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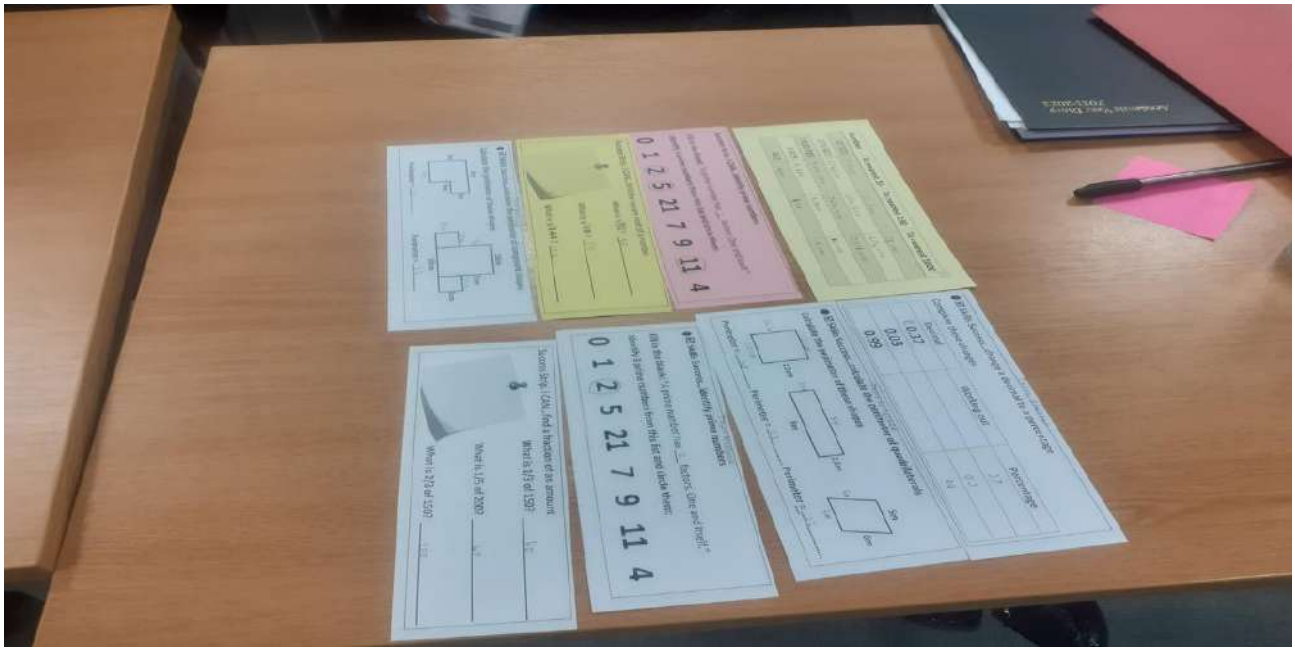

Developing tangible positive thinking tools and strategies to enable maths GCSE post-16 learners to develop confidence & resilience: Can positive action create impactful outcomes in mathematical progression at GCSE maths resit in an FE setting?

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About CfEM

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

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

Summary

Learners in the FE sector re-sitting a GCSE in maths are often faced with a subject they dislike because they have been unsuccessful in the past and this impacts negatively on their confidence and their ability to develop skills fully and progress. The amount of information that these learners are expected to digest in a short space of time (one academic year) normally requires two years in the compulsory sector and three years of preparation beforehand. This can be overwhelming and produce the opposite result to a pass grade or progress. Every textbook written for maths learners at this level has a lot of information, examples and practice questions contained on one page. Learners are over faced by this and 'switch off' believing that they will fail.

This research aims to break down the skills that learners need to develop into smaller manageable pieces and demonstrate to those learners that they can be successful in maths if they work on one skill at a time. This can then be built up into a set of skills, evidencing to the learner that they can be successful.

This research focusses on the lower attaining learners, those moving from entry level 3 to GCSE, or having no equivalent qualifications, grade 1 or 2 GCSE maths or those re-engaging with learning. These learners completed success skills strips which focussed on one skill only, without context, over time. These were then repeated in revision sessions and checked for completion. In addition to this, learners completed small focussed tasks concentrating on one skill to develop mastery in their approach to several subject areas over the year.

