just about being vulnerable, whether you're a coach or teacher, it's about being able to say that actually, I don't know, and that's OK and you've created an environment in class which is nice enough and safe enough that people know that it's OK because that's what you want. You want everyone to make mistakes, otherwise they're not going to learn."

Another coach added that if the classroom is a safe environment, then such vulnerability is minimal, particularly for a coach. For a teacher, however it is a harder to display visibly gaps in knowledge, as students need to feel confident that you have the subject knowledge to teach them.

Another coach conjectured that the teacher publicly taking time out to explain to the coach a maths concept demonstrated to the student that their mutual respect is not diminished but rather reinforced by the such help-seeking behaviour:

"I say oh, actually I'm not sure about this one and then I put my hand up and ask … Then the teacher comes over and tell us all how to do it. And it's just it's really positive and it's I think because I have worked as a teaching assistant in a school as well and I don't think that the maths teachers will take the time to explain to the teaching assistant in the school. I think that's actually the fact that the teacher is explaining to the coach as well is because it's an equal relationship."

Moreover, a teacher explaining a concept to a coach provides an opportunity for students to listen without being the one who has declared their lack of understanding.

As such participants believed that the help-seeking strategy encouraged students to similarly seek help when needed. Struggling with a concept is part of learning and should not entail not being respected.

Strategies to reduce anxiety and improve engagement

Participants employed many strategies to reduce anxiety and improve engagement. An overarching outcome was that teachers were prepared to be less strict in their teaching, even with more boisterous classes. Such an approach allowed them to slow immediate mathematical progress in order to attend to student's affective needs. Such an approach, all agreed, would ultimately enhance students' long-term progress.

The coach's presence, participants reported, permitted teachers to create a more relaxed, comfortable environment for everyone:

"…. we could have a laugh in the group without feeling like we'll need to get back on the task and I think was a big difference in that particular group. It was because it was quite relaxed. … I think I was very teacher, teacher previously"

Students could also see that members of staff enjoyed being in this lesson. This helped lower stress levels and encouraged trust. This strategy was summed up by one coach's comments:

"….by creating an adult environment in the classroom, they tend to adapt to an adult state and act more independently, rather than having to be led every step of the way. They always say it is very important that we are respecting them"

Moreover, simply having two people in a class helped with disruptive behaviour or lack of engagement:

"….and we found that the lessons became a lot more relaxed. Because for me as a tutor, I'm not a constantly worrying about trying to make them behave. The management within the classroom is better because Tracy was there on board to help out."

Teacher and coach often deliberately publicly communicated to each other. The aim was to demonstrate not only how to talk about mathematics, but more broadly how to communicate with each other in a respectful way. Participants believed such modelling encouraged students to mimic.

Coaches reported that they also aimed to create an equal environment. This was achieved, by, for example, working together with students through a worksheet. Another coach added that they also strove to create a room of equals:

"[I] approach the students in a way that makes them feel that we're working through things together side by side rather than opposite each other. What we don't want is for them to feel like we're someone with a lot of subject knowledge and they're not."

Such an approach developed an open and safe atmosphere and helped reduce student anxiety.

Another strategy, to reduce anxiety and encourage student engagement, a participant explained, was the use of mini whiteboards *"it's a lower risk activity, a way of showing your workings because it's not there permanently."* A teacher reported that to increase student agency they encouraged students to decide for themselves, for a particular topic the level of mathematics they could work on in the lesson.

Additionally, a coach mentioned a talking strategy she had developed with some students who found it challenging to stay focused. Instead of writing down solutions to questions, she organised a quiz for a small group of students. Together they talked through a problem. This she explained helped keep their attention without students moving too far out of their "comfort zone".

A key strategy for all participants was to develop exam techniques in order to reduce anxiety and help students feel they can 'have a go' at any of the questions. These techniques ranged from graded exposure to the exam papers, to a traffic light system in which students assigned each question a colour – red, amber, green, depending on how confident they felt about tackling the question:

"…without actually having to do any of the Maths, it meant that their anxiety levels came down and so then by the time they've got through the end, which had taken about 20 minutes, they were in a calmer state and then we could go through and work through the questions doing green, yellow, and then to red. And that worked really well."

Such strategies, participants explained, were aimed at shifting students' mind-set from the binary of either they can or can't do a problem, to one of having a go and possibly picking up one or two marks.

3. Reflecting and Refining Strategies

A process of reflection occurred either inside or outside the classroom. Usually in collaboration with the teacher, strategies could be adjusted or abandoned for a new approach. Planning was a key part of this approach. At the start of the year meetings between coach and teacher were held within formal, prearranged timeslots. As the year progressed as staff got to know each other better, this was replaced by informal spontaneous meetings. The meetings allowed participants to share knowledge of students, refine strategies in order to improve engagement, and ultimately build relationships between staff. One teacher explained how she benefitted from the coach's different perspective:

"It's not like they're destroying your planning, but it's things that you think, oh, I never thought that that could be a little bit anxiety inducing or perhaps I need to simplify that bit, or what if I put this picture on the board at the same time"

Because of the presence of a coach in a classroom, teachers were more prepared to try out new approaches to teaching and learning. They perceived that the embedded risk of introducing new strategies was shared and so decreased. One teacher reported her reaction to a strategy that was not working:

"I think I would have been quite flustered. if I'd been on my own, but as it was, we [teacher and coach] looked at each other and we just laughed. We just said I think we need to scrap this .... We were like, OK, we won't do that again."

