The influence of implementing classroom displays on student learning in mathematics

Katherine Flynn

A Research & Development Project Submitted for the MSc Learning & Teaching 2018

DEPOSIT AND CONSULTATION OF THESIS

One copy of your dissertation will be deposited in the Department of Education Library via the WebLearn site where it is intended to be available for consultation by all Library users. In order to facilitate this, the following form should be completed which will be inserted in the library copy your dissertation.

Note that some graphs/tables may be removed in order to comply with copyright restrictions.

Surname	Flynn
First Name	Katherine
Faculty Board	Education
Title of Dissertation	The influence of implementing classroom displays on student learning in mathematics

Declaration by the candidate as author of the dissertation

1. I understand that I am the owner of this dissertation and that the copyright rests with me unless I specifically transfer it to another person.

2. I understand that the Department requires that I shall deposit a copy of my dissertation in the Department of Education Library via the WebLearn site where it shall be available for consultation, and that reproductions of it may be made for other Libraries so that it can be available to those who to consult it elsewhere. I understand that the Library, before allowing my dissertation to be consulted either in the original or in reproduced form, will require each person wishing to consult it to sign a declaration that he or she recognises that the copyright of this thesis belongs to me. I permit limited copying of my dissertation by individuals (no more than 5% or one chapter) for personal research use. No quotation from it and no information derived from it may be published without my prior written consent and I undertake to supply a current address to the Library so this consent can be sought.

3. I agree that my dissertation shall be available for consultation in accordance with paragraph 2 above.

Abstract:

Classroom displays are common place in primary school and even in secondary school however, there is little research to suggest the influence that classroom displays can have on students in further education settings such as a large mainstream college. This study aims to explore and contribute to this gap in literature regarding classroom displays for students aged 16+. Focusing on my own classroom practice, this study endeavours to assess the influence that introducing and implementing student-led classroom displays can have on student learning experiences such as motivation, confidence and mindset. This study attempts to answer the following research questions:

- How has student motivation and confidence in the mathematics classroom changed with the implementation of displays?
- How has student mindset changed with the implementation of displays?
- Does giving students a voice in the creation of classroom displays promote or contribute to positive learning experiences?

Questionnaires were completed before and after the implementation of the new classroom displays by 28 students and semi-structured interviews were also carried out with two students and one Education Support Worker. Findings suggest that implementing student-led and well planned displays can have a positive influence on student motivation, confidence and mindset. As a result of implementing new classroom displays, there was an overall shift of 89% from negative to positive opinions of maths. Furthermore, there was a 75% increase in students 'liking' or 'loving' maths. Significantly, pre intervention 11% of students thought the displays aided their learning compared to 96% post intervention, indicating a massive 85% change towards positive opinions.

THE INFLUENCE OF IMPLEMENTING CLASSROOM DISPLAYS ON STUDENT LEARNING IN MATHEMATICS

TABLE OF CONTENTS

Introduction 5
Literature review 7
Methodology 25
The Intervention 32
Findings and Discussion 36
Conclusion and Evaluation 49
References 53
Appendices 57

The Influence of Implementing Classroom Displays on Student Learning in Mathematics

INTRODUCTION

Rationale

Just because some people can do something with little or no training, it doesn't mean that others can't do it (and sometimes do it even better) with training

Carol Dweck, 2006

The primary focus of this dissertation is to evaluate the influence of implementing classroom displays on student learning experiences such as motivation, confidence and mindset in mathematics. The research is targeted specifically with students aged 16-18 who are enrolled on a vocational study programme which include compulsory maths lessons. The compulsory maths lessons, which I teach, are for the qualification in functional skills (Entry Level 3 or Level 1) and are below the required grade C/4 at GCSE.

Functional Skills qualifications provide students with "essential knowledge, skills and understanding that will enable them to operate confidently, effectively and independently in life and work" (Functional Skills, 2017: 1) Functional Skills differs from GCSE in that mathematical rules, formulas and ideas are not memorised, revised and applied; it is about learning a skill-base, including communication, team work, presenting and problem solving. Thus providing students with a skill set that can be transferred to other areas of learning, life and work. For lower achieving students who are grades away from attaining a C/4 at GCSE, Functional Skills provides them with a platform to build skills and confidence in a safe and nurturing environment.

On a personal level, after three academic years of teaching the subject, it is very interesting to see how students on Functional Skills maths transition over the year in their perception of learning mathematics. The cohort that I teach are low-level students who generally have very few or no qualifications after leaving school and I have observed, over the past three years, how infectious my enthusiasm and my own growth mindset can be on these type of students. Students seem very receptive to my primary teaching background despite being post-16; as the majority of them thrive under a more nurturing environment. I hope to extend this now into the physical classroom environment. One of the main driving forces behind my idea to implement classroom displays stems from the fact that all of the classrooms that these students currently learn in are very sparse and lack quality learning resources in the

physical environment. Moreover, the students have no sense of ownership over their environment and there are currently no opportunities for them to personalise this valuable learning space. I would like to take my ideas back to my primary school training and create a rich, engaging and supportive classroom environment which is stimulating for the students. The desired outcome is that by implementing such engaging and stimulating displays will assist in triggering a growth mindset in students and they will use these displays as a supportive learning tool. Thus, by promoting a supportive environment, students should change their perceptions of learning in mathematics and as a consequence there should be a positive influence on learning. I am always eager to improve the mindset of my students every year as they tend to arrive at college 'hating' maths. I am intrigued to explore whether a rich, engaging classroom environment could help with their self-belief, confidence and subsequently, achievement as this isn't something the functional skills/GCSE maths team have ever considered as a contributing factor to achievement within my college.

Background of the College

My College is located in a large town belonging to the borough of a large northern city. It is a further education college with approximately 5000 students on roll compromising of A level, Vocational and Foundation Learning students. Of these 5000 students, 350 are currently enrolled on Functional Skills Maths as part of their study programme.
During the 2017 spring term, Ofsted inspected and graded the college's overall effectiveness as 'Requires Improvement' after a 10 year hiatus in which the college was previously graded as 'Outstanding'. Some of the key comments made by Ofsted resonate with my vision of improving the learning experience for students in mathematics:

"Too many students on 16 to 19 study programmes produce work below the level expected"

"Too few teachers plan lessons that consider the individual needs of students, which limits students' progress, particularly for the most able. Students often complete the same tasks regardless of ability, which results in a lack of challenge for the most able students. The least able students find tasks too complex and struggle to complete them. As a result students, particularly the most and least able, make limited progress"

Over the past two academic years, the college, and in particular the principal of the college, have taken Carol Dweck's (2006) research on Mindset into careful consideration for the potential improvement of student learning experiences. Following various Continuous Professional Development training sessions, I realised that my teaching ethos aligns with Dweck's notion of a growth mindset: with higher levels of effort and determination, anybody is capable of improving their ability and subsequently their achievement. I firmly believe that

all barriers to learning mathematics can be broken down. In the Principal's welcome on the Bury College website, he advocates the idea that grades and qualifications are important but it is a growth mindset that really helps you achieve:

'At Bury College we aim to help prepare you for life and your dream career. Qualifications are essential to enable successful progression, but employers are also attracted to motivated individuals who display wider skills such as resilience, tenacity, great communication skills and excellent team work. Your attitude and enthusiasm, alongside your qualifications, will help you secure a successful career and we will do everything we can to help you develop.'

There are over 600 staff at Bury College and it is, without a doubt, no mean feat to convince each member of staff that promoting growth mindset in students is essential for their levels of work to improve. Moreover, expecting each member of staff to consistently and effectively implement this particular ethos into their personal teaching ideology is a demanding task and one which could take a long time to develop. Therefore, my research dissertation focuses solely on my own promotion of mindset. More specifically, it will only focus upon one method: implementing classroom displays to identify the influence this could have on student learning experiences including motivation and confidence (and the potential transition to a growth mindset).

LITERATURE REVIEW

This literature review is split into two sections. The first section outlines four different aspects of research regarding the influence that classroom displays can have on student learning: what makes a displays effective – are they an attraction or distraction?; a consideration of the multisensory and neurological approach and the importance of classroom design and environment can affect student learning experiences; are students more enthusiastic when they are involved with the creation of classroom displays?; and an insight into student perception of classroom displays and how this could affect learning experiences such as motivation, confidence and mindset.

The second section of this literature review is concerned with measuring above mentioned learning experiences and how this can be used to inform the creating and improvement of classroom displays; the importance of student voice in the creation of classroom environments and displays and the influence that this can have on motivation is explored; utilising displays to encourage students to shift from a fixed to a growth mindset; and how to improve student motivation and confidence through the use of classroom displays.

Key definitions associated with this literature review:

Student motivation: “the degree to which students invest attention and effort in various pursuits, which may or may not be the ones desired by their teacher” (Brophy, 2010)

Motivation to learn: “the intention of acquiring the knowledge or skills that learning activities are designed to develop” (Brophy, 2010)

Confidence: “a feeling of self-assurance arising from an appreciation of one’s own abilities or qualities” (Oxford English Dictionary, 2018)

Fixed Mindset: “believing that your qualities are carved in stone… you have only a certain amount of intelligence, a certain personality, and a certain moral character” (Dweck, 2017)

Growth Mindset: “the belief that your basic qualities are things you can cultivate through your efforts, your strategies, and help from others” (Dweck, 2017)

What makes a display effective?

Attraction or Distraction?

Classroom visual displays have a significant impact on attention in students, and to a greater extent for students with Autism Spectrum Disorder (ASD) according to research conducted by Hanley et al. (2017). Their research used innovative eye-tracking techniques and video based lessons to determine the impact that a potentially distracting visual environment could have upon attention and learning. Hanley et al. (2017) acknowledge the prominence and significance of visual displays in the classroom, particularly primary schools, and place deserved value on research which proves that personalising classroom with a student’s own work can increase their level of self-esteem (Maxwell and Chmielewski, 2008). Additionally, in the college classroom (students aged 16-18), displays of students work can serve as a positive visual reminder of their achievements (UCU, 2013).

Nevertheless, UCU (2013) put forward the consideration that visual displays, whilst promoting positive self-esteem, could possibly impact how well students pay attention in the classroom and consequently how learning might become limited. However, the older the child the better they are at sustaining attention and the less susceptible to interference from distractions they are (Gaspelin et al. 2015). It is also important to consider where the classroom displays are located; in primary schools displays are commonly on every wall and cover most spaces but in secondary and tertiary classroom displays only tend to cover one wall and are much more subtle in colour compared to primary classrooms. Hanley et al’s study used a video of a teacher in two scenarios; one, she stood in front of a plain white wall

for a lesson and in the other she stood in front of a brightly decorated visual display that covered the whole wall behind her. The issue with this is the assumption that a teacher will always be teaching in front of a highly stimulating visual display whereas this may not actually be true for many classrooms.

Overall and as expected, Hanley et al. (2017) found that the students spent more time looking at the background in the high visual video than the non-visual video. Interestingly, even though the typically developing students showed an increased in their attention on the background visual displays they still prioritised their attention to the teacher and subsequently their learning was not affected. In contrast, there was a greater effect on the students with ASD: they looked at the visual display more than they actually looked at the teacher and the attention of students with ASD was atypical in all conditions. Consequently, it is evident that when creating classroom visual displays it is important to consider the placement and the level of stimulation of the displays, particularly if there are any students with ASD within the classroom.

A similar study carried out by Fisher et al. (2014) found similar results to Hanley et al: a higher visual environment can lead to more time spent off task thus a reduction in potential learning. However, it should be noted this study only took into account young children and therefore may not be generalisable to older, more developed students. Furthermore, Fisher et al (2014) acknowledge that the detrimental effect of the visually decorated classroom on the children's attention and learning could have actually occurred because of the frequent changes of sparse to decorated classrooms, rather than the displays actually being detrimental to children's learning. Interestingly, in Hanley et al's (2017) study they actually found that, despite students spending a lot of time looking at the displays rather than the teacher, their leaning was not affected. Importantly, it is noted that this study does not advocate sterilising the learning environment by removing educational displays and that the classroom visual displays can be optimised to promote on-task behaviour and an environment that induces effective learning outcomes (Fisher et al., 2014).

What is chosen to be displayed on classroom walls often demonstrates what a teacher considers to be important. Foster (2012: 217) poses many thought provoking questions:

- Ready-made mathematical posters or students own work?
- Only the 'best' work or a variety of different things?
- 'Finished' items or work in progress?
- Passive things to read or proactive images and text that might become interactive?
- Stale faded items from years ago or recent business?

It is evident from Foster's (2012) questions what he believes makes an effective mathematical learning environment and it is easy to see how teachers can fall into a routine of producing below average displays in the maths classroom. Therefore, when creating and designing classroom displays, these five key questions should be reflected on to encourage a fresher way of thinking. In turn, these questions create further musings:

- Would student's own work on the wall motivate them to use the displays more than a ready-made poster?
- Does work on the wall have to be 'perfect', surely students can also learn from work that needs improvement?
- Does a classroom display really need to be a finished article, can it be a work in progress by the students for the students?
- Are students going to be motivated to actively read passive text or do they need things to challenge their thinking?
- Surely recent displays related to current classwork (that students can be involved in creating) is a much more effective learning tool than old posters, even if they are relevant?

All of these further questions help us delve deeper into the thought processes and rationale for creating classroom displays. They should not be created mindlessly to fill the walls with colour but should be an effective tool for encouraging learning, independence and self-esteem within the classroom. Despite colourful walls becoming a staple of modern classrooms (Collingford, 1978) which students can look towards for hours a day (Tarr, 2004) is it vital to ensure that these 'colourful displays' have significant meaning and purpose.

Classroom displays can be utilised to stimulate interest in learning mathematics and to set the tone for the importance and accessibility of the subject (Briggs and Davis, 2015). Briggs and Davis (2015) believe that 'mathematising' the learning environment can encourage students to think creatively about the environment, particularly if the material on displays is thought provoking and a potential talking point for student discussions. "In the eyes of [students], displaying work reinforces the value you place on it" (2015: 38). Mathematical classwork is usually completed in books so careful consideration should be used to think of ways of displaying student work: creative posters, revision notes, giving students free-roam to choose a topic to make a fact sheet are all examples of how students can move their book-work onto an exciting, engaging display. Learning or working walls are also an effective way of displaying mathematical concepts to students in support of attaining curriculum targets during new and specific topics. As a working wall develops students can clearly see the progress they have made; they also have constant access to prior learning where they

can use the working wall to make connections between what they know and new knowledge (Briggs and Davis, 2015).

In contrast to the work of Barrett (2015), Fisher (2014) and Hanley et al. (2017) where focus is on the visual aspects of what teachers place on the walls, Almeda et al. (2014) lay emphasis upon the semantic content of what is placed on the walls. They investigated patterns in classroom display design choices made by teachers and their findings allow for better understanding of the impact teacher decisions can have upon outcomes for engagement and leaning within the classroom environment. By considering design choices more systematically, we can observe which wall display designs have a positive impact on promoting engagement and subsequently, learning: “differences in classroom design can have substantial impacts on student engagement and learning” (Almeda et al., 2014: 44).