Learners participated in focus groups to report their feelings related to maths learning especially in terms of how their confidence was impacted in maths lessons which supported and informed the premise of the action research.

Contents

Background

Introduction

Blackburn College in the north of England services a local community which was described by Lancashire County Council in 2019 as in the most deprived 10% in England relating to the indicators for income, health and employment and have been within the highest 20% of deprivation against several of these indicators since the year 2000. Within Lancashire itself 105,200 people are considered to be employment deprived and a further 223,287 people are considered to be income deprived. The service provided by further and higher education colleges in these areas to counteract these levels of deprivation for the residents are essential. The part played by GCSE resits within colleges is highlighted by government policy linked to conditions of funding and demonstrated in GCSE maths by university entrance and employer requirements. The links to future employment and therefore life chances for this subject are clear.

The College policy for maths GCSE resit at Blackburn College is aspirational. Each learner above entry level 3 will study towards GCSE as part of study programmes. Some learners are working towards a grade 1, 2 or 3 rather than a grade 4 or 5. All are expected to make one grade progress over one academic year. The College has seen a year-on-year trend of improvement in maths attainment both for the 9 – 1 and for the 9 – 4 profiles but these have generally been in small increments of percentage improvement. The CfEM has provided the opportunity to research and present the results of interventions that will have a positive impact on learners' attainment. In maths GCSE resit generally, all start with failure as a past experience and many have this as a personal expectation.

There is not a one size fits all method that will improve GCSE re-sit results in post 16 maths classes in further education. Each group of learners and each College have differences and the appropriate pedagogy related to groups of adults, study programme learners, sixth formers and apprentices is also different. There is no prescription for success that can be handed out for everyone.

A change to support positivity in the classroom in a tangible form may be difficult to implement if it is wide and sweeping. Small changes are easier to effect in the classroom by the individual teacher. Dunne and Zandstra (2011) whilst examining the management of change for curriculum, document the process of curriculum change with a 'micro' approach. Most curriculum change implemented follows a 'macro' approach in the further education teaching landscape. Using a 'core' curriculum or the change in qualifications from adult numeracy or Key Skills to Functional Skills and the implementation of a numerical grading system for GCSE are all 'macro' change examples.

Using small tasks and small skills practice and demonstration slips to support learners to gain confidence can be described as the implementation of a 'micro' approach rather than a 'macro' approach to change and development with the aim of positive improvement.

Learners

Although nationally many interventions are aimed at those learners with a current grade 3 aiming to gain a grade 4, those learners with a lower grade may make expected progress but do need to be supported and encouraged to exceed their projected one grades progress if possible. Learners at Blackburn College are subject to the same elements that are reported nationally as being difficult to address in maths GCSE resit including attendance

which is a yearly focus. The learners which are the focus of research here are mixed in terms of ability and needs, some have completed entry level and are aiming for a grade 1, others a grade 2 and some have no prior qualifications but have been transferred from functional skills due to the higher nature of their skills in assessment (above entry 3). One learner has English as a foreign language with their first language being Spanish and another has Tai as their first language. One is a wheelchair user. Two require in class support from a support worker. One is visually impaired. One has ADHD. One is an adult learner with an IPRA. A further seven have an EHCP (Educational health care Plan) or an IPRA (Individual Pupil resourcing Agreement) in place. Seventeen of the learners in the scope of the study have been previously removed from their college course for behaviour or attendance related issues and are learning GCSE maths as part of a reintroduction to study. One is learning remotely due to pregnancy. Five have requested a smaller room to attend for exams due to anxiety. Three require coloured paper or overlays.

In each teaching group where the interventions have taken place, there is at least one learner with a grade 3 aiming for a grade 4 and these learners have been offered a higher streamed grouping but have refused and elected to stay with their current groups.

Researcher bias

It is important to acknowledge at the outset that bias exists in research work. The researcher works from sets of assumptions and values which are part of the biology of a human being and should not be ignored.