Supporting this explanation, another teacher mentioned how, having a coach in the room makes it so much easier to abandon a failing approach and start another:

"it's settled in maybe 5 minutes, and you've moved them on. Whereas perhaps as a teacher It might take me half an hour out of an hour session to get that sorted, but because there's two of you, you can get it under control and move on, and it doesn't feel as daunting. It's less risk for me if you like. It's lower risk. I'm willing to try it and get out of my comfort zone knowing that if it all goes really pear shaped, we can move on quickly."

Challenges in the Intervention

As has been discussed nationally, student behaviour has been uniquely challenging this year, following the Covid-19 lockdowns. In addition, many are lacking the skills normally developed in their last year/s of school, both socially and emotionally. This is demonstrated in classroom relationships, lack of autonomy and boundaries. Other challenges faced were of a more logistical nature for example, classes shared with non-action research teachers and timetabling constraints. In addition, some student took longer to build relationships with and therefore were slower to take up offers of more intensive support.

Participants reported that unrealistic ambitions, with regard to developing mathematical understanding or improving students' mindset, can hamper progress. For example, one coach commented that they persuaded one extremely anxious student to attend a one-to-one coaching session:

"….it was really hard to get him in there and he's very anxious beforehand and the session went quite well. But afterwards he said, I don't want to do that again. And really, it made me question, should we have pushed him to do that, it's easy for us to think, oh, it's going to be so brilliant for him because this is going to happen, and this is going to happen. But actually,

I feel like maybe we should have listened to him more and not put him through that experience because now he looks back at that as something that caused him a lot of anxiety. Do you see what I mean? It makes me really upset that happened, we saw what could have been and wanted that for him. You have an agenda as a coach and then I think sometimes you just get fixated on that agenda."

All participants acknowledged the ongoing challenge of active listening. It often required them to relinquish their own agenda for the lesson in order to react to a student's comments. But not reacting, a coach reflected could obstruct the development of trust between them and students and ultimately limit student progress. Furthermore, many staff reported that building trust takes time, particularly as there is only 2 or 3 hours a week contact time. Teachers in particular, cited that such time pressures were often a source of tension between 'we're here to teach' and giving space to 'have a little bit of a laugh' in order to build positive relationship.

Recommendations

- **Employing Student Engagement Coaches in Further Education settings** to work with mathematics students would address the student's psychological barriers to learning mathematics, which is key in raising attainment in the GCSE mathematics re-sit cohort as well as raising motivation and engagement, leading to more successful outcomes.

- Maths teachers are not specialists in the psychology of addressing student's barriers to learning, although elements of this can be taught and embedded in pedagogical practice, there is a **need for a specialist separate role** such as Student Engagement Coaches to focus on this element of the students learning journey.

- **Generic teacher training needs to address barriers to learning mathematics** including how to **build mathematical resilient students**. This will better prepare teachers to challenge and overcome the prevailing negative attitudes towards maths and STEM subjects that have become culturally acceptable in the UK.

- **Trainee Teachers should be given support to overcome their own maths anxiety** alongside pedagogical practice to ensure they do not pass on to their students the feeling that maths ability is intrinsic and cannot be developed.

- **Educational Psychologists should be trained** to recognise and give strategies to overcome maths anxiety, supporting teachers and students.

- It has been acknowledged on an international level that math anxiety poses a severe problem over entire life spans, affecting all aspects of life. **Interventions to address parent's maths anxiety** is crucial, particularly in early years to ensure this is not passed on to the next generation.

- **Further Education settings should increase awareness of barriers to learning mathematics and mathematics anxiety**, offering coaching strategies and solutions to all teaching and support staff. Mathematics is a life skill and an integral part of learning, irrespective of career paths and goals.

Moving Forward

In the next academic year, the project aims to expand its reach to deliver professional development on coaching strategies and solutions to all teaching, team-leaders, and support staff. It will attempt to share findings with maths teachers by creating short-term teacher-coach partnerships in differing vocational areas to observe whether a short-term intervention can influence maths teacher's behaviour and practice to raise engagement and motivation. Regardless of outcomes, educating all stakeholders on the barriers to learning mathematics and the need for coaching for mathematical resilience in students would be an enormous advantage in raising motivation, engagement, and attainment in post-16 mathematics.