Considerable amounts of wall displays can potentially appear cluttered and overwhelming, resulting in students having difficulty in recognising and locating pertinent information (Almeda et al, 2014; Apps and MacDonald 2012). Therefore, an important factor to consider is the amount of walls and the wall space dedicated to visual classroom displays. Furthermore, Almeda et al. (2014) record that there are four main clusters of classroom design distinguishable features:

- Walls with considerable decorations and non-academic content
- Walls with little or no academic content or decorations
- Walls with high levels of decoration and academic content
- Walls with academic content and student procedures (e.g. rules)

Whilst the Almeda et al. (2014) study accentuates the importance of different design decisions in the classroom, it does not further the investigation into which type of design cluster is the most effective for promoting leaning and engagement thus further research is necessary to draw conclusions about *what* should go on classroom displays. Nonetheless, the implications of this study provide an interesting insight into how teachers systematically design the visual classroom development (Almeda et al., 2014) and it can provide further opportunity for teachers to consider how they might create their displays and which aspects of the four clusters they might use to create an effective learning environment.

The multisensory and neurological approach

People spend an estimated 90 percent of their lives indoors (CIB Task Group 42, 2004) and students, on average, spend anywhere between five and eight hours in the classroom every day, five days a week for up to 21 years of their lives. Thus it is vital to consider the potential

impact and influence of the quality of the classroom environment on health, well-being and, most importantly, learning. Despite Barrett and Barrett's work focusing largely on buildings and the structure of classrooms, they do make significant reference to the way the classroom environment is used to promote learning by pursuing two themes: "sense perception and human response" (2010: 219). They explored the potential of positive places on student learning within the classroom, framing their research using neuroscience theories to explain the way the human brain makes calculations to link perceptions to actions; they argue that classroom design should take consideration of individualisation and stimulation so that sensory environments can enable students to reach their fullest possible potential.

The complex issue is rooted in the idea that students will experience their learning spaces holistically and interactively: this suggests that, regardless of how stimulating a wall display is, students neurological perception of the mathematics on the wall could be affected by other essential factors such as satisfactory air temperature and sufficient natural lighting in the classroom. Moreover, Eberhard (2007) affirms that students will turn stimuli into usable experience, called 'percepts', and these perceptions are intricately linked to memory: "sensory information about the world is collected as raw data that then enters the orbitofrontal cortex of our brain where the value of the environmental stimulus is assessed" (Barrett, 2017). This multisensory experience of the classroom learning space highlights the subtle influence on thought process and the powerful effect this could have (Barrett and Barrett, 2010), particularly on how the students perceive the information on the wall displays and subsequently what they learn from them. It can be implied from this research that visually stimulating and content rich displays might not be enough for students to access an extra layer of leaning as satisfactory air temperature, natural quality lighting and pleasing noise levels can affect and contribute neurologically to how students perceive the space around them. Barrett and Barrett conclude that student learning spaces should be designed to meet "the human needs of those pursuing activities in each space" (2010: 226) and a wide range of influential factors appear to be important, namely "the type of stimulus involved, its intensity or quality and factors such as the different reinforcement contingencies and the emotions associated with them" (2010: 226).

Nanda et al. (2013) emphasise the importance of environments because of the experiences and behaviours that they can afford. They argue that previous research into this topic is subject to interpretation due to the inferences from observational behaviour However, Nanda et al. suggest that further investigation through neuroscience "offers the opportunity for a more objective understanding that can take us beyond the 'what happens' to the 'why it happens', and allow a more sophisticated use of science within design practice" (2013: 62). One of the core beliefs from this research is that aspects and elements of a visual environment and visual stimulus can be rapidly extracted to trigger an emotional response,

one which can be measured neurologically: this idea has significant implications for design of visual stimulus and classroom displays. The research findings imply that stressful environments can trigger negative emotions. In terms of education - where some students who despise mathematics could feel pressure and lack of confidence - a stressful environment and negative emotions are not conducive to learning and therefore the design of the classroom displays and visual stimuli should take this into careful consideration. The visual stimuli within the classroom should seek to encourage, motivate and give the students a sense of belonging and ownership over their learning.

Are students more enthusiastic when they are involved?

Continuing along the theme of student perception of the classroom environment and the potential influence this could have on a sense of ownership and responsibility, Beadle (2010) states that when students are involved with classroom display designs, “it will give the students a real sense of ownership of the classroom in which they are taught, and this being so, they will be more likely to respect not just the school fabric, but also the leaning that takes place in the room they have ownership over” (2010: 117). Cowley (2009) advocates a similar opinion suggesting that “displays will elicit a more positive response if the students have been involved in creating them” (2009: 79).Packard and Race (2000) suggest that when students are involved, “often they will come up with original and exciting ways of doing it which should be encouraged and facilitated”. In turn, this could create unexpected learning experiences for students due to the independent and exploratory nature of the task.

Barrett et al. (2015) completed a study which revealed a 16% impact on 3766 students’ learning rates based on classroom design, and as a result an Environment-behaviour factors model has been strongly validated. Their conceptual model consists of three key areas: naturalness, individualisation and stimulation. The individualisation strand incorporates students’ ownership in the classroom and the stimulation strand focuses on the appropriate level of complexity in the classroom. Barrett et al’s research states that “ownership is… a measure of both how identifiable and personalised the room is” (2015: 119). Barrett et al. make specific reference to ownership of the classroom and how it is measurable by student involvement with display creation. They further this by suggesting that an intimate and personalised classroom is better for absorbing, memorising and recalling information; “when children feel ownership of the classroom, it appears the stage is set for cultivating feelings of responsibility” (2015: 120). Classrooms that feature students’ intellectual engagements were found to promote greater participation and involvement in the leaning process: “permanent students’ artwork enhanced the student’s sense of ownership over the learning process” (2015: 128). Barrett et al. found that there was a significant positive effect on student’s self-

esteem as a result of displays that had been created by students and which featured the students own work.

Coinciding with the idea of ownership, the Stimulation principle of Barrett et al's research relates to how exciting and vibrant the classroom is: "complexity is a measure of how the different elements in the room combine to create a visually coherent and structured, or random and chaotic environment" (2015: 120). Barrett et al. discuss how visual features such as classroom displays can be a distraction and a challenge for younger children as it could tax their developing and fragile ability to focus and ignore potential distractions, thus suggesting for older, more developed students richer visual displays in the classroom are perhaps more appropriate. In their discussion, Barrett et al. explore the idea that learning scores were higher in the sparse-classrooms than in decorated-classrooms however, this finding was not fully consistent and did differ. The research found that the display diversity ranged from under-stimulation to overstimulation and that only when the room had "an intermediate level of stimulation does it have a positive effect on pupils' leaning progress" (2015: 129). It is important to consider that this study takes into account many environmental factors and that classroom displays are not the only contributing factor, however, they did have a positive contribution to the increase in student's learning. Consequentially, highlighting the importance of well-planned classroom displays that provide ownership to students whilst not being overstimulating or under-stimulating.

Pointon and Kershner (2000) conducted a study intended to show how three different experienced teachers in three different schools manage the classroom learning environment. The study refers to how the teachers' personal views and perceptions relate to those of their student. Moreover, they focus on how the teachers involve the students in decision making. One teacher found that they had to focus the student's attention in the right direction in order for them to use the information on the displays to inform their learning. However, if students have a strong influence over the creating of the displays they might be more inclined and understanding of where they can find and how they can use that information. Another teacher strongly believed that the classroom environment should capture student's attention and help them see beyond the decorative aspects of displays; the creation of a display should include intrinsically interesting and meaningful items thus providing an opportunity to make a strong impact on learning. Additionally, classroom displays should not be seen as 'perfect': if students are to be involved with the creation then you should expect an imperfect finish, displays do not need to look perfect as long as the students can access the information successfully. In concurrence with the teacher perceptions surrounding the importance of classroom wall displays, the children in one school actually found a 'gap' distracting; interestingly, 90% of them commented on their survey that they did not like the lack of display on the wall.

Despite their positive findings, Pointon and Kershner (2000) acknowledge that there is a difficulty in identifying conclusive research findings that link changed environmental factors directly to an increase in effective learning. They argue that there is a certain difficulty in measuring leaning processes and outcomes and this, in turn, can lead to teachers and researchers focusing upon students' observable behaviour, such as 'time on task' rather than measuring the intended outcome of effective learning. Therefore, when conducting research similar as this, one should be cautious of how they measure the desired outcome and keep it consistent with how they measure the outcome for all students. Furthermore, educational researchers may dispute the nature of 'effective learning'. Pointon and Kershner (2000) state that there may be a lack of agreement about this and a student who is working hard and concentrating might be misjudged as effectively learning. Another factor that should be taken into consideration is the diversity in students and how their personal preferences and their individual educational needs could, and probably will, differ from the next student.

Student perception of classroom displays

Moving from primary school to secondary school is a daunting process and one in which students might find themselves questioning their identities as learners (Pointon, 2000). The ideology and points raised about the transition from primary to secondary school could be generalised to students transitioning from secondary school to a tertiary setting as there is still a sudden difference in space, size and a potential for this to affect a student's sense of identity within the educational setting.

Until the study by Pointon (2000), little had been investigated into students' views of changes in their classroom learning environments, including the use of classroom visual displays. Students liked moving into specialist rooms as they felt a stronger presence of that particular subject (Pointon, 2000) thus suggesting that effectively implementing classroom displays relevant to that specialist topic is important to the culture of the classroom. Furthermore, negative feelings about the room environment lead to some students having negative views of the subject itself: "the maths room is dense and hot and stuffy and one colour. That's why I feel I don't like maths… it's not a very nice room… maybe put up better displays" (2000: 379) and "it's not going to help you learn because you think 'this is so boring, I don't feel happy" (2000: 379). These comments made by students support the neurological theory that student emotions, triggered by their current environment, can have a direct impact upon their leaning experience.

Two key themes emerged about how students felt about their classroom displays: lack of ownership and the lack of purpose they served (Pointon, 2000). In regards to ownership of the classroom, one student commented that the classroom arrangement is entirely up to the teacher and you can no longer display your own work. Regardless of age a barrier should not be erected for any student to display their work, students can gain positive ownership over a classroom and their confidence and self-esteem can grow if this opportunity is provided (Maxwell and Chmielewski, 2008; UCU, 2013; Barrett, 2015; Hanley et al., 2017)**.** Additionally, students found that classroom displays in the secondary school were not particularly helpful in assisting with the leaning process: "usually there are only posters anyway, and because you have to do the work on your own there's no help, you can't get it from looking at the displays" (2000:380). Clearly, despite moving into a more mature learning environment, students still see the benefit of classroom displays and the approach taken to create displays in primary schools could be adapted to suit the environment of secondary and tertiary classrooms. It is also evident that students might come to rely on displays for additional leaning support; if classroom displays are not utilised effectively then we may be creating a barrier to learning. Pointon's (2000: 382) study presents the intriguing question of "to what extent is it possible for teachers to give students, through the classroom and school environment, a greater sense of control and ownership of the spaces in which they work and learn?" Amidst all this research, it is imperative to remember that there is a "consequent importance of listening to children's [and students] opinions about the learning environment" (Pointon, 2000: 376). When students are consulted seriously it "can make them feel, often for the first time, that their school and their class are to some extent *their* school and *their* class. This is important to them" (2007: 141).

It is important to understand student perspective, emotions, interests and needs towards their environment in order to provide a better learning experience (Ramli et al., 2013). A study into student perspectives on improving the classroom physical environment conducted by Ramli et al. (2013) investigated, but was not limited to: student participation in the classroom including the decoration of the classroom and the interior variety variation of the classroom including the amount of use adornments on the walls such as personal work. Most of the students reported that they did not have any interior variety in their classroom, 78% of the students agreed that they were not involved with the classroom decorating and arrangements at all and 76% of the students perceived that the classroom physical environment needed to be improved (Ramli et al., 2013). When the teachers of these students were surveyed only 20% agreed that they allowed students to be involved with the decoration of the classroom: "they felt that the students can't get involved in classroom arrangement because classroom arrangement is related to the classroom management which the teachers as leader need to choose to suit the students' behaviour" (2013: 226).

This issue relates to the strict classroom pedagogical approach whereby the teacher feels the need to control in order to achieve maximum learning potential. However, despite feeling unnatural to transfer control over to students, by allowing students to have a voice within the classroom can provide significant gains to the learning process (Packard and Race, 2000; Cowley, 2009; Beadle, 2010; Barrett, 2015). The perceptions between students and teachers are fairly significant with students placing more emphasis on the importance of an enjoyable and fun learning experience as opposed to the teachers who believe that changes in the classroom environment should suit pedagogical reasons such as behaviour management. Consequently, teachers should consider the potential to loosen their control in order to provide students with a student voice an extra, alternative route for learning.

As explained in the first section of the literature review, effective classroom displays can have a positive influence over different learning experiences and can greatly benefit students' confidence, motivation and growth mindset. However, the research relies on measuring the outcomes of the intervention therefore, the following section of this literature review will discuss student voice, mindset, motivation and confidence within the classroom and how this is measurable in terms of improving classroom displays.

Student voice within the classroom

Following on from the discussion surrounding students' perceptions of their classrooms, in order to create meaningful learning experiences through the addition of classroom displays, it is imperative to allow students a voice within their own classroom. Student voice refers to the extent to which students have the "opportunity to influence decisions that will shape their lives and those of their peers either in or outside of the school setting" (Toshalis and Nakkula, 2012: 23).

A powerful way to harness motivation to learn in any classroom is to encourage student voice and opportunity for choice: meaning that we must include them in the teaching and learning process (Middleton and Perks, 2014). Laux (2018) suggests that allowing student voice in the classroom can lead to students feeling empowered, more motivated, able to construct value and meaning from the subject that they are studying and, consequently, there will be an increase in engagement and achievement. Additionally, Ferguson et al. (2011) assert that there is massive potential for an increase in engagement and motivation if students ae given a voice for decision making about their own classroom environment. Arnot and Reay (2004) suggest that allowing student voice in the classroom can positively impact upon student perspectives and their desired to learn, thus improving intrinsic motivation. In

concurrence with this idea, Rudduck and McIntyre (2007) found that, where teachers encourage consultation regarding learning with students, students show a greater willingness to learn and have a greater sense of self. However, to ensure that giving student a voice in the classroom is effective, we must ensure that we do not simply ask for their ideas; but we must listen and act upon what students have to contribute to the learning environment (Cook Sather, 2007).

Clarke (2013) states that the inclusion of student voice relates to their learning experience after the fact and not just during the lesson itself. This suggests that student voice should go beyond the immediate leaning objective and into the further learning experiences provided by the environment: a key educational aim for the implementation of classroom displays is the successful and meaningful acquisition of knowledge. Through interactions with the world, students consider knowledge as meaningful (Crotty, 2013) therefore, to achieve successful meaning in mathematics through the use of visual classroom displays, "students must have the opportunity to interact with the world and use their voice to make education meaningful to them" (Laux, 2018: 125).

The implications for encouraging and growing student voice within the classroom can have significant influence on the creation of classroom displays. First and foremost, opportunity for student voice should be given, heard and acted upon for the design of the classroom environment if students are to recognise the educational and applicably meaningful nature of the classroom environment around them. Secondly, students should be given the choice of design, what is to be displayed and whether they'd like to contribute to the displays with their own work in the expectation that they will experience ownership of the learning environment, motivation to learn and a sense of empowerment. Giving students the opportunity to make choices that directly affect their learning environment can have a significantly positive impact on engagement and achievement and an effective way of measuring this is to observe how students interact with the classroom displays and how they utilise them to create additional learning experiences for themselves. As Tollefson and Osbon (2008: 56) submit "for whom or what are students working, if ownership of the learning environment isn't theirs?".