The first assumption here is that individuals are inherently negative about mathematical and numerical skills. This bias is an underpinning principle or assumption and is based on several different pieces of research conducted in the past, investigating this area.

Other assumptions which can be acknowledged at the outset include the need for mathematics as a life skill and its inherent usefulness and necessity for everyday life. Mathematical skills are important and act as a door opener for people to significantly improve their life chances. The main assumption that underpins this and any previous research is that no-one ever reaches their level. The human brain is a complex and fantastic thing that should not be underestimated, despite any barriers that nature may have included for us. Humans have the capacity to learn from cradle to grave, every day we know more than we did the day before.

The aim of research

This research aims to identify a way in which lower achieving learners can be supported to improve in a GCSE resit setting. These learners do not demonstrate a mastery in their skills set and unlike higher achieving learners they appear to have very low self-esteem or levels of self-efficacy and low levels of confidence in their maths abilities. There are no vast repositories of resources or textbooks that are specifically aimed at those learners who have not been successful with maths previously for further education and none available that indicate how learners aiming for a lower grade should be supported.

Over several years of a College policy that gives everyone the opportunity to study the benchmark qualification of GCSE it has become clear that no one size fits all approach has been entirely effective, especially for learners with the classic characteristics of the resit learner that we have come to accept as the norm. Disaffected, disengaged, de-motivated, lacking confidence, displaying no skills mastery and poor attenders are some of the descriptions applicable to this group. With a worldwide pandemic, this has not been improved, since resit learners now have ‘anxious’ to add to their list of characteristics. In

addition to this, learners consistently provide scores in assessment lower than expected and this can be attributed to CAG and TAG grades which may not have provided an entirely accurate picture of a learner's level at the start of the course and this may lengthen their journey to their achievable grade.

These learners must be equipped for the world of work, and for life beyond work that is effective and of a suitable quality to be fulfilling. That is our job, as further education practitioners. If we send our learners to job interviews without the pre-requisite qualifications (and they had the ability to gain these) it would be like sending them into calculator-based exams without a calculator, we have set them up to fail. Almost every employer will choose the candidate with a GCSE in maths over the candidate without one. The motivation for research here is to find ways to support learners to reach their potential. Avoid the negative associations that have been held as pre-conceptions about these learners for so long and look at the underlying elements that contribute to these, as well as how we can overcome them to ensure learners gain from the experience of being in their GCSE maths classroom in a positive way.

Very negative feelings towards mathematics have been explored by others researching in the field, keen to change the situation for future generations of learners in classrooms. Ransom (2012) examined the question of how schools can help to change a negative attitude to mathematics for learners in classrooms. He identified that the biggest barrier to learning in mathematics and numeracy is produced by the inherent attitude towards the subject of mathematics being an overwhelmingly negative one. Ransom calls this the 'attitude barrier'. Positive or negative attitudes are a prerequisite to change and action and Ransom describes the UK attitude to mathematics as: 'dismissive', which has contributed to many young people and adults accepting that it is okay to be bad at maths.

Widespread negativity towards mathematics was described by Ashby (2009) as appearing in many forms; he described misrepresentation in the media and the social stigma that seems to surround those who are mathematically gifted as two examples of this pervasive negativity surrounding mathematics. Ashby's focus was on determining the causes of negative attitudes towards mathematics as a subject. Ashby discovered that the application of mathematics was difficult for many children to discern clearly, if tasks lack any context and do not appear to have any practical application then learners start to lack motivation. A lack of self-belief was also observed in low achievers and a lack of understanding of mathematical language. All of these factors contributed to a negative attitude towards mathematical learning.

This research is based on the supposition that resit maths learners lack confidence, have a negative self-impression of their skills and need to develop a mastery in parts of their skills set to improve their confidence and subsequently their performance. How do we improve confidence and skills mastery?

Literature Review

Introduction

This section includes a review of literature within several areas that relate to the research conducted. A brief profile is included to outline where the subject area of GCSE maths fits into its surrounding further education landscape and some elements of research into perception and confidence are presented. This is developed to examine perceptions

underpinning the delivery of the curriculum and methods which impact on the delivery of a positive curriculum in relation to the development of transferable skills for confidence building and self-efficacy.