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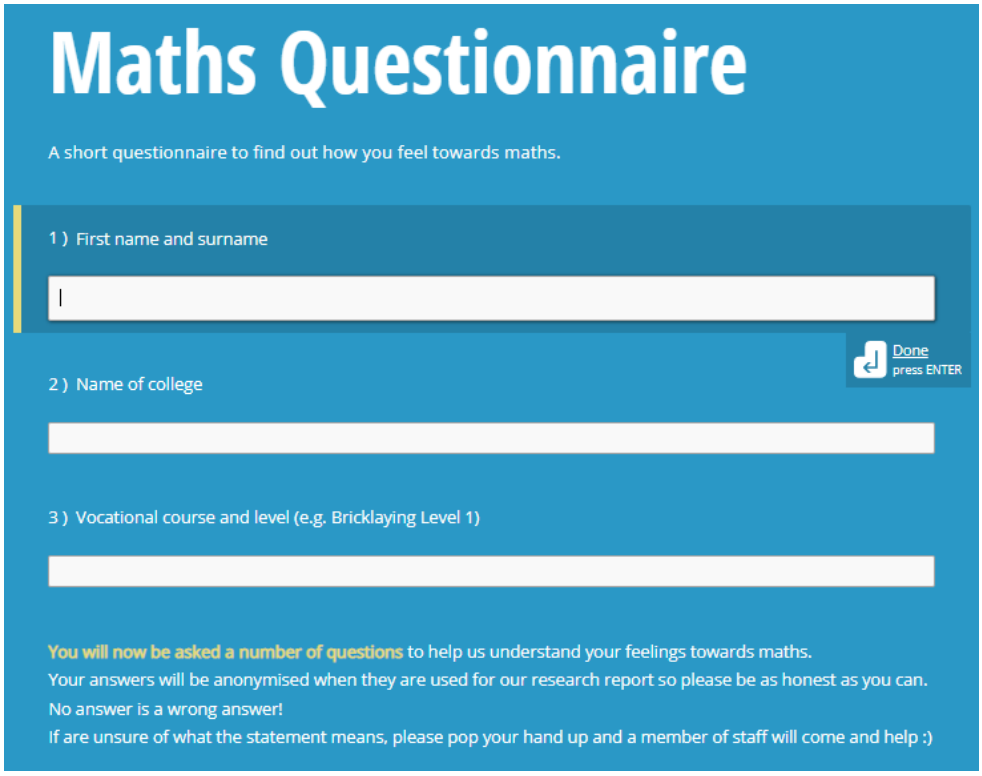
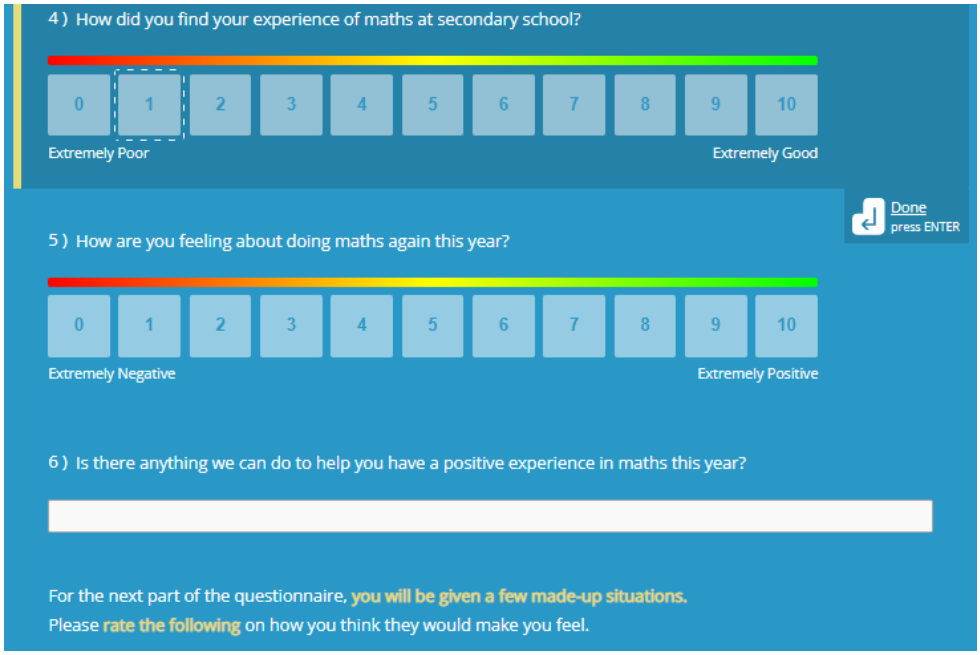
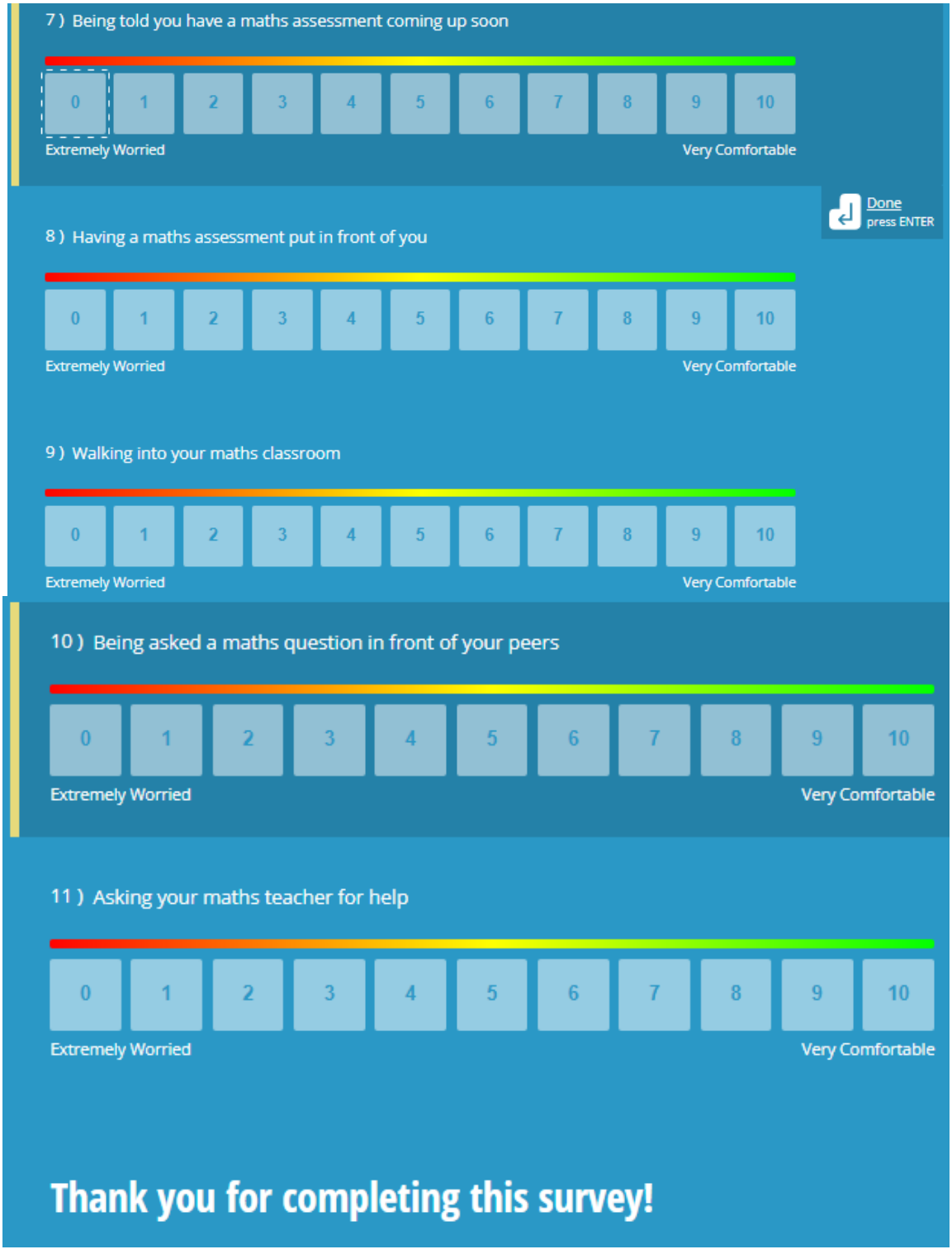
Appendices