Shifting from a negative to positive student mindset

Arguably one of the most influential researchers of student mindset in the educational setting is Carol Dweck and her theory of fixed and growth mindsets. Dweck (2008) illustrates that how a student perceives themselves, their intelligence and their abilities can play a vital part in how much progress they make in mathematics. The first branch of Dweck's theory of mindset is a 'fixed' mindset; this particular mindset limits achievement and students will "see

strengths and skills as innate traits" (2016: 6). The second branch of Dweck's mindset is a 'growth' mindset; in contrast to a fixed mindset, a growth mindset is based on the belief that your "basic qualities are things you can cultivate through your efforts... everyone can change and grow through application and experience" (Dweck, 2012:7). Students must understand that intelligence is not fixed and they can improve with effort and practice (Lloyd-Rose, 2018). Predictably, many students who have to re-sit their maths qualifications when they transition from high school to college have very strong fixed mindsets and have a very common opinion that 'maths is hard', they 'hate it' and they will 'never be any good at maths'. Repeated failure of maths exams (including their GCSE exam) is not conducive to effective learning and so can create a culture where a lack of intrinsic motivation and low self-esteem is the norm; thus fixed mindsets are created which produces immediate barriers to learning and success (Schraw et al., 2006). Hence why it is important to cultivate a classroom which fosters growth mindset so that these students, who have only ever experienced failure and low expectations, have a 'second chance' and a nurturing environment suited to their educational needs.

One way of promoting growth mindset is by directly and indirectly using classroom displays. Directly, a display which explains and produces thoughts about mindset can be useful for students to reflect upon and challenge their own perceptions of themselves as learners. Indirectly, classroom displays that celebrate student work and achievement (of varying levels, not just the 'best' work) can also nurture students' self-esteem and confidence thus creating a culture where *anyone* can achieve *anything* if they put the effort in (Dweck, 2012; Maxwell and Chmielewski, 2008; UCU, 2013; Barrett, 2015; Hanley et al., 2017). Yeager and Dweck conclude that "students who believe (or are taught) that intellectual abilities are qualities that can be developed… tend to show higher achievement… and greater course completion rates in challenging maths courses" (2012: 1). Once students start to believe that they can grow as individual learners, regardless of prior achievement or failure, their performance in the classroom has potential to change; they can grow to become more resilient, successful students (Ricci, 2013).

Further methods of promoting growth mindset through the use of classroom displays can be applied through the following three pedagogical strategies (Boaler, 2015):

- believing in every student and expecting the highest achievement from all
- value students for producing in-depth, quality, thoughtful work
- encourage student questions and display them where the whole class can think about them

Each of these strategies can be transferred effectively onto classroom displays and, as a result of celebrating student achievement, there is an expectation that students should develop more confidence, motivation and self-esteem. If we provide students with these high expectations and opportunities for their work to be celebrated then we are allowing for growth mindset and for progress to take place within the classroom (Tosto, 2016, Dweck, 2008 and Dweck and Yeager 2012), even more so if we provide students with the opportunity to have a voice and a choice within the classroom about what they would like displaying and how they would like to present displays around their learning space (Laux, 2008; Toshalis and Nakkula, 2012; Arnot and Raey, 2004). By expressing student work and achievements on the classroom walls, an environment is created where students feel 'safe': "many important creative traits, such as willingness to take risks and independence of judgment, are nurtured in environments where students feel they can freely express themselves" (Seibel, 2016: 39). It is also important for the classroom environment to make explicit that all students are individual learners and as such will all have different starting points when learning mathematics. Subtle exposure to experience which demonstrate that intelligence is not inherit and can be worked for is crucial alongside overt strategies that teach the malleability of intelligence (Dasgupta, 2015); this can be achieved though well planned displays about mindsets in mathematics, as long as the teacher also promotes and demonstrates a growth mindset too. This change in mindset is measureable via discussions with students and through observations; are the students reading the mindset display? Are they discussing it with others? Are students responding to having their work on the wall? Are their attitudes to learning changing from 'fixed' to 'growth'?

Student Motivation

When we discuss the learning process and student mindset it is impossible to ignore the matter of motivation. There are two primary types of motivation: intrinsic and extrinsic motivation. Extrinsic motivation is geared towards completing tasks for external rewards and reinforcers such as praise, awards, money, following rules, disciplinary action and set boundaries: essentially extrinsic motivation is based around the idea of control being from an authoritative figure, i.e. the teacher. Intrinsic motivation, on the other hand, evolves around the notion that a task is completed for self-satisfaction and no tangible reward. In the classroom intrinsic motivation, as outlined by Deci (2012), consists of students completing activities where there is no apparent reward other than that of completing, understanding and gaining knowledge from a the task. In regards to intrinsic and extrinsic motivation, consideration should be given to how much emphasis is placed on the 'reward' of student

work being placed on the wall and students should not see the classroom displays as a reward for being motivated but as a tool for nurturing their motivation.

Students must utilise their self-motivation so that they can achieve academic success (Zimmerman et al., 1992). Moreover, Velayutham (2012: 1) highlights that students' "motivational beliefs… have been identified as instrumental in influencing the engagement of students in the learning process". Two important aims of education are to empower students by nurturing their self-motivational belief that they can succeed and to develop a learning environment that helps to cultivate that success (Velayuthum, 2012). This idea supports the pedagogical strategy of creating classroom displays for the purpose of igniting motivation in students. There is also evidence to suggest that there are significant associations between student motivation and how they perceive the classroom learning environment (Tas, 2016). Tas (2016) also found in their study that equality in the classroom and supportive work with other students is positively correlated with student engagement and motivation. This alludes to the idea that student voice, a sense of ownership over the classroom and student collaboration and participation with creating classroom displays could have a positive contribution to students' level of motivation to learn. Similarly, Gilbert (2014) found that student motivation acted as a mediator between student perceptions of the classroom environment and their academic achievement. The implications are that classroom displays, as part of the classroom environment, should encourage students to feel nurtured and thus motivated to learn. It is "critical that we understand how to maximise the beneficial aspects of the mathematics classroom environment and student motivation so that all students can achieve at the highest possible level" (Gilbert, 2014: 301).

A common thought process for students is that finding things difficult means they lack ability (Claxton, 2009) thus a classroom environment which utilises displays that counters this argument is crucial. Displays should encourage students to understand that learning mathematics is a working progress and "acquiring the 'skill' is only a part of the learning that is required; the rest involves slowly discovering when and how and for what purpose it can be used" (2009: 180). Furthermore, having classroom displays that are current, relevant and functional is essential as students tend to be highly motivated to learn when something seems practical and applicable to real life: Mason and Johnston-Wilder affirm that "no good can come from teaching children things that have no immediate use for them" (2004: 100).

Student Confidence

Often, some students may seem unwilling, non-compliant or just plain lazy but these student are usually resisting learning because they lack the confidence to participate and make

potential mistakes (Hannell, 2004). Students need thee overarching qualities in order to engage with learning and to successfully achieve academically: confidence, independence and resilience (Lloyd-Rose, 2018). Confidence, as defined by Lloyd-Rose, is concerned with "believing you can succeed, being willing to try and take risks, and daring to think ambitiously about the future" (2018: 6). If confidence is situationally-specific, it means that it can be raised and lowered depending on circumstances such as the immediate classroom environment (Norman and Hyland, 2003: 6).

In terms of the classroom environment, confidence is about students having faith in themselves and how they perceive their abilities, and the affect this can have on their effort, willingness and motivation to engage in learning. Moreover, students must understand that mistakes are a normal part of the learning process and this should not waver their confidence. Tosto et al. (2016) hypothesised through their study that maths self-efficacy could be the strongest predictor of achievement and that boosting factors such as interest and self-belief could have a positive impact upon maths achievement in students aged 16+.

Lloyd-Rose (2018: 7) sets out the following idea about the journey students will make from lacking to having confidence. Lloyd-Rose (2018) states that for students to make the transitions from one stage to the next, they must acquire a specific mindset.

Stage 1: **Growing in positivity and willingness to participate**	Lacking in confidence
Stage 2: **Taking risks in a safe environment**	Tentative confidence within positive, trusting classroom culture
Stage 3: **Seeking out challenge and taking ownership of learning**	Growing in genuine confidence based on overcoming challenges and experiencing success

Stage one suggests that there might be some engagement in learning and positive attitudes towards the learning environment. Stage two suggest that there is growth mindset and more openness and engagement with mistakes, challenges and feedback. Stage three suggests a culture of self-efficacy where persistence, sustained effort and ownership are factors of

intrinsically motivated individuals (Lloyd-Rose, 2018). This type of learner centred teaching, coupled with high standards set by teachers can also inspire students to grow in confidence and to accept their responsibilities as learners (Weimer, 2013).

Ortiz-Ordonez et al's (2015) project undertaking revealed that students, particularly older students and adults, need self-regulated learning skills as these are the pinnacle of sustainable learning processes, essential for lifelong learning. Students who are self-regulated believe that academic success will arise from opportunities to tackle challenges, through practice of the subject and by exerting a lot of effort (Perry et al., 2006). This idea aligns with stage three of Lloyd-Rose's (2018) model whereby students who have a strong sense of self-efficacy and are intrinsically motivated to learn are the ones who have the highest levels of genuine confidence. It cannot be assumed that all students will enter the classroom with confidence especially when that classroom is one in which they have been forced to attend because of failure in their maths GCSE exam. Therefore, one strategy to promote confidence in leaning is to focus on already acquired competencies in students and incorporate daily life issues into learning (Ortiz-Ordonez et al., 2015); additionally this can be promoted through a supportive classroom environment where students have some control over the visual displays and have their own work celebrated on display (Tas, 2016; Gilbert, 2014). As opposed to low-achieving students who have a complete lack of confidence, Scott (2017) found that high achieving students are more likely to under-assess their own work and often lack confidence in their own abilities and thus, providing students with the opportunity for their work to be displayed could provide the confidence boost they need to reassure them of their skills.

It is also important to consider, when measuring student confidence, that fluency can cause overconfidence: "things that make something *appear* easy to learn sometimes increase confidence in leaning without increasing actual learning" (Toftness et al., 2018 1). Therefore, when designing a classroom environment with emphasis on the visual displays it is crucial that the displays do not provide students with a wrongful delusion of confidence; students have been known to overestimate their learning when it is presented in the context of colourful images, diagrams and pictures (Carpenter and Olson, 2012).

Literature Review Conclusions

Visual displays could cause distraction in the classroom and impact how well students pay attention (Hanley et al., 2017) however, the older the students the better they are at sustaining attention and the less susceptible to distractions they are (Gaspelin et al. 2015). Despite visual displays causing potential distractions, they should not be eradicated from the

learning environment as they can be optimised to promote engaging behaviour and an environment which induces effective learning outcomes (Fisher et al., 2014; Hanley et al., 2017). Furthermore, *what* we choose to put onto classroom displays and *how* we choose to display it is crucial for the development of student learning: they should not be created mindlessly to fill the walls with colour but should be an effective tool for encouraging learning, independence and self-esteem within the classroom (Foster, 2012; Almeda et al., 2014). Finally, classroom displays should be utilised to stimulate interest in learning mathematics and to set the tone for the importance and accessibility of the subject (Briggs and Davis, 2015); by 'mathematising' the classroom effectively we will not be creating distracting, colourful, useless 'wallpapers' but we can create a classroom that envelopes the safe culture of learning.

The multisensory and neurological approach takes into consideration factors that are important to the creation of successful classroom environments and displays. Classroom design, including the displays on walls, should take consideration of individualisation and stimulation so that sensory environments can enable students to reach their fullest possible potential (Barrett and Barrett, 2010). Stimulating wall displays are vital and a student's percept - turning stimuli into usable experiences – are intricately linked to memory where they will make assessments about the value of the stimuli on display (Eberhand, 2007). Finally, design implications for classroom displays rest upon the experiences and behaviours that they can afford: aspects and elements of a visual environment and visual stimulus can be rapidly extracted to trigger an emotional response, and the neurological effects of this can either help or hinder learning (Nanda et al., 2013).

When students are involved with classroom display designs they become much more enthusiastic about learning. From involvement, students find a real sense of belonging and often have a strong belief of ownership and responsibility within the classroom (Beadle, 2010; Cowley, 2009; Barrett et al., 2015). It should be acknowledged that there may be difficulty in directly correlating changed environmental factors - such as the classroom displays – to an increase in effective learning (Pointon and Kershner, 2000) however, the value of involving students in the creation of their learning space is immense.

How students perceive their classroom and the displays within can have a strong link to how motivated and confident they are to learn and how well they perceive the learning environment to be theirs (Pointon, 2000). Two key aspects to consider when creating classroom displays is student ownership and the purpose they serve for the students. It is also essential to understand and act upon student perspective, emotions, interests and needs towards their environment in order to provide a better learning experience (Ramli et al., 2013).

Linked closely with student involvement and student perception, giving students a voice within the classroom is imperative if we want to create classroom displays that motivate, provide self-esteem and create a sense of ownership over an effective mathematical learning environment; student voice is also key to allowing students to construct value and meaning from what they are studying in mathematics (Middleton and Perks, 2014; Laux, 2018; Ferguson, 2011; Arnot and Reay, 2004; Rudduck and McIntyre, 2007).

Growth mindset, as opposed to the negatively viewed fixed mindset, is what all teachers aim to develop in their students. Using explicit displays which challenge the ideas of fixed a growth mindset are useful ways of promoting a growth mindset that will improve learning and achievement. Moreover, classroom displays that celebrate student work and achievement (of varying levels, not just the 'best' work) can also nurture students' self-esteem and confidence thus creating a culture where *anyone* can achieve *anything* if they put the effort in (Dweck, 2012; Maxwell and Chmielewski, 2008; UCU, 2013; Barrett, 2015; Hanley et al., 2017).

Students must have a high level of motivation in order to be engaged with and achieve academic success (Zimmerman et al., 1992; Velayutham, 2012). How students perceive their classroom environment has a significant association with how motivated they are therefore, it is important to create classroom displays that successfully motivate (Gilbert, 2014; Tas, 2016).

Similarly, students must have confidence to engage with and successful achieve academic goals (Lloyd-Rose, 2018; Ortiz-Ordonez et al., 2015): maths self-efficacy could be the strongest predictor of achievement and boosting student confidence and self-belief could have a positive impact upon maths achievement in students aged 16+ (Tosto et al., 2016). In order to increase student confidence through classroom displays we must incorporate real-life maths issues (Ortiz-Ordonez et al., 2015) and ensure that we do not facilitate overconfidence by presenting too many colourful images, diagrams and pictures; the displays must present a slight challenge and be realistic for students (Carpenter and Olson, 2012). Finally, a massive boost in confidence for students is having their work celebrated on the wall displays, even if it is not a perfect piece of work (Maxwell and Chmielewski, 2008; Foster, 2012; Barrett et al., 2015; Tollefson and Osbon, 2008).

METHODOLOGY

Research Questions and Action Research

The literature review, conducted off the back of my identification of a particular pedagogical issue, has created three significant research questions:

1) How has student motivation and confidence in the mathematics classroom changed with the implementation of displays?
2) How has student mindset changed with the implementation of displays?
3) Does giving students a voice in the creation of classroom displays promote or contribute to positive learning experiences?