A profile of GCSE mathematics in the further education setting

Learners in further education who do not have a grade 4 GCSE in maths must continue to study this qualification in tandem with other aspects and subjects that make up their study programme with the aim of gaining a grade 4 GCSE. If learners do not have a GCSE grade they can study other maths qualifications. This is a condition of funding for study programmes required by the government to ensure that all learners are getting the best opportunities to gain the required qualifications.

In a written statement to parliament in 2014 the then Education secretary, the Rt Hon Matt Hancock set out the condition of funding amendments which placed GCSE maths at the forefront of study programmes in further education. GCSE became the standard with other qualifications being described as a stepping stone to the GCSE. Since that point in 2015 where the amended conditions of funding were implemented, Colleges have been working towards GCSE as the main qualification delivered in preference to any other at similar levels. This has brought its own issues, especially for learners coming into College with grade 1 or 2 rather than grade 3 as there is an expectation of slower progress for them and the likelihood of being in maths classes over a period of years. Now we have had a pandemic and the subsequent lockdown to contend with, the landscape of GCSE delivery in further education has undergone some more radical changes. Online learning has been essential as a form of delivery in education and is now a feature of almost all further education delivery for GCSE. For mathematics especially, there is the issue of maths anxiety for learners, where online methodologies may have a part to play.

On 14/12/21 the results of a MORI Poll commissioned by the Maths Anxiety Trust found that 36% of people aged 15 – 24 feel anxious about maths. The poll was actually conducted in 2018, prior to Covid and the expectation would be (as reported in the media) that the results would now be higher, currently maths anxiety is becoming an accepted normative term in further education.

Celia Hoyles has conducted numerous studies into maths anxiety and is credited as being the first person to coin this term. In 1982 she published *'The pupils view of mathematics learning'* and investigated the anxiety experienced by learners in classrooms. She stated:

'…the quality of learning experiences in mathematics often seems to be coloured by rather general expectations of success or failure in the subject and the bad experiences, in particular, may tend to be associated with feelings of anxiety, hopelessness or shame.'

Perception and confidence

Past research has shown us that Mathematics is seen as a subject even at lower levels which is associated with inherent difficulty, and requires intelligence at a higher level for an individual to be successful. According to Abrams (2013), Sam (2002) and Ashby (2009) mathematics is viewed as a subject where only 'clever' people can be successful.

If we do not perceive ourselves as successful with mathematics or numeracy then we have the perception that we are not intelligent or 'clever'. This negative self-perception can

severely impact an individual within the subject area and hinder any progress, contributing to low levels of self-confidence and self-efficacy.

The implications for maths teachers in the Further Education sector are clear. Teaching GCSE maths resits to learners who maintain a negative mindset, studying a subject they didn't choose and have previously experienced failure with, is an uphill struggle. The values, rhetoric and belief systems of these learners must be challenged clearly before any progress can be evidenced. Learners must be prompted in some fashion to question all the beliefs that they have previously nurtured about themselves in relation to mathematics and their abilities.
It is only when we question different values or belief systems that we find conflict between action and value or rhetoric and belief. We need to challenge the learner negative mindset and self-perception with a positive perception and effect change through concrete experiences.

Schwartz (1996 P. 119-144) expanded on motivational values and their possible conflict with action for individuals and groups:

'It is in the presence of conflict that values are likely to be activated, to enter awareness and to be used as guiding principles. In the absence of value conflict, values may draw no attention'.

Schwartz (1996) described a circular motivational value system where the pursuit of different values can occur at different or opposing points of the circle, creating conflicting values and actions. This conflict is what we are pursuing as it can form the catalyst to change.