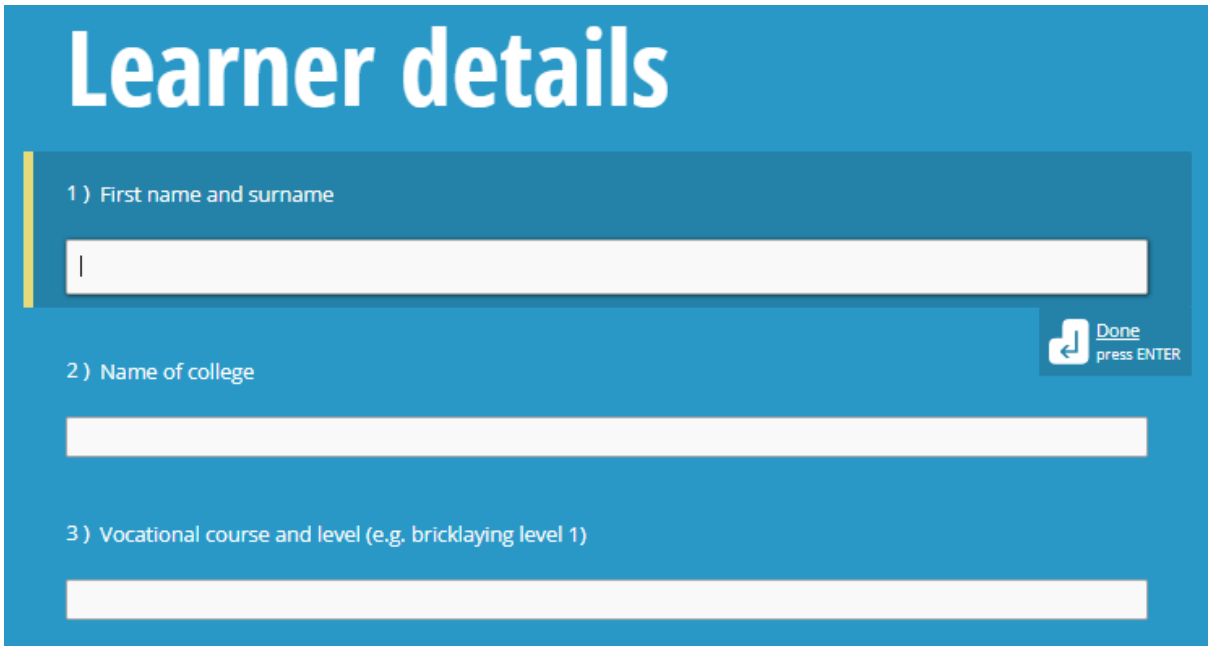
Appendix A – Pre-intervention questionnaire