These research questions support the use of an action research framework: “action research is a name given to a particular way of looking at your practice to check whether it is as you feel it should be… you will be able take action to improve it, and produce evidence to show how the practice has improved” (McNiff, 2013: 23). McAteer (2013) also describes action research as something that allows a teacher to develop their practice having identified an issue or problem. By taking an action research approach, I will be fully involved with the pedagogical changes that may arise from the research questions and it will allow me to be embedded in the results which will aid in fully understanding the potential implications for my students: naturalistic settings are best researched by those experiencing the problem first hand (McKernan, 1996).

The style of action research used within this study will be threefold: first, initial questionnaires to assess the problem and gain student opinion; second, the actual implementation of classroom displays with the help of the students; and third, follow up questionnaires and interviews to assess the changes that may have occurred due to the intervention. Should it be necessary and if time allows, this cycle can be repeated as many times as required.

Data Collection

As mentioned above, this research collected data via two different methods: questionnaires and interviews. These two data collection methods were chosen because of their ability to allow the research to see through the eyes of the student and seek their views and feelings (Hattie, 2012).

<u>Questionnaires:</u>

The students in the study were surveyed through two questionnaires which contained a mix of closed and open questions and these were administered to a whole group in two different classes. The first questionnaire was administered before the intervention [see appendix 1] and the second questionnaire was administered after the intervention [see appendix 2]. The

questions included in the questionnaire have been crafted from the ideas studied in the literature and from the consideration of what the research questions aspire to discover. The questionnaire had to consider the knowledge base and level of understanding of students to ensure that the questions were accessible (Macintyre, 2000) therefore, questions were kept relatively short and simple to match the ability of the students.

Questionnaires were been chosen because of their ease to administer, the ability for quick collection of information of a large sample size and because of the opportunity to include open and closed questions. Cohen, Manion and Morrison (2007) state that larger samples should have more closed questions as opposed to smaller samples which should use more open questions. The sample size chosen for this research is not very large but there will still be a fair amount of results to analyse and this, tied with the constraints of the teaching profession, lends itself to creating a questionnaire crafted primarily of closed questions and only a small amount of open questions. Furthermore, there is a relative ease associated with collecting, comparing and analysing the data from 'before' and 'after' questionnaires thus providing opportunity to make direct comparisons and potential correlations. However, the limitations of questionnaires should be acknowledged and the main criticism associated with this research is that the students may not answer honestly on their questionnaire: they might be influenced by the idea that they're providing answers for their own teacher and they could be reluctant to be honest or share their true thoughts and feelings.

The questions were carefully created by drawing upon the literature readings. Below are some of the most pertinent questions that addressed the research questions outlined in this study.

- Are the current classroom displays distracting?

This particular question links directly to the first part of the literature review – attraction or distraction? – and the discussion over the effective use of classroom walls and the immediate environment. Whilst the review concluded that classroom displays can be distracting if they are too bare or overpopulated, it argued that classroom walls can be used in a positive way to promote and influence learning, confidence, motivation and mindset (Hanley, 2017; UCU, 2017; Gaspelin et al., 2015; Almeda et al., 2014). As part of this research it was important to assess how my students perceived the classroom displays before and after the intervention so that the effectiveness of the new displays could be measured.

- Would/Do you like to see your maths work on display?

This was an important question, stemming from the literature review, as it addresses the idea that allowing students to be involved and having their work celebrated on display has a positive impact on their learning experiences (Maxwell and Chmielewski, 2008; Foster, 2012; Barrett et al., 2015; Tollefson and Osbon, 2008). In relation to addressing the research questions, the findings from this particular question facilitated in addressing the research question 'Does giving students a voice in the creation of classroom displays promote or contribute to positive learning experiences?'

- How do the current classroom displays make you feel?

This question had five potential responses: Ready to learn, Confident, Encouraged, No influence and Uninspired. The thought process behind choosing this question was that their feelings towards the classroom environment could be measured and compared pre and post intervention; the five different responses can also be categorised into key themes such as confidence and motivation. There is a lot of potential for students' motivation and confidence to be positively influenced by effective classroom displays (Gilbert, 2014; Tas, 2016) and this question helps to address the research question: 'How has student motivation and confidence in the mathematics classroom changed with the implementation of displays?'

- How do you think displays could be used more in the classroom?

This open-ended question provided students with an opportunity to 'have their say' in how the classroom displays could be used. This particular use of question allowed the students to have a voice within the classroom before the intervention had started and it was of interest to record how they responded to this opportunity. Furthermore, it also assisted in measuring how effective the use of displays had been on the students' ownership and responsibility of the classroom (Beadle, 2010; Cowley, 2009; Barrett et al., 2015). Asking the students this question, acting upon it and then allowing even more opportunity to have ownership over the displays was important for addressing the research question: 'Does giving students a voice in the creation of classroom displays promote or contribute to positive learning experiences?'

Interviews:

To further develop the themes highlighted in the survey carried out with the students, two students and one Educational Support Worker (ESW) were selected to take part in separate interviews. The students were given the option to volunteer or opt out of taking part in the interviews and they were all given pseudonyms to protect their identity and to keep the conversation confidential between practitioner and participants. The interviews were crafted to be semi-structure or 'qualitative interviews' (Bryman, 2004) so that a base structure and base questions could be used as a guide for the interview however, the students and ESW

were given the opportunity to fully express themselves and develop their thoughts due to the flexible nature of the semi-structured interview. The semi-structure interview consisted of "some guideline questions around issues [the researcher wants] to explore, but will have flexibility in how the questions are worded, in how they lead to follow-up questions and in the order in which they are asked' (McAteer, 2013: 73). Finally, the interviews were recorded in accordance with McAteer's (2013) view that audio-recording is a preferred method whenever possible; participant self-consciousness of being on record should subside quickly as it is not an invasive method and listening back to an interview is much more reliable than relying on memory to write up the findings (Cohen, Manion and Morrison, 2007).

In contrast to a questionnaire, an interview allows participants to provide more depth and justification to their thoughts and responses, an effective way of accessing different perceptions (Punch, 2009; Lodico et al., 2010): by asking open ended questions in a face to face environment, students are given the opportunity to answer in their own words, providing a clearer insight into their opinions, perspectives and ideas where a questionnaire would not be able to accommodate this (Check and Schutt, 2012). Through using this form of semi-structured interview, the flexibility may create an atmosphere related more akin to a natural conversation rather than the intimidating perception that is often associated with the concept of being interviewed. As with the questionnaires, the limitations of interviews should be acknowledged. Firstly, analysing interview data is time consuming and thus only two students and one ESW were interviewed to combat the lack of time available to conduct this research. Secondly, the students chosen may not be confident or comfortable sharing their thoughts and ideas however, as they know me and they know that the data will be made confidential I am confident that they were as honest as possible. Moreover, the lack of anonymity as the interview will be face to face might cause some researcher influence whereby the students respond with answers that they think I want to receive. Finally, the openness of semi-structured interviews could cause off-topic answers that are not relevant to the research nevertheless, this could be set right by drawing upon the skeletal structure and prompts provided by the outlined questions.

As discussed above, the interview consisted of a pre-set list of questions that could be expanded upon or adapted if necessary. The questions selected for the joint student interview were chosen to support the questionnaire findings and to delve deeper into some of the responses where the questionnaire limited itself [see appendix 3].

Student Interview Questions:

- What do you think to the new classroom displays?
- How do you feel about your work being on display?
- Why do you think we have created the new displays?

- Do you think having all the displays on the wall has had any influence on your own learning experience?
- Do you feel more confident in class with the displays around you?
- Do you feel more enthusiastic to learn?
- Have the displays changed how you feel about maths?

For the interview with the ESW fewer questions were asked but they were more specific in terms of the information I was trying to gather, to support the questionnaire findings and the student interview findings. Mindset was only discussed at this point as I wanted somebody fairly impartial to observe whether the displays had any influence on changing student mindsets [see appendix 4].

Staff Interview Questions:

- Do you feel like the implementation of displays in the classroom has had any effect on the students (positive or negative)?
- Have you noticed any students using the classroom displays to aid their learning?
- Have you noticed any change in attitude towards maths since we have created the displays?
- Do you think the mind-set of any students has changed?

Data Analysis

A Likert scale was used as a guideline to shape the majority of the questionnaire response options. Likert scales allow for an enhanced differentiation of scores as they frequently use seven point scores due to the range of answers procured from this (for example: excellent, very good, good, neutral, bad, very bad, terrible). Azzara (2010) argues that, generally, respondents to this type of complex scaling are educated individuals and are often in management or a position of authority. Based upon this insight, following such a tight Likert scale structure was not entirely appropriate for my students hence why the structure of five point scores was used as a guide for some of the questions. Furthermore, the decision to move away from a strict Likert style questionnaire was confirmed by the argument against averaging Likert scale scores and how these results are actually analysed: a Likert scale assumes that the emotional distance between agreement and disagreement and strong agreement and strong disagreement is the same, which is not usually the case. At the most fundamental level, the ‘numbers’ in a Likert scale are usually an emotional response and not numbers which can be averaged out: “with Likert scale data we cannot use the mean as a measure of central tendency as it has no meaning i.e. what is the average of Strongly agree and disagree?” (University of St. Andrews, 2014). Thus suggesting that the most appropriate

way of measuring and displaying the distribution of the responses is through using a bar chart and discussing percentages that refer to agree and disagree responses.

Moreover, the questionnaire questions provide opportunity for the responses to be quantified which is particularly important for my research as to answer some of the research questions, before and after comparisons are required. The decision to analyse the interview questions qualitatively transpires from the semi-structured nature of the interview and the open-endedness of the student responses. Using qualitative and quantitative data in unison allows for a range of analysis; the qualitative data can support the quantitative findings and vice versa.

Research Sample

The research compromised of 28 students from two different Functional Skills maths classes, all students were within the age range of 16-18 and all were taught by myself. The two classes were not chosen at random but were selected due to the fact that both groups' maths lessons take place within the same classroom, albeit at different times, thus making the research project viable. The two groups chosen to participate were also carefully selected as the students represented two very different vocational areas: childcare and construction. The students selected are from mixed ability classes where most students are aiming for a Level 1 qualification with the exception of three students who are aiming for the slightly lower qualification at Entry Level 3. Of these 28 students, 82% are currently on target to achieve a PASS (they sit one exam which is graded pass/fail). The two students chosen to be interviewed are from the same class and they opted for a joint interview: one student is highly motivated and achieves quite highly in class, the other student is making expected progress but has mid to low motivation and struggles with self-confidence. The Educational Support Worker (ESW) volunteered to participate in an interview after an informal discussion about the research project.

Ethical Considerations

The research has been conducted in conjunction with the ethical guidelines published by the British Educational Research Association (BERA, 2011) and the research was subject to CUREC approval from the University of Oxford. The principle of the college's permission was explicitly sought and granted through a detailed letter outlining the research proposal and all of the ethical considerations associated with the research. Parents' permission was not sought as the data collection methods were considered to be low risk, classified in line with the Modus Operandi of the MSc Learning and Teaching. Furthermore, all participants

were over the age of 16 so could give their own informed consent to participating in the research.

In order to ensure that ethical guidelines were met, all research involvement was voluntary. Students were informed about the research and were given the option to opt-out and were not made to feel obliged to take part in any questionnaires or interviews. The voice recorded interviews were kept on a password protected computer and upon the completion of typing up the transcript, the recording were destroyed to protect the identity and confidentially of the students and ESW. Additionally, all questionnaires were anonymous and no names were written anywhere as to protect the identity of the students. All references made to students, staff or the college within this research project are done so using pseudonyms to protect their identity thus maintaining confidentiality between participants and the researcher.

The questionnaire used in this study was administered with care and a verbal introduction detailing the research, ethical considerations and important factors such as anonymity were given. These cautious steps were taken to ensure no ethical guidelines were broken. Moreover, students were informed that by completing the questionnaire they were giving their informed consent and if they did not wish to partake in the research then they should not complete the questionnaire. Similarly, the notions of anonymity and confidentiality were discussed and explained to the students to ensure that they understood that they would not be able to be identified from the research.

The two separate interviews used in this study followed ethical guidelines. The first interview was joint involving two students: this was purposefully proposed to the students to allow them to feel ‘safer’ and less like they were being ‘interrogated’ in a one-to-one situation. Before the interview both students were informed that their voices would be recorded however, only I would have access to this file and it would be destroyed as soon as I had created a transcript of the interview. The students were also informed that their names would not appear anywhere in the study and I would use pseudonyms to protect their identity. As with the questionnaires, the students were informed not to take part in the interview if they did not want to participate in the research and by taking part they were giving their informed consent. The exact same procedures were followed for the interview with the ESW.

THE INTERVENTION

Following the completion of the initial questionnaire, the intervention could begin. The intervention followed a three step process. Step one required the students to converse in

discussions, as a whole class, including myself about what they would like their classroom environment to look like and what displays they would like to have on the various display boards and I made notes for every suggestion. Once the preliminary discussions had taken place in the classroom, students decided which display ideas they would find the most useful in terms of aiding their leaning, confidence, motivation and mindset. Step two concerned the creation of the classroom displays with as much emphasis on student involvement in this as possible. Four key display ideas were chosen and then created by the students and I created a fifth learning aid for the classroom clock:

1) Examples of student work from lessons drawn up in poster fashion (this ranged in ability and included 'imperfect' work)
2) A 'mindset' displays highlighting the students' negative thoughts toward maths and the thoughts that they perceived to be 'healthier' and positive
3) A working wall display dedicated to the different mathematical subjects that they have learnt
4) A display emphasising the learning process of maths, shown as a formula and created after a week spent on learning about formulas
5) A display around the clock face indicating fractions in words and symbols (quarter past etc.)

The third and final step of the intervention involved another whole class discussion where students had time to reflect and freely comment on their displays and the improved classroom environment. Alongside this discussion students were given the post intervention questionnaire to complete, the two students were chosen for their interview and the ESW was also interviewed.

To put the following findings into perspective and to provide some additional background into the study the following section shows photographs of the classroom environment before and after the intervention.

The classroom environment BEFORE any intervention took place:



Figure 1: left wall of classroom



Figure 2: black wall of classroom - left



Figure 3: back wall of classroom – centre



Figure 4: back wall of classroom - right

As can be seen in the four photographs above there has been a previous attempt at including displays in the classroom environment but upon further inspection these displays are merely ‘posters’ that give some detail of English or maths skill and are not particularly personal to any students. Figure 2 also shows an official college poster about English and maths but it does not actually add anything to the learning environment as it is just an ‘inspiration’ poster. There is also a noticeable amount of ‘blank’ space which creates a very bland atmosphere and most walls lack colour.