When learners are in the classroom, evaluation of their work and the checking of feedback is often encouraged or planned into their curriculum for maths GCSE. Hirsh (2007) presented evaluation as essential for learning to be internalised, Lucas and Claxton (2011) were interested in learners 'habits of mind' and their development within lessons. Numerical or mathematical skills are made more difficult to learn due to the connectedness of the individual – emotional response impacts on 'learning' intelligence. Learned techniques for improving or expanding intelligence or habits of mind are often shown to be inert – they do not: 'come to mind spontaneously'. These skills need to be supported and nurtured to be able to develop more fully.

Intertwined within the process of evaluation and the development of 'habits of mind' is the question of whether we can actively develop positive evaluative strategies and positive habits of mind for learners, rather than a constant focus on what we need to improve or what we currently cannot do.

Perceptions underpinning delivery of the curriculum

Askew, et al (1997) in a study of over 90 teachers and more than 2000 learners revealed that the most effective teachers held a set of coherent beliefs which acted as an underpinning for their work in the classroom with learners. These included generic beliefs about teaching and learning and the importance of that, not just in everyday life but for the future prospects of their learners, and beliefs about the value of numeracy as a subject and how being numerate is represented. What we believe as teachers, our own perceptions, views and experiences influence what we do in the classroom with learners. What we teach, how we teach and our attitude and beliefs surrounding teaching and learning are all included in each lesson where we are present.

Teachers need to be more aware of the history, the paradigms and the underlying principles that are beneath their teaching practice (Maasz, 2005). A teacher that has a fund of knowledge to draw upon is likely to be more successful than a teacher who does not.

Trained within a prevailing pedagogy, what teachers teach, and how they teach it, depends in part, on the point in time that they enter the profession. Swartz (2004) described the transmission of prevailing pedagogy as cyclical, starting within programmes of teacher education where positive or negative ideas are perpetuated and supported.

Delivering the positive curriculum

In terms of curriculum models and the design of curriculum, McKimm's (2007) report examined vertical integration which is level based, integrating aspects of different levels of learning, applying lower level skills to higher level problem solving for instance, and horizontal integration which is integration between subject areas. Both of these apply to the delivery of mathematical skills and supports Hirsh's (2007) conclusion that a multi-dimensional model of learning strategy is likely to reach as many individuals and groups as possible as no one size fits all approach was suitable.

Hands on experiences in mathematics can aid the development of skills, by forming genuine experiential memory for learners. Locke (1632 – 1704) argued that 'experience' was the strongest form of knowledge and ultimately, learning through experience created the most enduring type of knowledge. Cole (2002 P.3) expounded the same principle, referring to Aristotle for support;
"Aristotle emphasised experience filtered through logic as the way to gain this abstract knowledge".

Swan and Swain (2007) provided a more up to date rationale for hands on teaching, resulting in experiential learning of significance in mathematics as the approaches were presented for mathematics teachers in particular by the Department for Education. Swan and Swain advocated a more experiential type of learning for both teachers and learners that did not detract from the essential knowledge base, ensuring that this was key at all times.

The Cockcroft report (1982) proposed an ideal for mathematics teaching in terms of the structure of sessions, and the different methods which should be employed to aid learning for learners. These did include the more traditionalist methods such as teacher exposition but also included practical work, problem solving and discussion.

Within the different methods described, there exists the opportunity to differentiate tasks to cater for different learning preferences, 'discussion' for instance aids the auditory learner, whilst 'practical work' will enhance the learning experience for the kinaesthetic learner in particular (if examining learning preferences using a VAK continuum). Ollerton (2003) disputes the idea that people can simply be classified in terms of their learning styles clearly, indicating that other factors affect the learning experience for the individual including context and stimuli, the only way to account for all of these elements is to use vastly different methods and resources in the classroom. Emphasis has often been placed on the 'three-part lesson', but the recommendations for the amount of methods would indicate a lesson in an infinite number of parts, rather than limited to three distinct elements of beginning, middle, and end.

Kirby and Sellers (2006) examined the practical application of learning styles in the numeracy classroom. The most usual application of learning styles is to assess individual learners, and note down the result (paying a type of 'lip service' to the process). Kirby and Sellers went on to develop CPD training in the practical application of learning styles

information, informing the pedagogical process in the classroom. The main aim being not just to pay 'lip service', but to allow learners to develop a 'metacognitive awareness' related to their own numerical skills, and through this to further develop the whole process of teaching and learning. It should be noted that although the subject of much study, learning styles is not considered to be scientific and has fallen out of favour with educationalists over time.