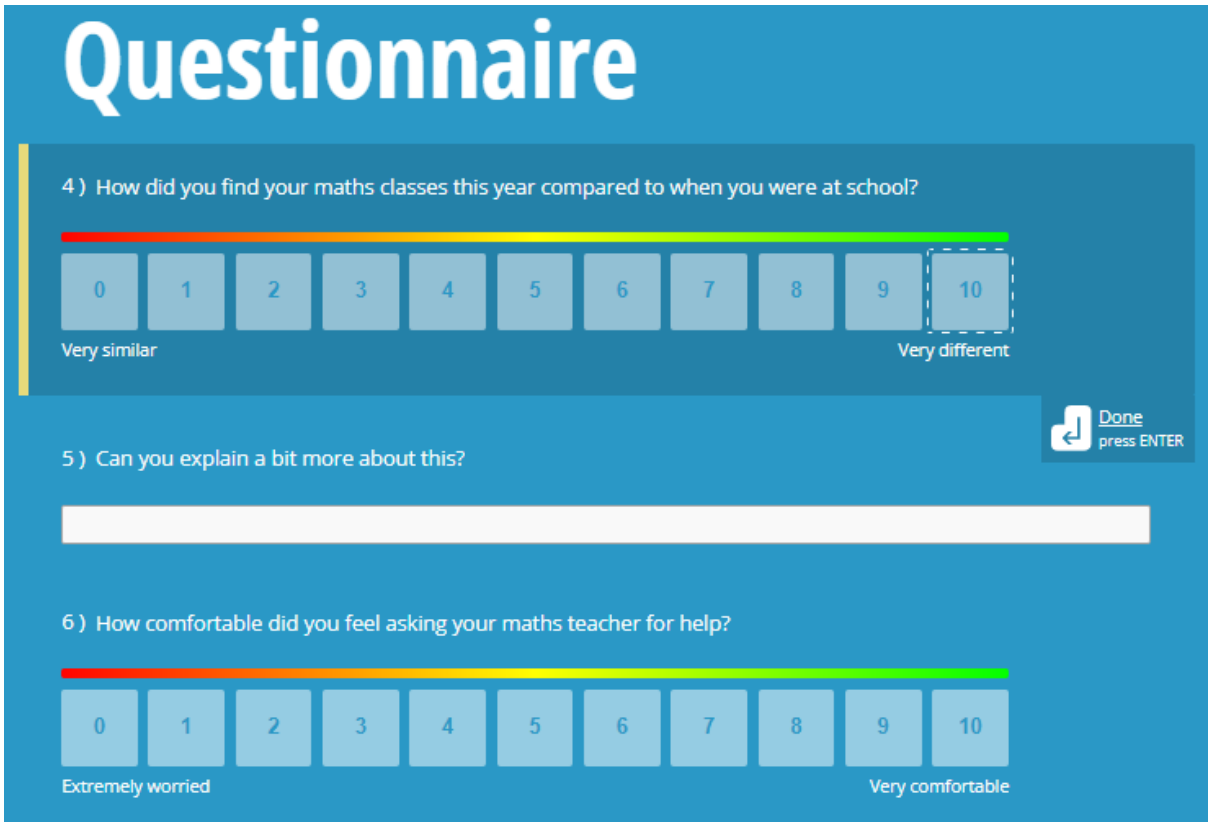


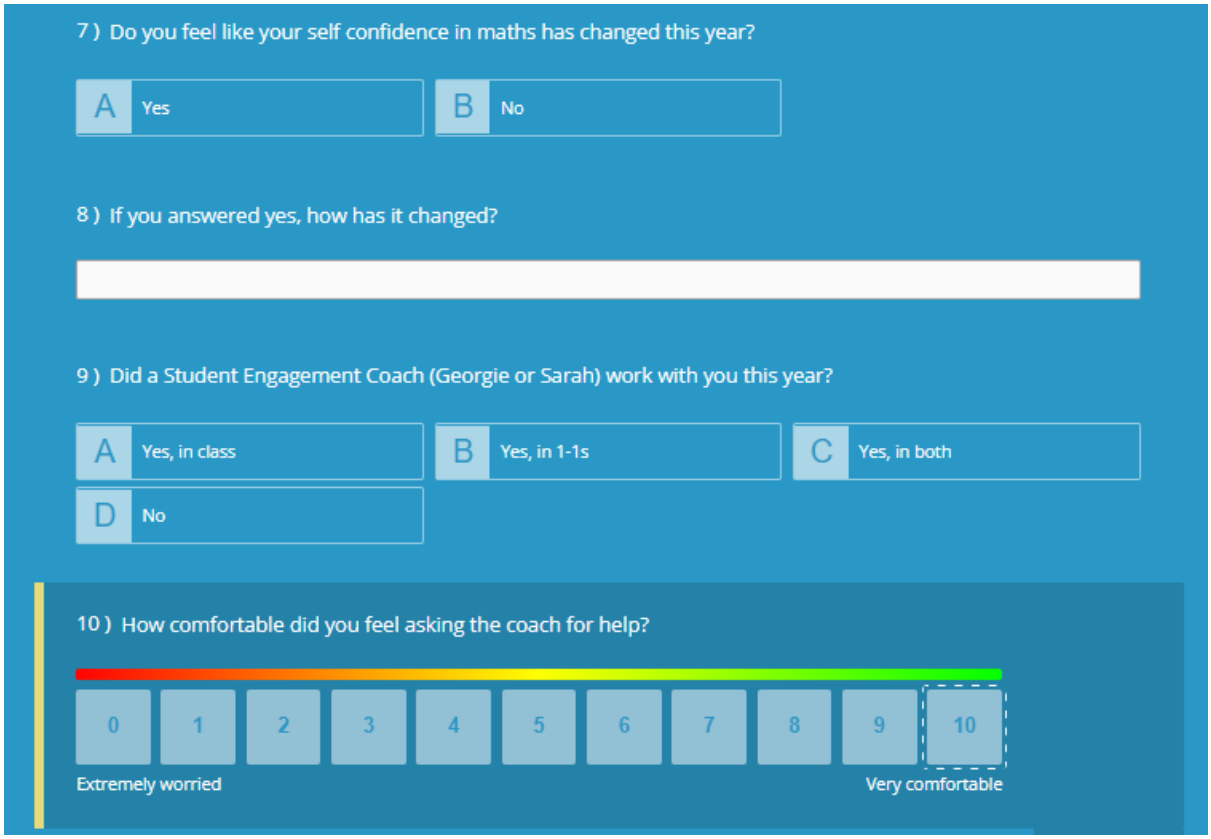


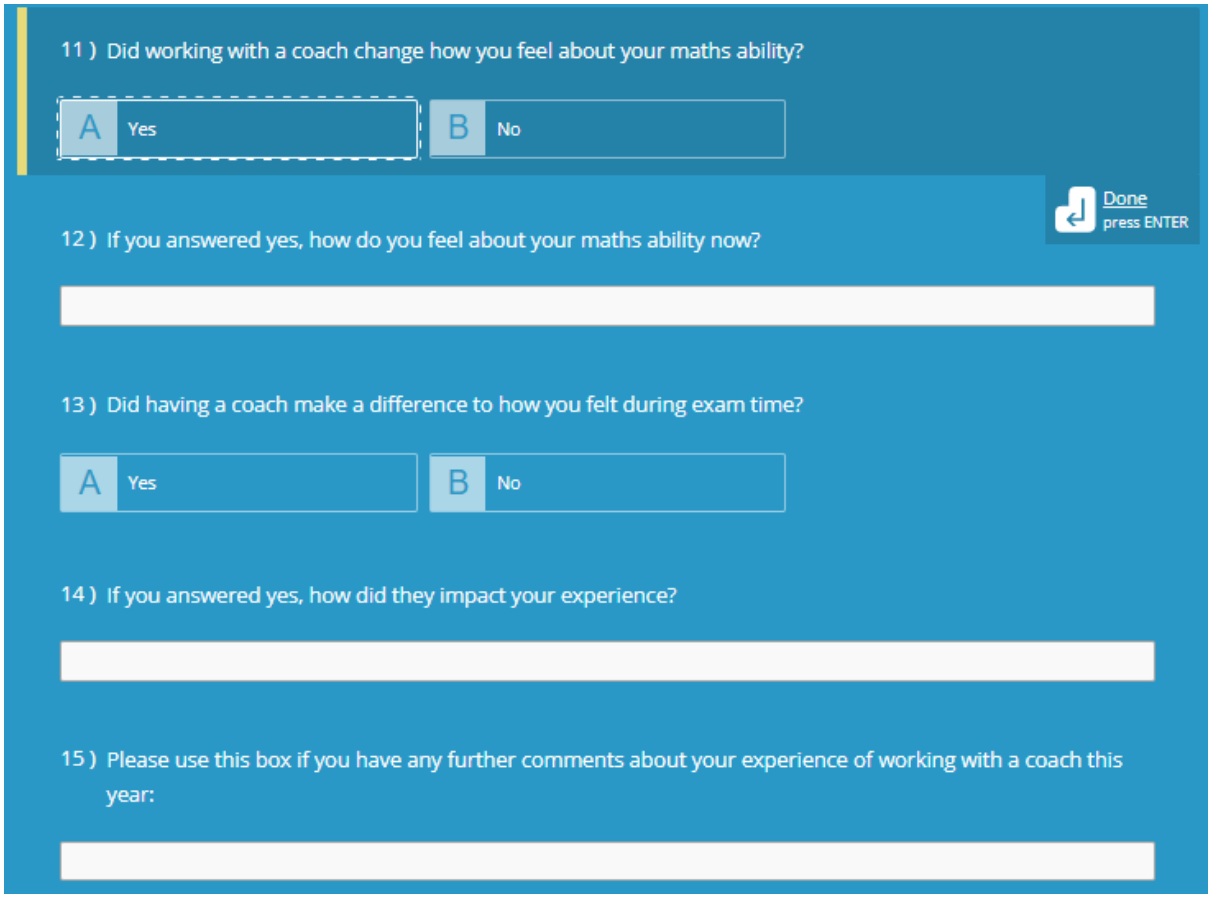

7) Being told you have a maths assessment coming up soon
0 1 2 3 4 5 6 7 8 9 10
Extremely Worried
Very Comfortable
Done
press ENTER
8) Having a maths assessment put in front of you
0 1 2 3 4 5 6 7 8 9 10
Extremely Worried
Very Comfortable
9) Walking into your maths classroom