The classroom environment AFTER the intervention took place:



Figure 5: back wall of classroom - left

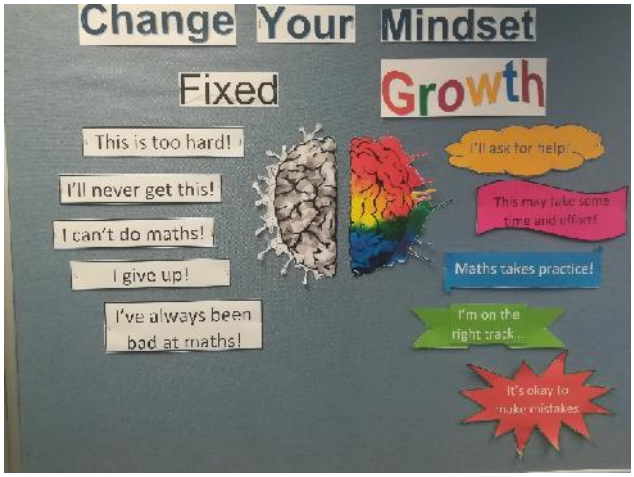


Figure 6: back wall of classroom - centre

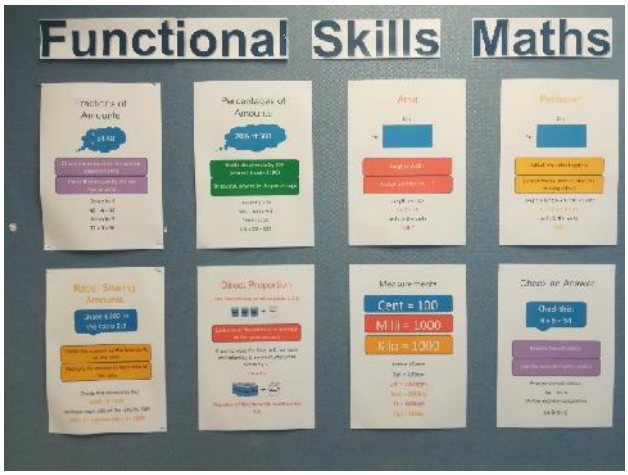


Figure 7: back wall of classroom - right

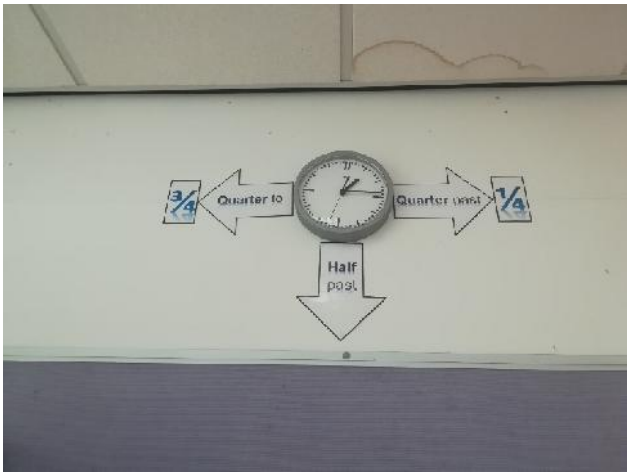


Figure 8: left wall of classroom

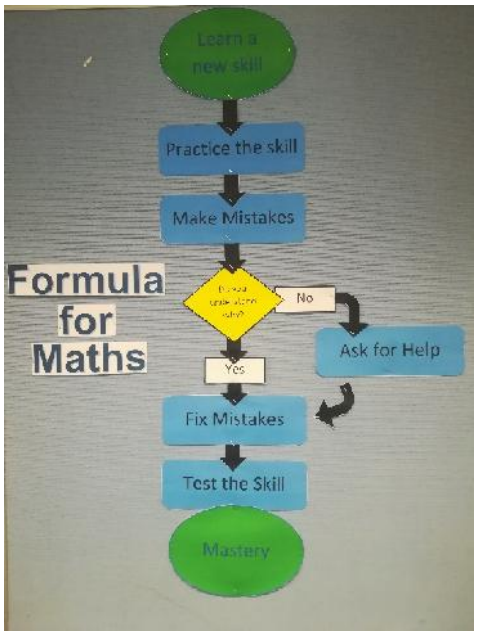


Figure 9: left wall of classroom

The above five photographs above illustrate the improved classroom displays. Figure 5 depicts work completed by students; these pieces of work were chosen by the students to go on display as they were proud of their achievement. The students could choose whether to photocopy something out of their maths books, complete 'fact sheets' and questions on plain or coloured paper: interestingly, all of the students opted to complete their work on coloured paper as they thought their display would benefit from this. Figure 7 shows a display titled 'Functional Skills Maths' which the students created as a 'working wall' that was updated every time they explored a new skill or topic. Figure 8 was created by myself as two students did not know how to tell the time thus creating a discreet way of helping them to understand the analogue clock. It is also a great way of embedding fractions into 'real life' time as, often found, a lot of students struggle with the concept of how many minutes there are in a quarter of an hour and three quarters of an hour. Figure 6 was created by the students, with some guidance and assistance from myself when required; I felt this a necessary step as my students definitely held a fixed mindset towards learning mathematics and sometimes they were not sure how best to express their feelings for the display. Figure 9 was a collaborative display between myself and my students: they had just learnt about formulas and thought it was a good idea to make a formula about how to actually learn maths. Figure 9 shows a lot of development in their growth mindset.

FINDINGS AND DISCUSSION

Questionnaire Analysis and Comparison: pre and post intervention

Analysing the questionnaire data was relatively easy due to the comparability of each student's response to each particular aspect of the research investigation. However, due to the varying requirement for the key response words, a Likert scale could not be utilised on each question thus there will be a number of different tables to examine as opposed to one combined table. As stated

How would you describe the quality of the maths displays in this classroom?

	Excellent	Good	Poor	Very poor	Total:
Pre intervention	0	3	9	16	28
Post intervention	16	12	0	0	28

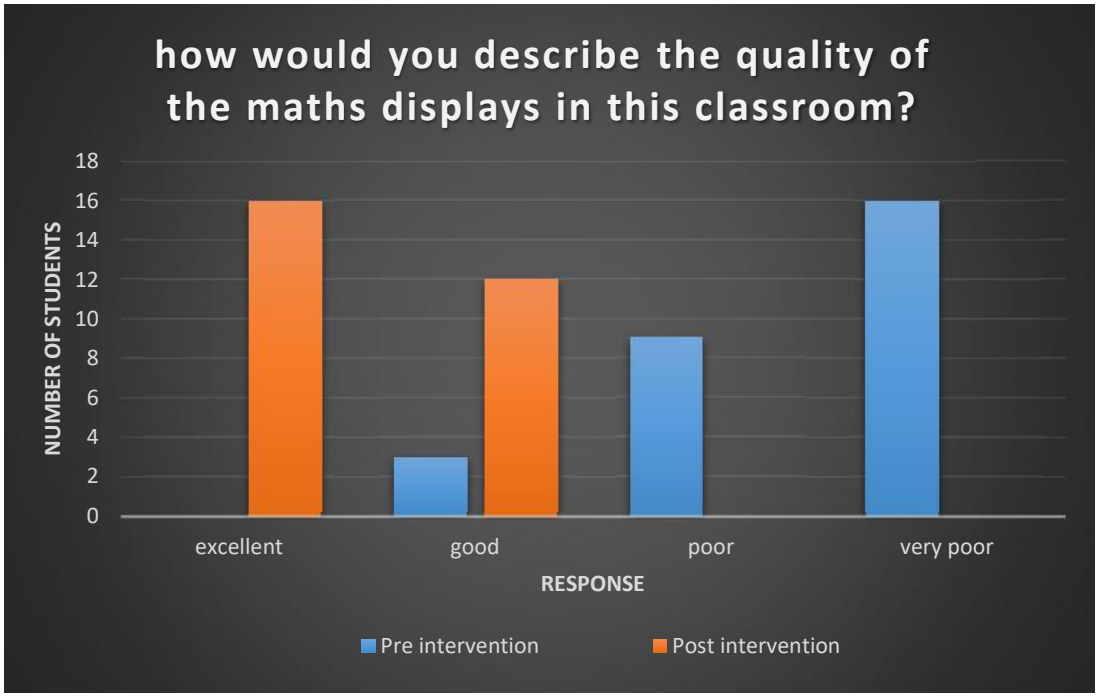


Table 1: highlights the change in student response to the quality of the classroom displays pre and post intervention.

As can be observed from table 1, there has been a considerable shift in student perception of the quality of the classroom displays. Pre intervention, just 11% of the students thought the original classroom displays were good with 89% responding that the displays were poor or very poor. This initial response was overwhelming and definitely indicated that students do pay attention to their learning environment and this particular environment was unacceptable. One month after the intervention, when asked to complete the successive questionnaire, 0% of students gave a negative response (poor or very poor) and 100% gave a positive response (good or excellent). Furthermore, 57% described the classroom displays as 'excellent', compared to 0% pre intervention. In concurrence with these findings, in the student interview Aliya commented that the classroom displays were *"quite understandable and colourful and they definitely look better than before".* Cameron furthers this by commenting that "*the classroom looks more beautiful and it's not a boring place to be anymore. It is more enjoyable to learn with the displays around us".* How students perceive their classroom and the displays within can have a strong link to how motivated and confident they are to learn and how well they perceive the learning environment to be theirs (Pointon, 2000).

Do the current classroom displays help you learn?

	Yes	No	Total:
Pre intervention	3	25	28
Post intervention	27	1	28

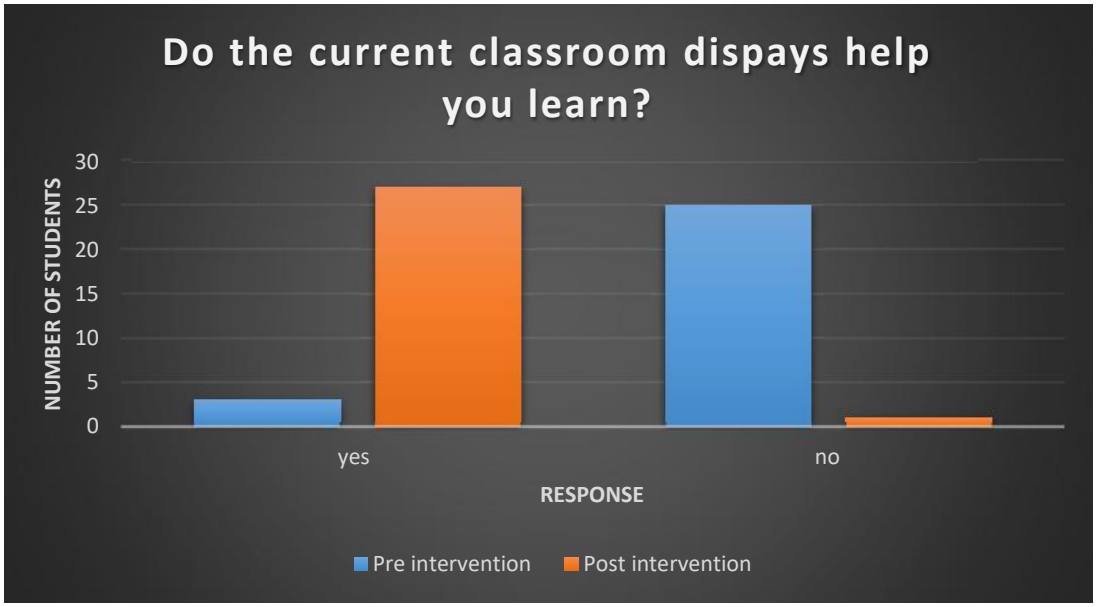


Table 2: highlights the change in student response to whether the displays support and help with learning.

Table 2 illustrates the very obvious change in student opinion regarding the usefulness of the classroom displays and whether they support their learning. Prior to the intervention, there were displays around the classroom and the students were aware of these however, as seen in table 1 these displays were judged to be of very poor quality. Thus, as can be expected prior to the improvement of the displays, 89% of the students responded that learning was not helped by the current environment. After one month of the intervention, there was obviously some benefit now as 96% of students indicated that their learning was supported by the new displays. In the joint interview, Cameron commented *"I think they're good because if I get stuck I will go up and use the displays to help me now because I know they are there and they are actually useful".* Similarly, when questioned in interview about why she thinks I have created new displays, Aliya thought it was *"so we could look around at the displays and we can check to see if we have worked something out right and if we don't know how to do something it's helpful and we can use the maths rules we made".*
Furthermore, in her interview the Educational Support Worker (ESW) observed that she had:

"Definitely noticed students looking at the new displays because they know they are there because they helped to create them! I saw Josh looking at the percentage part of the display

yesterday because he was doing a problem solve which had a percentage in it and when he read it he sort of nodded his head because it helped him to remember what he was doing, he seemed quite pleased with himself. I have also noticed a few students looking at the mindset display too and I think it gives them a bit of a confidence boost although, that poster just backs up what you are always saying in class to them".

Stimulating wall displays are vital in supporting students to learn as these very important design decisions can be utilised to trigger neurological effects which can either help or hinder learning (Nanda et al., 2013). Moreover, Barrett and Barrett (2010) argue that a considered and an individualised environment can enable students to reach their fullest potential.

Do the classroom displays have a positive or negative influence on your learning?

	Positive	Negative	Total:
Pre intervention	8	20	28
Post intervention	28	0	28

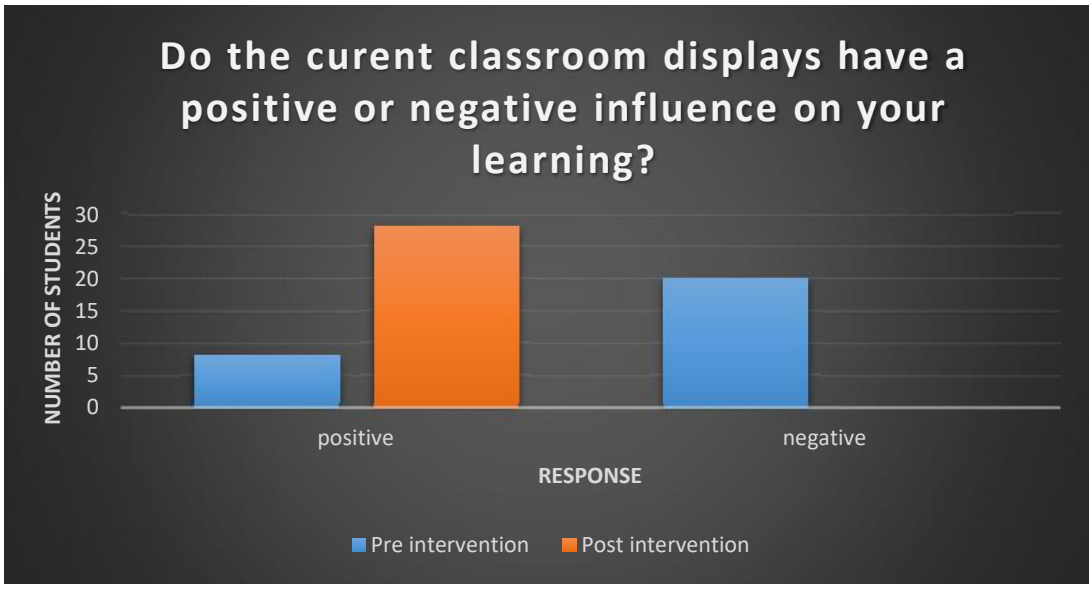


Table 3: highlights the change in student response to the negative or positive influence that the displays have on their learning

Table 3 displays student response to how the displays could have a negative or positive influence on their learning. Interestingly, even though only 3 student had commented that the displays were 'good' before the intervention, 8 responded that these displays had a positive influence on their learning. This suggests that despite the poor quality, students still perceive classroom displays to have an importance in their learning and thus has a positive impact.