Rumelhart and Norman (1981) considered all learning to be defined by a set of schemas or schemata or blocks of knowledge. The process of learning includes 'assimilation' which has particular relevance to adult learners, who assimilate new learning to prior knowledge, regardless of whether their prior knowledge is accurate. Context is important to the process of assimilation for adult learners, a true contextual clue can hinge on to prior knowledge, building on foundations that are already present. The value of making mistakes should not be under-estimated. Learners' mistakes often lead to independent investigation, confusion and frustration, but in turn these can lead to the development of a re-constructed knowledge in a cyclical logical format developed through problem solving. Wadsworth (1996) saw intellectual and mathematical development as full of errors and making mistakes in mathematical and numerical learning as not only acceptable but desirable.

Barak Rosenshine (2012) examined research findings from successful teachers and cognitive science to develop a list of the ten most successful principles of instruction, a list that Rosenshine suggests all teachers should be aware of. Two of these principles were particularly pertinent to the research conducted here, principles two and seven. The second principle was to present any new material in small steps with practice after each step, the idea is to only present very small amounts of information or new material at any one time.

Principle seven was to gain a high success rate from task completion. It was presented as important for learners to achieve a high success rate in classroom instruction. The research went on to outline that this success was achieved through teaching in small steps. Mastery learning was described as lessons organised into short units so that each small piece of information could be observed, digested, practiced and the learner could achieve success before moving on.

Development of transferable skills for confidence and self-efficacy

Mathematical skills in particular have a strong influence on the development of 'other' more generalised learning and cognition. Numerical learning provides the tools for analytical thought and can develop the ability to conceive quantitative descriptions of the world (RAND Mathematics study panel, 2003). Through the development of mathematical and analytical skills we develop confidence, this grows the more we perceive ourselves succeeding. Since these skills are transferable, we then grow in confidence in other areas and set a rolling snowball in motion. This can be within or between subjects. Skills in maths are often repeated, cancelling down fractions and ratios for instance relies on the same skills set – when the connection is made the skill becomes transferable from one area of numeracy to another.

Assiter (1988) provided a definition of transferable skills which wasn't entirely fixed, described as including 'problem solving skills' and 'critical thinking skills', with 'numeracy' mentioned in a list of more definite skills sets. These transferable skills developed through academic work are desirable in terms of creating employability skills, or in making a link between the world of learning and the world of work, responding to the needs of employers. Transferable skills rely on other aspects of a person's makeup to be wholly effective.

The report of the Advisory Committee on Mathematics Education (ACME) in 2002, examined the CPD of mathematics and numeracy teachers. Several lengthy recommendations were made by ACME, including that CPD programmes aimed at teachers of the subject should take into account opportunities which would allow teachers to relate theory and practice to each other within the classroom environment, supported by Coben et al, (2003).

Lucas and Claxton (2011) present intelligence as a fluid and flexible construct, inter-connected to the person in every sense, representing interplays of every facet of an individual make up, not separate from it in any way. A learners intelligence in maths or numerical thinking is then fluid and flexible. This perceived intelligence can be grown or developed over time and is not the fixed construct that many learners present of 'I cannot do this' or 'I do not know this'.

Vorhaus (2006) examined teaching and learning in numeracy classrooms, through direct observations, finding that the quality of teaching was not always directly correlated with the standards of learning, in some instances, 'poor' teaching did not correlate with learners progress being poor and conversely noting within classroom observations that the opposite was also the case, where teaching was good this did not correlate with high gains for learners in every instance. Vorhaus concluded that the characteristics of the learners themselves may have a bigger part to play in their success than expected.