0 1 2 3 4 5 6 7 8 9 10
Extremely Worried
Very Comfortable
10) Being asked a maths question in front of your peers
0 1 2 3 4 5 6 7 8 9 10
Extremely Worried
Very Comfortable
11) Asking your maths teacher for help
0 1 2 3 4 5 6 7 8 9 10
Extremely Worried
Very Comfortable
Thank you for completing this survey!

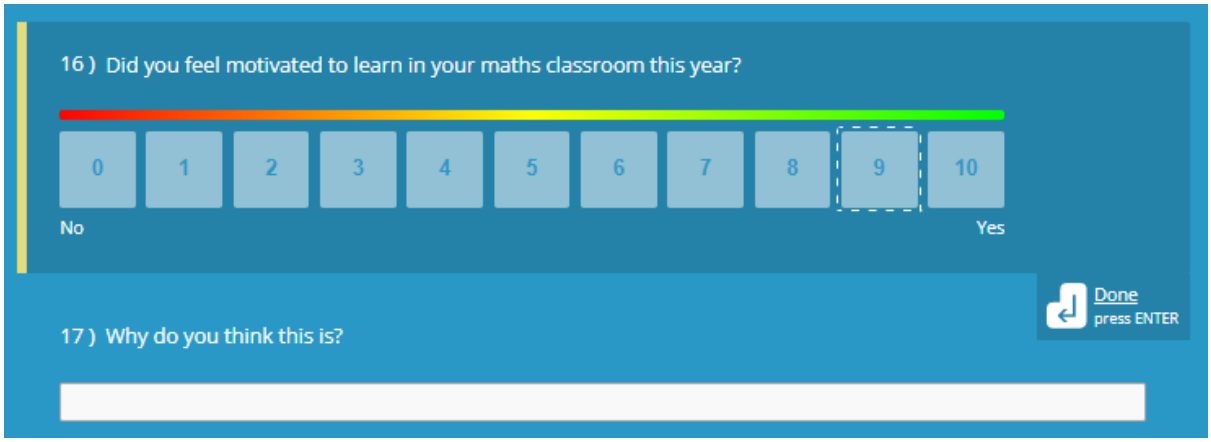
Appendix B – Post-intervention questionnaire