Pre intervention, 71% of students believed that there was a negative influence on learning. Astonishingly, all 20 students altered their opinion post intervention resulting in 100% of students believing that the new classroom displays now have a positive influence on learning. Strengthening this argument, in their interview Aliya and Cameron discuss the influence that they think the implantation of more effective displays has had on their learning:

> *Aliya: Yeah obviously because it's helpful with problem solving and it has changed my mindset*
>
> *Cameron: Yeah I agree with Aliya, it's an extra thing to help us learn when you are busy helping someone else*
>
> *Aliya: Oh yeah, before I ask you for help now I go and look at the display because I know the working wall one has the skills on it we've just learnt*
>
> *Cameron: Mmm... at first I was a bit scared to do that but because everyone looks at them its dead normal and I reckon that extra learning area has had a positive impact on my learning recently.*

Moreover, in the interview with the ESW it became clear that she had observed this positive impact:

"*No one has had a negative reaction to the displays and they all seem quite proud that their work is on the wall. It's also good because it gives them another way of finding out how to do something rather than asking you or just sit at their desk doing nothing because they can't do it. They like the fact that they helped to decide on the content and actually put things up. They like the added independence and the fact that you allow them to freely move around the classroom to use the displays if they want".*

How do the current classroom displays make you feel?

	Ready to learn	Confident	Encouraged	No influence	Uninspired	Other	Total:
Pre intervention	0	2	0	16	6	4	28
Post intervention	10	8	9	1	0	0	28

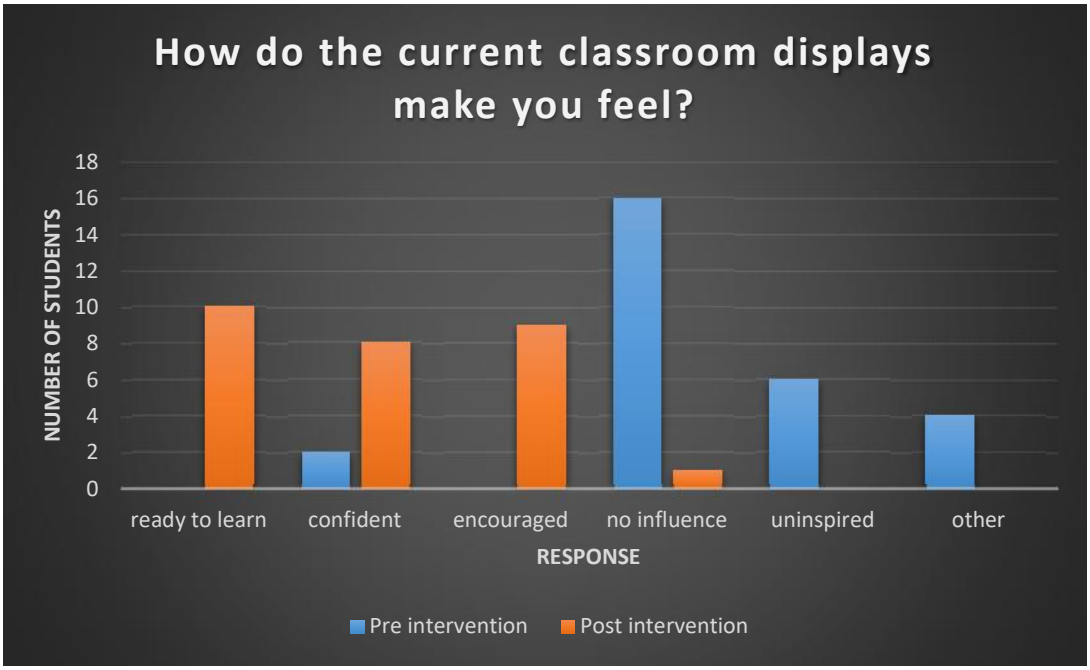


Table 4: highlights the change in student response to the how the classroom displays 'make them feel'

Table 4 clearly demonstrates the positive shift in student response regarding how they perceive the classroom displays and the influence that the displays have on their feeling towards learning maths. Pre intervention, only 7% of students thought that the classroom displays had any sort of positive influence on feelings, suggesting that the existing displays were not conductive to a rich and engaging learning environment. Furthermore, an overwhelming 57% of students felt that the classroom display had 'no influence' at all: revealing, rather disconcertingly, that the current use of the classroom environment was not a conductive or supportive learning tool and was not being used to enhance the learning experience for students. However post intervention, a significant shift in perception is evident. In contrast to the 93% of students who felt negatively or 'no influence', only 4% felt the improved environment still has 'no influence' over their learning. Moreover, 96% of students felt 'ready to learn', 'confident' or 'encouraged' in regards to learning maths. This extreme shift in perception of learning is very reassuring and further supports the argument that a well-produced and well-planned set of mathematics classroom displays can have a substantial influence upon how students view their learning environment and the potential impact this could have on progress and success in the classroom. In support of these findings when asked whether they felt more confident and more motivated to learn Aliya and Cameron responded:

> *Aliya: yeah I feel more confident because there's more opportunity to find answers*

Cameron: Yeah, I agree and it makes me feel confident about my work being right as I didn't want it on the wall originally

Aliya: I think I feel more motivated too. They are not distracting at all and they are just so helpful. And, if I did some really good work I would like to see it put up on the wall

Cameron: yeah, I agree. The displays don't distract me but they do make the room feel more like a classroom and a place where I want to learn.

A massive boost in confidence for students is having their work celebrated on the wall displays, even if it is not a perfect piece of work (Maxwell and Chmielewski, 2008; Foster, 2012; Barrett et al., 2015; Tollefson and Osbon, 2008). How students perceive their classroom environment has a significant association with how motivated they are therefore, it is important to create classroom displays that successfully motivate (Gilbert, 2014; Tas, 2016).

Have the new classroom displays changed the way that you think about maths?

	Yes	No	Total:
Post intervention	26	2	28

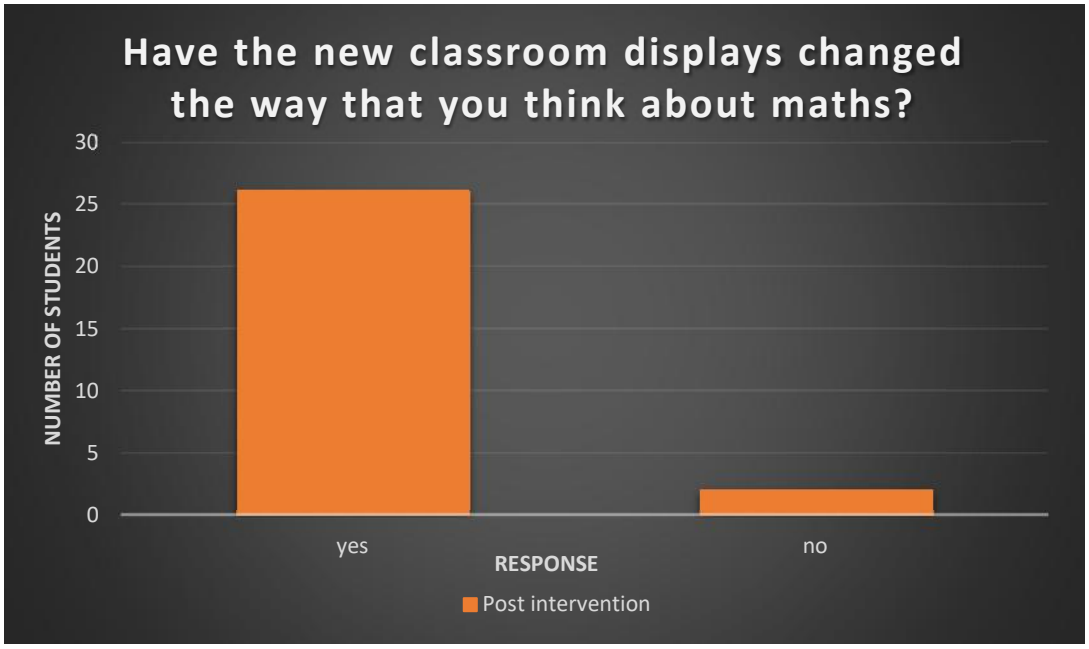


Table 5: highlights the change in student response about their thoughts towards maths

Table 5 demonstrates the difference in student opinion regarding how they think about maths. It could be argued that this positive movement could have various influencing factors such as stronger relationships with the teacher and the fact that they've had six months to settle into college life however, students were advised to answer this question by

considering and focusing on the impact or the influence of the classroom displays. With 94% of students stating that they have a changed opinion it is quite clear that students value a powerful learning environment. This question needs further clarification about what type of change has occurred as students could, potentially, move to a negative view of maths therefore, students had to provide a reason for their change in opinion. The table below outlines 26 out of 28 responses that provided more than a ‘yes’ or ‘no’ answer:

They [the posters] help
I had trouble in maths at school. Katherine helps me a lot and the displays remind me of [what] I have to do in lesson
They [the posters] have made class fun for me and improving maths
It has changed mindset because the work is on and if I am stuck I can look on the wall and find my answer
It [the new displays] wants me to want to learn more
Make it more fun and it help you
I like maths more now
colourful and seems eye-catching
The mindset display which makes me think about how I think about maths. My mindset has changed and I’m more positive.
The displays explain maths in a clear way like Katherine teaches it so it makes sense
My work is good enough to put up now which means I am doing well and learning
I think I can do it now and the posters help me and encourage me to try. I used to hate maths but now I love it
I think more about my mindset and how I can tackle maths differently
It [maths] doesn’t seem scary now
it’s not as bad now and I like my work on display
I’m more confident anyway now but the displays make the classroom a good place to learn
They [displays] are good because I feel like the classroom is our proper maths classroom and it’s our work etc.

They help a little bit
They are very encouraging
As well as my teacher, the displays make the room feel more like a maths room now
They sort of complete the room and where we learn
I feel a bit more confident because I never thought my work was good enough for the displays but it is!
The mindset display reminds me to think differently. I can do maths
I liked it before but now it's a great place to learn as our work and what we have learned is all around us
I like the displays around the clock as I struggle with time and it's good to always be able to get the help when I look at the clock and it's not embarrassing
I can see how they can be helpful for others

Table 6: Outlines the student responses to *why* the displays have changed the way that they think about maths

Within these student responses there appears to be four main recurring themes: mindset has been positively altered, the displays create an inclusive 'maths' classroom environment, the displays support learning and there is a sense of pride and achievement for personal work on display.

Of these commonly occurring themes, the most surprising is the awareness of mindset. In class I often make reference to positive mindsets, encouraging students to alter the negative opinions they hold of themselves and what they perceive to be a lack of ability in maths. However, I did not expect so many to take such note of the display created specifically to promote a healthier, more positive mindset and it is extremely satisfying to see these 'low achieving' students, who have never passed a maths exam, to openly admit that they feel 'confident', 'encouraged' and that they *can* do maths. What is more, students are not embarrassed to admit that they now like maths where they originally have always hated it. In her interview, the ESW notes that she has observed this change in behaviour during the month following the new displays:

"Yeah, definitely their mindsets have changed for the better. Only Sarah liked maths when they started in September, some of them have grown to like it since but I think since we put the displays up they have all really started to come around to the idea that maths isn't so bad and that they can do it with practice, hard work and lots of help from you! The mindset

display is really good at reminding them that they can on those days where their confidence is low. I also think that doing the displays has given them more confidence as they felt like they were good enough to be chosen to put work on the wall and it's always there, every lesson, as a reminder to them that you think they are capable in maths".

The second reoccurring theme, the creation of an inclusive maths classroom, exemplifies just how much students actually value the space within which they are learning; many students made reference to the classroom feeling like a 'proper' maths classroom and it feeling like 'their own' classroom. Having ownership over a learning space and feeling like that learning space is for a particular subject is vital in the growth of student mindset and success. When students are involved with classroom display designs they become much more enthusiastic about learning. From involvement, students find a real sense of belonging and often have a strong belief of ownership and responsibility within the classroom (Beadle, 2010; Cowley, 2009; Barrett et al., 2015). In their joint interview Aliya and Cameron exemplify how important the learning space is for them:

A: I have never liked maths but now I am like 50/50. I have learnt lots but I actually understand how to work things out and why so I am beginning to like it. We all feel like it's our maths classroom and it's our room but before it just felt like any other random college classroom. It is nice to be able to have some control over what it looks like and it feels good.

C: Yeah, I hated maths in September but I love it now. You're a really good teacher and that's most of the reason why I like maths now but I think the displays have added something extra to the classroom and it's a good place to learn in because it actually feels like a maths classroom and it's for us.

Thirdly, a large proportion of the students stated that, yes, the classroom displays have changed the way that they think about maths and this is evident through their positive responses that refer to the displays being supportive of learning: "the displays remind me of [what] I have to do in lessons", "the displays explain maths in a clear way", "the posters help me and encourage me to try", "it's good to always be able to get the help when I look at the clock [display] and it's not embarrassing". These type of responses remind us, as teachers, that students might seek help in other ways, perhaps less embarrassing ways, and effective classroom displays are a great way to provide students with an alternative approach.

The fourth and final identified theme suggests that the implementation of effective classroom displays has created a culture of pride and achievement based on students creating work that is, in their eyes, 'display-worthy'. It is very refreshing to learnt that, as a result of consulting students about what the classroom walls should display and allowing them to create and choose personal work to put on display, students feel that the maths classroom is

a safe and inclusive environment to learn in. Comments such as “my work is good enough to put up now which means I am doing well and learning” and “I feel a bit more confident because I never thought my work was good enough for the displays but it is!” really emphasise the impact that including students and displaying their achievements (no matter how small) can have, particularly on low-level students who have never really had opportunity to have their work celebrated within a maths classroom. In addition, comments such as “I’m more confident anyway now but the displays make the classroom a good place to learn”, “they [displays] are good because I feel like the classroom is our proper maths classroom and it’s our work” and “I liked it before but now it’s a great place to learn as our work and what we have learned is all around us” advocate the importance that students place on the environments in which they learn: they obviously value an environment which is ‘theirs’ thus allowing them to become submerged in the whole learning experience.

What is your opinion of maths?

	love it	like it	no opinion	don’t like it	hate it	total:
Pre intervention	0	4	7	11	6	28
Post intervention	7	18	3	0	0	28

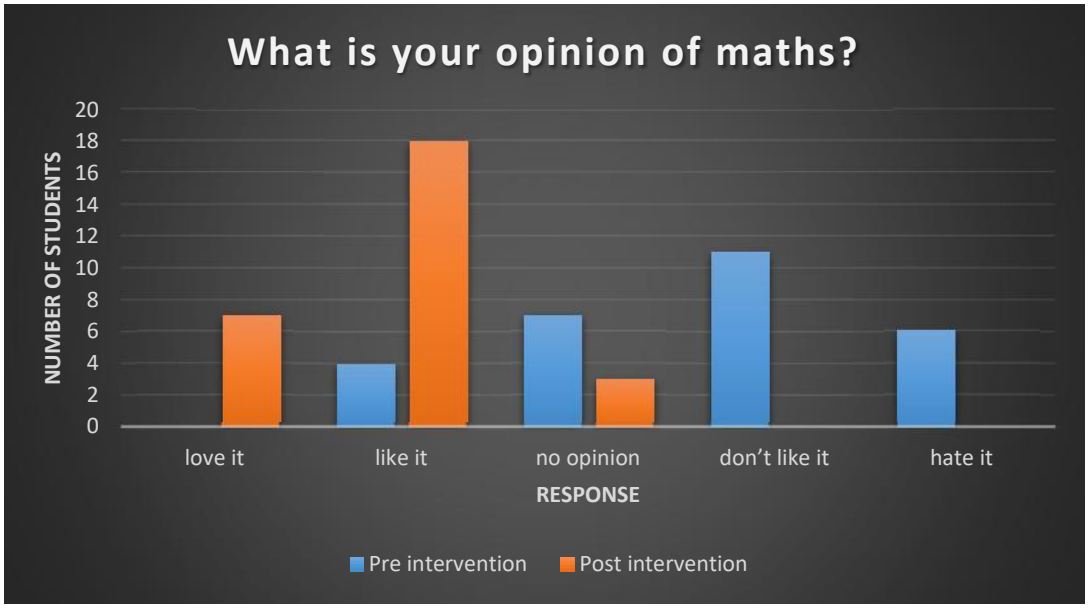


Table 7: highlights the change in student response to their opinion of maths, pre and post intervention

Before analysis begins on this particular question, it should be recognised that there could, quite possibly, exist external factors which affect the validity of whether the implemented displays have changed opinions or whether it was something else. Despite this, the question was still conveyed to students because one of the biggest barriers faced with teaching functional skills students is their palpable dislike for maths. I hoped to discover if student

opinions has altered at all, particularly after their input with the display designs and their interactions with the displays in class. As seen with previous analysis, the students seem to really value the displays and it does seem to have had an extremely positive effect on how they perceive themselves as mathematicians therefore, this could be used as evidence to suggest that the displays have had some influence on their changed opinions towards maths.

Concurrent with the general trend each year, only 14% of the students liked maths with 25% having no opinion and 61% reporting that they did not like it or hated it. Interestingly, post intervention, 89% of students had a positive opinion of maths compared to the 14% pre intervention. Of that 89%, 25% reported to now 'love' maths compared to 0% beforehand. Only 11% reported to still have no opinion and an impressive 0% did not like or hated maths. As stated previously, this data could have been positively influenced by other factors such as strong teacher relationships however, it does suggest that some of the positively influenced opinions have occurred from effective classroom displays created a rich, engaging and inclusive learning environment that students have ownership over and enjoy being surrounded by and this theory is support by the interview conducted with students.

Are the classroom displays distracting?

	yes	no	total:
Pre intervention	3	25	28
Post intervention	0	28	28

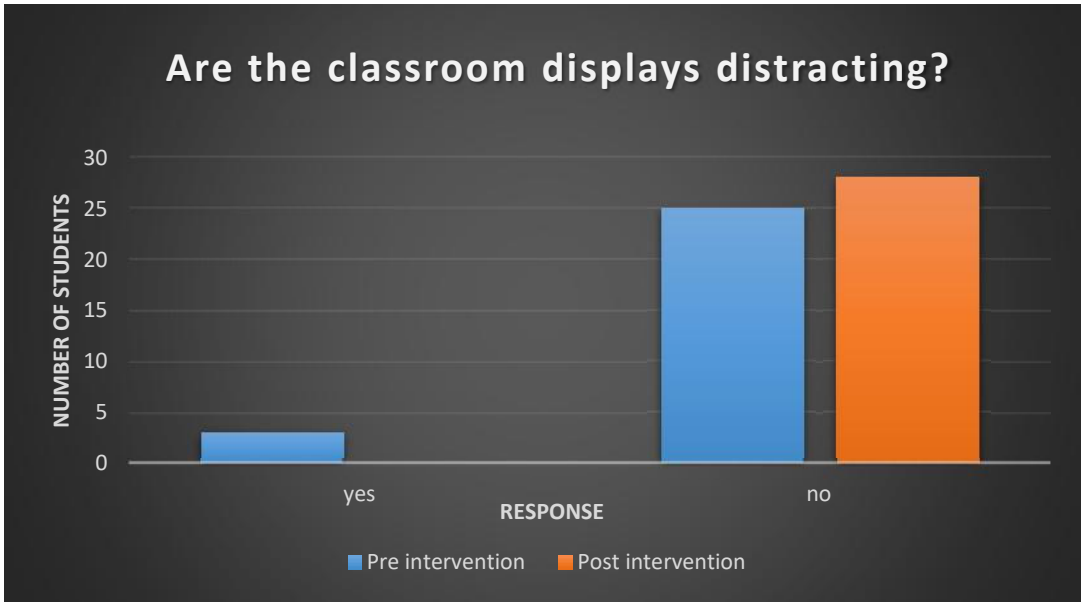


Table 8: highlights the change in student response concerning whether or not they find the classroom displays distracting

This particular question did not procure any ground-breaking discoveries however, it is useful to include in the findings as it serves to affirm the idea that the new classroom displays have not created any additional distractions and have not had a detrimental effect on students' learning experience. Interestingly, pre-intervention, when the classroom walls were relatively bare and irrelevant 3 students found the environment distracting. Moreover, post intervention, 100% of the students did not find the new displays a distraction which aligns with the idea that a carefully crafted classroom environment can be beneficial for students and not just simply act as a 'wallpaper'. Cautious steps were taken to ensure that the classroom walls were not cluttered and overstimulating (Almeda et al, 2014; Apps and MacDonald 2012) and consideration was given to the idea that secondary and tertiary classroom displays only tend to cover one wall and are much more subtle in colour compared to primary classrooms (Gaspelin et al. 2015).

Would you like to see your maths work on display in the classroom?

	yes	no	total:
Pre intervention	18	10	28

Do you like having your work on display?

Post intervention	23	5	28

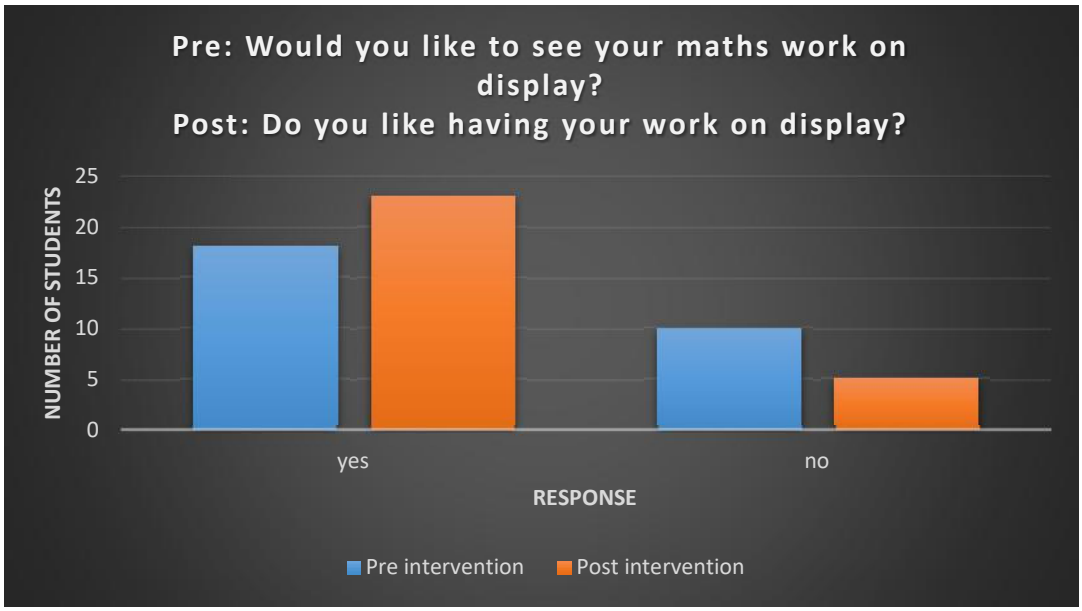


Table 9: highlights student response to having their work on display

Student response from these two questions affirm the positive impact that creating a student orientated classroom environment can have on self-esteem and confidence. Interestingly and quite unexpectedly, 64% of students indicated that they would like to see their maths work on display in the classroom. What is more, once said classroom displays had been created with the students an additional 18% indicated that they liked having their work on display, leaving only 18% of students who did not like having or did not want to see their work on display. This large increase advocates the use of effective student centred classroom displays in the hopes of increasing student self believe and confidence in their mathematics abilities. Classroom displays that celebrate student work and achievement (of varying levels, not just the 'best' work) can also nurture students' self-esteem and confidence thus creating a culture where *anyone* can achieve *anything* if they put the effort in (Dweck, 2012; Maxwell and Chmielewski, 2008; UCU, 2013; Barrett, 2015; Hanley et al., 2017). In conjunction with these findings both Aliya and Cameron had positive observations about their work being on display.

Aliya: *"I feel really positive and proud that my work is on the wall because I've finally learnt how to do it and work it out. I am happy".*

Cameron: *"I feel a bit nervous because I didn't want people to see it in case it was wrong but I know it's right now so I am actually happy about it being there for others to see".*

Both of these comments highlight the positive influence that displays student work can have, even in Cameron's case where he was nervous about it being on show. These two students clearly express how much of an impact displaying their work can have on their confidence. By the same token, the ESW comments on the students' confidence and motivation to learn:

"They seem more confident now in using the displays as a tool for helping them learn and they seem motivated to discover their maths problems for themselves. I think the displays have definitely given the class a bit of a more proud attitude because it's their work and they know the displays are for them. I think they feel more included and that it is their space for learning now, rather than just another generic dull college classroom".

CONCLUSION AND EVALUATION

Addressing the research questions:

I feel that based upon my current findings that a tentative conclusion can be drawn confirming that classroom displays can have a positive influence on student learning experiences in mathematics, particularly on growth mindsets and increased confidence and

motivation. More specifically, in terms of the three research questions an increase in student motivation and confidence because of the new displays is evident; the displays have contributed to changing some students' mindset regarding learning mathematics; and giving students a voice in the creation of classroom displays can promote positive learning experiences.

To recap, below are the three research questions that were used to guide and elicit answers from the intervention project:

1) How has student motivation and confidence in the mathematics classroom changed with the implementation of displays?
2) How has student mindset changed with the implementation of displays?
3) Does giving students a voice in the creation of classroom displays promote or contribute to positive learning experiences?

In terms of research question one, the influence of implementing classroom displays on student motivation and confidence can be measured through the results seen in table 1 where a 100% positive response to the quality of classroom displays is found. In addition, Cameron's comment of "*the classroom looks more beautiful and it's not a boring place to be anymore. It is more enjoyable to learn with the displays around us"* exemplifies that the students perception of their classroom environment can have a positive influence upon their own motivation and confidence. Additionally, table 4 highlights a positive shift in student feelings towards the learning of mathematics, as a result of implementing new classroom displays. There was an overall shift of 89% from negative to positive opinions of maths. An increase in motivational feelings were measured through the selection of 'ready to learn' (36% increase of this response) and through a selection of confidence (22% increase of this response).

It is much harder to conclusively argue that the new classroom displays have changed student mindset however, correlations can be formed to suggest that they have had a positive influence. Tables 5 and 6 both demonstrate that the displays have had an influence over positively altering students' mindset based on the anonymous feedback left on the questionnaires. This is measurable via the positive shit in response regarding the way that they think about maths; students were asked to only consider the influence that the classroom displays had on their mindset and try to ignore anything else that might have altered their mindset. Similarly, but also open to criticism of extraneous variables, table 7 highlights the change of negative to positive views of learning maths. Again this is

measureable via their change in response after the implementation of displays which shows a 75% increase in students liking or loving maths.

Research question three, concerning student voice in the creation of displays, is measurable through table 2: pre intervention 11% of students thought the displays aided their learning compared to 96% post intervention, indicating a massive 85% change towards positive opinions. These student led aspect of this intervention allowed for countless opportunities for students to use the displays as an additional learning resource, as commented upon by the students and ESW in interview. Moreover, table 3 measured student response to the influence that they thought the displays had on their learning with 100% now believing that the displays have a positive influence. An alternative way of measuring whether giving student voice promoted a positive learning experience was through questioning student opinion of having their work on display. 82% of students liked having their work on display which, in turn created an environment of confidence where students felt comfortable enough to speak out about the change: **"***I feel really positive and proud that my work is on the wall".*

Collaborating with colleagues:

Throughout this research project there was constant collaboration between myself and my two colleagues; we are a department of three, recently downsized from ten, and both of my colleagues were very supportive and eager to use my research to improve their own pedagogy and teaching strategies. Dwight (pseudonym) is an older teacher close to retirement who is quite set in his way and Phyllis (pseudonym) who is the team leader and middle aged. Colton et al. (2016) suggest that collaborative teaching allows teachers to move away from 'best practices' towards approaches that are culturally and linguistically responsive that meet the needs of individual students. Moreover, teacher self-awareness, which can stem from collaboration, is important for creating positive attitudes about teaching and learning (2016). Similarly, educational communities that promote collaboration in learning can improve student learning (Lassonde and Israel, 2010).

Collaboration took place from the initial research stage as both of my colleagues were consulted on whether they would like to use my research and have my assistance in creating similar classroom displays into their classrooms. I constantly reported my findings to Dwight and Phyllis and, once my displays were implemented, I collaborated with both of them to create similar displays within the classrooms which they taught. Their classroom displays have only been up for a very short amount of time but their initial thoughts and feelings towards the impact it is having on their students is very positive.

Implications for future research

Many positive outcomes have emerged from this research including implications for myself, colleagues, the college and potentially for a wider audience. For myself, there has been a massively positive impact on my pedagogy and how I perceive the learning environment: before undertaking this research project I was well aware of the dull, uninspiring learning environment but had never been given directive or time allowance to resolve the problem. However, through this research I have to come appreciate the impact that time, effort and communication with students can have on the space where they learn and, in fact, how they use this space to aid their learning. There has been positive implications for my colleagues too as they have both been fully engrossed in improving their classroom displays for a richer, more engaging learning environment; so much so that it has been decided that for next academic year I will take charge of ensuring that the Functional Skills maths department has high quality classroom displays that support and reflect the learning of the students. Further implications for the college have also emerged from this research project as the team leader of Functional Skills English has taken my research to the Curriculum Manager and Curriculum Director suggesting that this intervention is one that would benefit many more students and they would like to roll it out across English too. The research does suggest that wider implications for other FE colleges would be beneficial however, it should be noted that this research is very specific to my own cohort of students and generalising it to other students across other colleges in the country might not produce the same results and outcomes.

REFERENCES

Almeda, M., Scupelli, P., Baker, R., Weber, M. and Fisher, A. (2014). Clustering of design decisions in classroom visual displays. In: *Proceedings of the Fourth International Conference on learning analytics and knowledg*e, pp. 44-48.

Arnot, M. and Reay, D. (2004) 'The social dynamics of classroom teaching' in M. Arnot, D. McIntyre, D. Pedder and D. Reay (eds.) *Consultation in the Classroom: Developing dialogue about teaching and learning*. Cambridge: Pearson.

Barrett, P. (2017). Lessons from schools for productive office environments. In: D. Cements-Croome (ed.), *Creating the Productive Workplace: Places to Work Creatively*, 3rd ed. London: Routledge.

Barrett, P. and Barrett, L. (2010) The Potential of Positive Places: Senses, Brain and Spaces. *Intelligent Buildings International*, 2, pp. 218-228.

Barratt, P., Davies, f., Zhang, Y. and Barrett, L. (2015) The impact of classroom design on pupils' learning: Final results of a holistic, multi-level analysis. *Journal of Building and Environment*, 89, pp. 118-133.

Beadle, P. (2010) How To Teach. Carmarthen: Crown House.

Boaler, J. (2015) *Mathematical Mindsets: Unleashing Students' Potential Through Creative Math, Inspiring Messages and Innovative Teaching*. San Francisco, CA: Jossey-Bass.