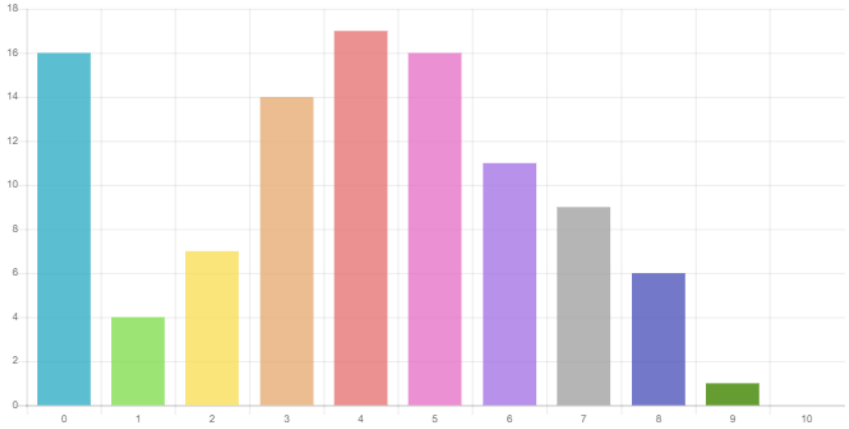

7) Do you feel like your self confidence in maths has changed this year?
A Yes
B No
8) If you answered yes, how has it changed?
9) Did a Student Engagement Coach (Georgie or Sarah) work with you this year?
A Yes, in class
B Yes, in 1-1s
C Yes, in both
D No
10) How comfortable did you feel asking the coach for help?
0 1 2 3 4 5 6 7 8 9 10
Extremely worried
Very comfortable