Briggs, M. and Davis, S. (2015) *Creative Teaching: Mathematics in the Primary Classroom*, 2nd ed. London: Routledge.

Brophy, J. E. (2010) *Motivating Students to Learn*. Oxon: Routledge.

Carpenter, S. K., and Olson, K. M. (2012) Are pictures good for learning new vocabulary in a foreign language? Only if you think they are not. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 38, pp. 92–101.

CIB Task Group 42. (2004) Performance Criteria of Buildings for Health and Comfort, J. Sateri (ed), *Rotterdam, International Council for Research and Innovation in Building and Construction (CIB),* pp. 3–70.

Clarke, D. (2013) *Student Voice in Mathematics Classrooms around the world.* Rotterdam: Sense Publishers.
Claxton, G. (2009) 'Cultivating positive learning dispositions' in H. Daniels, H. Lauder, J. Porter, with S. Hartshorn (eds.) *Educational Theories, Cultures and Learning: a critical perspective*, London: RoutledgeFalmer.

Collingford, C. (1978) Wall Displays – children's reactions. *Education*, 6(2), pp. 3-13.

Cook Sather, A. (2007) What Would Happen If We Treated Students as Those With Opinions That Matter? The Benefits to Principals and Teachers of Supporting Youth Engagement. *NASSP Bulletin,* 91(4), pp. 343–362.

Crotty, M. (2013) *The Foundations of Social Research: Meaning and Perspective in the Research Process*. Prahran: Sage.

Cowley, S. (2009) How to Survive Your First Year in Teaching. 2nd ed. London: Continuum.

Dasgupta, L. (2015). *Exploring strategies that foster a growth mindset rather than a fixed mindset in previously high attaining secondary school Mathematics students* (Master's thesis). Oxford: University of Oxford.
Deci, E.L. (2012) *Intrinsic Motivation*. London: Plenum Press.

Dweck, C. (2006) *Mindset: The new psychology of success*. New York: Random House.

Dweck, C. (2008) *Mindsets and Math/Science Achievement*. New York: Carnegie Corporation of New York.

Dweck, C. (2012) *Mindset: How you can fulfil your potential*. London: Constable & Robinson Ltd.

Dweck, C. (2017) *Mindset: Changing the way you think to fulfil your potential*. New York: Robinson.

Eberhard, J.P. (2007) *Architecture and the Brain: A New Knowledge Base from Neuroscience*. Atlanta: Ostberg.

Feguson, D. L., Hanreddy, A. and Draxton, S. (2011) Giving Students Voice as a Strategy for Improving Teacher Practice. *London Review of Education,* 9(1), pp. 55-70.

Fisher, A. V., Godwin, K. E. and Seltman, H. (2014) Visual Environment, Attention Allocation, and Learning in Young Children: When Too Much of a Good Thing May Be Bad. *Psychological Science*, 25(7), pp. 1362-1370.

Foster, C. (2013) *The Essential Guide to Secondary Mathematics: Successful and enjoyable teaching and learning*. London: Routledge.

Functional Skills (updated 2017). *What are Functional Skills?* [online]. Available: http://www.functionalskills.com.

Gaspelin, N., Margett-Jordan, T., and Ruthruff, E. (2015). Susceptible to distraction: Children lack top-down control over spatial attention capture. *Psychonomic Bulletin & Review*, 22, pp. 461– 468.

Gilbert, M. C., Musu, L. E., Woolley, M. E., Karabenick, S. A., Strutchens, M. E. and Martin G. W. (2014) Student Peceptions of the classroom environment: Relations to motivation and achievement in mathematics. *Learning Environments Research*, 17(2), pp. 287-304.

Hanley, M., Khairat, M., Taylor, K., Wilson, R., Cole-Fletcher, R., & Riby, D. M. (2017). Classroom Displays—Attraction or Distraction? Evidence of Impact on Attention and Learning From Children With and Without Autism. *Developmental Psychology,* 53(7), pp. 1265-1275.

Hannell, G. (2004) *Promoting Positive Thinking: Building Children's Self-Esteem, Self-Confidence and Optimism*. Oxon: David Fulton.

Hattie, J. (2012) *Visible learning for teachers: maximizing impact on learning*. London: Routledge

Laux, K. (2018) A theoretical understanding of the literature on student voice in the science classroom. *Research in Science and Technological Education*, 36(1), pp. 111-129.

Lloyd-Rose, M. (2018) *The Character Conundrum: How to Develop Confidence, Independence and Resilience in the Classroom*. Oxon: Routledge.
Mason, J. and Johnston-Wilder. S (2004) *Fundamental Constructs in Mathematics Education*. London: RoutledgeFalmer.

Maxwell, L. E., and Chmielewski, E. J. (2008). Environmental personalization and elementary school children's self-esteem. *Journal of Environmental Psychology*, 28, pp. 143–153.

Middleton, M. and Perks, K. (2014) *Motivation to Learn: Transforming Classroom Culture to Support Student Achievement*. London: Sage Publications Ltd.

Nanda, P., Pati, D., Ghamari, H. and Bajema, R. (2013) Lessons from neuroscience: form follows function, emotions follow form. *Intelligent Buildings International*, 5, pp. 61-78.

Norman, M. and Hyland, T. (2003) The role of confidence in lifelong learning. *Educational Studies*, 29, pp. 261-272.

Ortiz-Ordonez, C. J., Stoller, F. and Remmele, B. (2015) Promoting Self-confidence, Motivation and Sustainable Learning Skills in Basic Education. *Social and Behavioural Sciences,* 171, pp. 982-986.

Oxford Dictionary of English (2007) 3rd Edition. Oxford University Press: Oxford.

Packard, N. and Race, P. (2000) 2000 Tips for Teachers. London: Kogan Page.

Perry, N. E., Phillips, L., and Hutchinson, L. (2006) Mentoring student teachers to support self-regulated learning. *The Elementary School Journal*, 106, pp. 237-254.

Pointon, P. (2000) Students' views of environment for learning from the primary to the secondary school, *International Journal of Educational Research*, 33, pp. 375-382.

Pointon, P. and Kershner, R. (2000) Making decisions about organising the primary classroom environment as a context for learning: the views of three experienced teachers and their pupils, *Teaching and Teacher Education*, 16(1), pp. 117-127.

Ramli, N. H., Ahmad, S. and Masri, M. H. (2013) Improving the Classroom Physical Environment: Classroom users' perception. *Social and Behavioural Sciences,* 101, pp. 221-229.
Ricci, M.C. (2013) *Mindsets in the Classroom: Building a Culture of Success and Student Achievement in Schools*. Austin, TX: Prufrock Press.

Rudduck, J. and McIntyre, D. (2007) *Improving Learning by Consulting Pupils*. London: Routledge.

Schraw, G., Crippen, K. J., & Hartley, K. (2006). Promoting self-regulation in science education: Metacognition as part of a broader perspective on learning. *Research in Science Education*, 3, pp. 111-139.

Scott, G. W. (2017) Active Engagement with Assessment and Feedback can Improve Group-Work Outcomes and Boost Student Confidence*. Higher Education Pedagogies,* 2, pp. 1-13.

Seibel, H. M. (2016) *Growth mindset and fluency in the art classroom.* Iowa: ProQuest Dissertations Publishing.

Tarr, P. (2004) Consider the walls. *Young Children*, 59(3), pp. 88-92.

Tas, Y. (2016) The Contribution of Perceived Classroom Learning Environment and Motivation to Student Engagement in Science. *European Journal of Psychology of Education*, 31(4), pp. 557-577.

Toftness, A. R., Carpenter, S. K., Geller, J., Lauber, S., Johnson, M. and Armstrong, P. I. (2018) Instructor Fluency Leads to Higher Confidence in Learning, but Not Better Learning. *Metacognition and Learning,* 13(1), pp. 1-14.

Tollefson, K. and Osborn, M. K. (2008) *Cultivating the Learner-Centered Classroom: From Theory to Practice*. California: Corwin Press.

Toshalis, E. and Nakkula, M. J. (2012) *Motivation, Engagement, and Student Voice*. Boston: Jobs for the Future.

Tosto, M.G., Asbury, K., Mazzocco, M.M., Petrill, S.A., Kovas, Y. (2016) Learning and Individual Differences: From classroom environment to mathematics achievement: The mediating role of self-perceived ability and subject interest. *Journal of Psychology and Education*, 50, pp. 260-269.

UCU (2013) *Classroom Management*. London: UCU.

Velayutham, S. (2012). *The Influence of Classroom Environment on Students' Motivation and Self-Regulation*. Ph.D. Peth: Curtin University.

Weimer, M. (2013) *Learner-Centered Teaching: Five Key Changes to Practice*. San Francisco: Jossey-Bass.

Yeager, D.S. and Dweck, C. (2012) Mindsets That Promote Resilience: When Students Believe That personal Characteristics Can Be Developed. *Educational Psychologist*, 47(4), pp. 302-314.

Zimmerman, B., Bandura, A. and Martinez-Pons (1992) Self-motivation for Academic Attainment: The Role of Self-Efficacy Beliefs and Personal Goal Setting, American Educational Research Journal, 29, 3, 663-676

Appendix 1: Pre intervention questionnaire

Student Questionnaire: Classroom Displays

UNIVERSITY OF OXFORD

How would you describe the quality of the maths displays in this classroom?
Please tick only one box.

- ☐ Excellent
- ☐ Good
- ☐ Poor
- ☐ Very Poor

Do the current classroom displays help you learn?

- ☐ Yes
- ☐ No
- ☐ Please explain why you have selected yes or no:

How do the current classroom displays make you feel?
Please tick only one box.

- ☐ Ready to learn
- ☐ Confident
- ☐ Encouraged
- ☐ No influence
- ☐ Uninspired
- ☐ Other:

Do the classroom displays have a positive or negative impact on your learning?

- ☐ Positive
- ☐ Negative

Are the current classroom displays distracting?

- ☐ Yes
- ☐ No

Would you like to see your maths work on display in the classroom?

- ☐ Yes
- ☐ No

How do you think displays could be used more in the classroom?:

What is your opinion of maths?
Please tick only one box.

- ☐ Love it
- ☐ Like it
- ☐ No opinion
- ☐ Don't like it
- ☐ Hate it

Appendix 2: Post intervention questionnaire

Student Questionnaire:
Classroom Displays

UNIVERSITY OF OXFORD

How would you describe the quality of the maths displays in this classroom?
Please tick only one box.

- ☐ Excellent
- ☐ Good
- ☐ Poor
- ☐ Very Poor

Do the current classroom displays help you learn?

- ☐ Yes
- ☐ No
- ☐ Please explain why you have selected yes or no:

How do the current classroom displays make you feel?
Please tick only one box.

- ☐ Ready to learn
- ☐ Confident
- ☐ Encouraged
- ☐ No influence
- ☐ Uninspired
- ☐ Other:

Do the classroom displays have a positive or negative impact on your learning?

- ☐ Positive
- ☐ Negative

Are the current classroom displays distracting?

- ☐ Yes
- ☐ No

Do you like having your work on display?

- ☐ Yes
- ☐ No

Have the new classroom displays changed the way that you think about maths?:

What is your opinion of maths now after 6 months of studying Functional Skills?
Please tick only one box.

- ☐ Love it
- ☐ Like it
- ☐ No opinion
- ☐ Don't like it
- ☐ Hate it

Appendix 3: Interview transcript – Students

Interview Questions: Classroom Displays

For students:

What do you think to the new classroom displays?

A: It's quite understandable and colourful and it definitely looks better than before
C: I think they're good because if I get stuck I will go up and use the displays to help me.

How do you feel about your work being on display?

A: I feel really positive and proud because I've finally learnt how to do it and work it out. I am happy.
C: I feel a bit nervous because I didn't want people to see it in case it was wrong but I know it's right now so I am happy about it.

Why do you think we have created the new displays?

A: so we can look around at the displays and we can check to see if we have worked something out right and if we don't know how to do something it's helpful as we can use the maths rules.
C: the classroom looks more beautiful and it's not a boring place to be. It is more enjoyable to learn with the displays around us.

Do you think having all the displays on the wall has had any impact on your own learning experience?

A: Yeah obviously because it's helpful with problem solving and it has changed my mind set
C: yeah, it's an extra thing to help us learn when you are busy helping someone else.

Do you feel more confident in class with the displays around you?

A: yeah because there's more opportunity to find answers
C: Yeah, I agree and it makes me feel better about my work being right as I didn't want it on the wall originally

Do you feel more motivated to learn?

A: I think so. They are not distracting at all and they are just so helpful. And, if I did some really good work I would like to see it put up on the wall
C: yeah, I agree. The displays don't distract me but they do make the room feel more like a classroom and a place where I want to learn.

Have the displays changed how you feel about maths?

A: I have never liked maths but now I am like 50/50. I have learnt lots but I actually understand how to work things out and why so I am beginning to like it. We all feel like it's our maths classroom and it's our room but before it just felt like any other random college classroom. It is nice to be able to have some control over what it looks like and it feels good.
C: yeah, I hated maths in September but I love it now. You're a really good teacher and that's most of the reason why I like maths now but I think the displays have added something extra to the classroom and it's a good place to learn in because it actually feels like a maths classroom and it's for us.

Appendix 4: Interview transcript – Staff

Interview Questions: Classroom Displays



For staff:

- Do you feel like the implementation of displays in the classroom has had any effect on the students (positive or negative)?

I honestly do think so. In the space of time that the displays have been up, the students seem to have felt the benefit of the new and more exciting and useful displays. No one has had a negative reaction to the displays and they all seem quite proud that their work is on the wall. It's also good because it gives them another way of finding out how to do something rather than asking you or just sit at their desk doing nothing because they can't do it. They like the added independence and the fact that you allow them to freely move around the classroom to use the displays if they want.

- Have you noticed any students using the classroom displays to aid their learning?

Yes, there wasn't a very useful display here before and the students didn't really even take any notice of it because I don't think they thought it was relevant to them. I have definitely noticed students looking at the new displays because they know they are there because they helped to create them! I saw Josh looking at the percentage part of the display yesterday because he was doing a problem solve which had a percentage in it and when he read it he sort of nodded his head because it helped him to remember what he was doing, he seemed quite pleased with himself. I have also noticed a few students looking at the mind-set display too and I think it gives them a bit of a confidence boost although, that poster just backs up what you are always saying in class to them and it's nice and colourful!

- Have you noticed any change in attitude towards maths since we have created the displays? – Ownership? – Motivation? Confidence?

Obviously, they are improving all the time anyway as you teach new things and I think their attitude is changing slowly and some of them even enjoy maths now, well that's what they tell me anyway! They seem more confident now in using the displays as a tool for helping them learn and they seem motivated to discover their maths problems for themselves. I think the displays have definitely given the class a bit of a more proud attitude because it's their work and they know the displays are for them. I think they feel more included and that it is their space for learning now, rather than just another generic dull college classroom.

- Do you think the mind-set of any students has changed?

Yeah, definitely. Only Aliya liked maths when they started in September, some of them have grown to like it since but I think since we put the displays up they have all really started to come around to the idea that maths isn't so bad and that they can do it with practice, hard work and lots of help from you! The mind-set display is really good at reminding them that they can on those days where their confidence is low. I also think that doing the displays has given them more confidence as they felt like they were good enough to be chosen to put work on the wall and it's always there, every lesson, as a reminder to them that you think they are capable in maths.