11) Did working with a coach change how you feel about your maths ability?
A Yes
B No
Done
press ENTER
12) If you answered yes, how do you feel about your maths ability now?
13) Did having a coach make a difference to how you felt during exam time?
A Yes
B No
14) If you answered yes, how did they impact your experience?
15) Please use this box if you have any further comments about your experience of working with a coach this year:

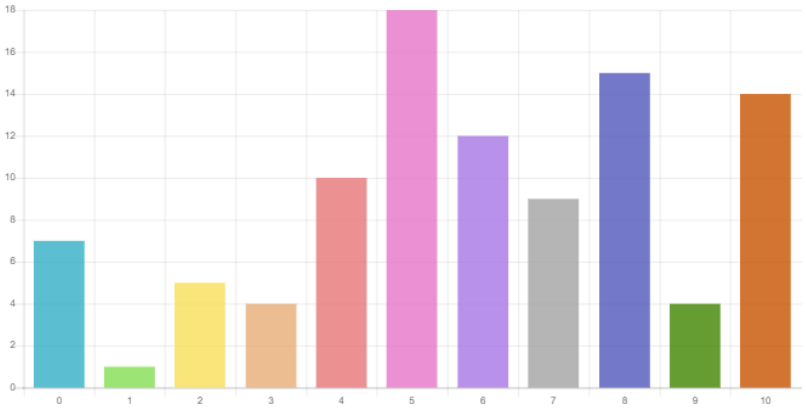

16) Did you feel motivated to learn in your maths classroom this year?
0
1
2
3
4
5
6
7
8
9
10
No
Yes
Done
press ENTER
17) Why do you think this is?

Appendix C – Questionnaire results example

How did you find your experience of maths at secondary school?



Being asked a maths question in front of your peers



Did working with a coach change how you feel about your maths ability?

85% (22) Yes

15% (4) No

9 Standard Deviation

26 Responses

Did having a coach make a difference to how you felt during exam time?

88% (22) Yes

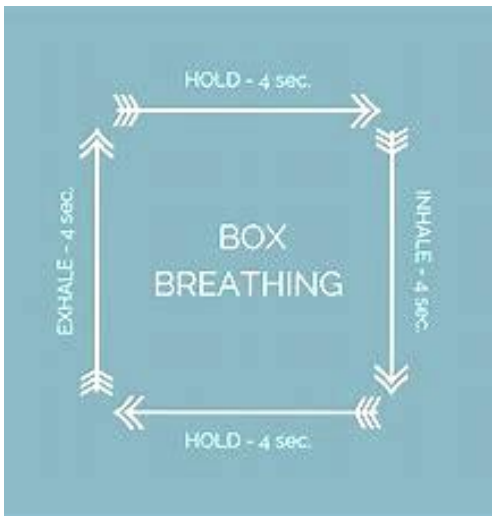
12% (3) No

9.5 Standard Deviation

25 Responses

Appendix D – Coaching techniques

Box breathing



Appendix E – draft of themes and codes

Background Student *Student behaviour*	Background Student Anxieties/confiden Background - Student engagement Background Student organisiation	Pre-existing either from school or within the year this can include disruptive behaviour Attendance and punctuality
Background - Staff/school *Staff behaviour - schools and FE*	Background - teacher pressures Background - impact of school Background - college support	Pressures to get results, pressures of time Reference to students' experience in school Comments on how students were supported in previous years in college
Challenges	Barrier - time Student fragility	Reference to how developing a supportive classroom culture takes time Comments on how students can easily loose confidence/trust etc
Affective Strategies	Getting to know students Strategies Modeling relationships Modelling help-seeking strategies	Finding out about students - their background, but also listening and acting on their preferences Teacher and coach model relationships of trust and equality Staff models how to seek help on some maths . For example, student may see coach seeking help, but this hasn't entailed a loss of respect
	Student agency Design of classroom Considered responsiveness	Strategies to develop student agency, e.g. allowing students to decide what topic they want to revise Comments on how the design of the classroom
General strategies	Working with a number of students Risk and strategies Roles of teacher and coach Planning	Staff working with one to one or small groups of students Comments on what coach and teacher did in lesson
Mathematical strategies	Exam techiniques Different perspectives on the maths	References to exams and exam questions Two members of staff can use different methods to solve a problem
Student Impact *Impact on intervention - may refer to individual students*	Impact - student confidence Impact - student engagement	Student confidence, empowerment and anxiety levels Engagement can include attitude, engagement, behaviour, attendance and organisation

Classroom culture impact	Impact Safe environment	Comments on how relaxed the classroom was, including whether the lessons were fun for students and staff
	Impact - teacher/ student relationship	Comments on students' relationship with coach or teacher. This could be connected to respect or trust
	Collaboration	Comments on the extent students work together - cluster learning
Staff impact	Staff learning	Comments on learning new strategies, new maths etc
	Staff job satisfaction	Comments on the extent staff enjoy the intervention - e.g. have fun