These recommendations were presented with the aim of promoting the involvement of learner characteristics within the classroom, and included: Improving teachers' confidence and skills in classroom management (balance of whole group, small group and individual work) supporting teachers to become more skilled and flexible with different teaching approaches and involving learners more in the learning experience (Vorhaus 2006). Learners in maths are the subject of a lot of interaction based on perceptions. Behaviour, attendance, retention and work ethic are essentially the elements that cause the most negative judgements. The learners 'won't do homework' for example, or 'they can't cope with group work or project work'. If we change the perception or change our reaction to the perception then we can change the outcome.

If we overcome the perception and keep the main aim in mind we are likely to be more successful and productive. All of our interactions are coloured by our perceptions, and we can, with some effort, change the colour of the filter.

Conclusion

The review conducted here has journeyed through a profile of GCSE mathematics in the further education setting and an examination of learner's self-perceptions and confidence. This was followed by an examination of perceptions underpinning delivery of the curriculum and models of positive curriculum that can help to support the development of skills mastery for confidence, self-efficacy and improvement. Transferable skills can be seen in a variety of ways or contexts but here they rely on a form of mastery to be effective. Once a learner has mastered a skill in isolation, they can then transfer it to another context or curriculum area within mathematics. Using a line of best fit to predict an unknown score in a scatter plot and reading data from a conversion graph for instance require the same skill. Once a learner is armed with several skills and can experience success with those, then they can widen this to include more skills over time. It is clear from the findings of Lucas and Claxton (2011) and Vorhous (2006) that the teacher is not the most important element in a classroom in terms of teaching and learning. Instead the learner is the central pivot point around which everything else must rotate.

Methods

Research style

The research conducted here is a form of action research which follows a cycle described by Coghlan and Brannick in 2010 constructing, planning and acting, then evaluating action before going back to the beginning of the cycle. In their book, 'Doing Action Research In Your Own Organization' they also advocated a 'pre-stage' of context and purpose, a very practical step designed to identify any collaboration required or support for research and to centre the research or ground it within its appropriate context, considering at this point the desirable outcomes. This has been described as practical because cost can be a consideration. We are often made aware through the media of spending budgets from central and local government that may impact on us as practitioners in the classroom but the implications of these budgets are not always clear. Throwing money at an issue will not always be successful and other ways of creating improvement are likely to be more welcome. Positive action does not equate to payment.

Action research is likely to be underpinned by identifiable biases and assumptions that make us question within our setting but the research itself and the questions we ask are not the testing of a specific hypothesis, more a questioning within a specific situation, in an attempt to lead to discernible action that produces change. Action research often represents a connection between research and practice (Coben, 2003) which for teachers provides a route towards 'inclusive practice enhancing processes' described by Robertson (2000). Every teacher wants to deliver the best lesson possible, the most effective, the most interesting, the most engaging lesson that they can. Action research is a vehicle to examine more clearly how that can happen.

The methodology employed for this action research is essentially qualitative with some limited quantitative style data included for comparisons and to examine trends in the data in a more traditional or numerical way. The qualitative methods are the mainstay and include a focus group, observations and evaluation, conforming to the action research cycle. Each method was used for a different reason and to provide a type of data or information to which the method was best suited.

A focus group gives us opinion and feeling, described by participants which has been analysed for themes and a simple accretion method of word frequency mapping. Observations in the classroom tell us what is happening through our implementation of a method, strategy, or tool although in this instance these are anecdotal in nature. Evaluation can then bring this together in an effort to consolidate our knowledge and plan for another cycle of research and implementation.

In addition to these methods, a small-scale learner survey was used to ask questions that provided small amounts of quantifiable data to allow comparisons over time for small aspects of the research, balancing the qualitative methods.

Establishing context

Learners are taken from the lowest achieving groups and a specific group being reintroduced to learning, identified by qualifications on entry to their course and all learners are re-sitting GCSE maths as part of a study programme or re-introduction to study programme in FE. More than 75% of the learners have prior grades below grade 3 generally, see figure 1 below which indicates profile information for the cohort of learners in the scope of the research.

Summary of Qualifications on Entry & Target Grades				
	Quals on Entry No of learners Entry 3 or below	**Quals on Entry No of learners GCSE grade 1**	**Quals on Entry No of learners GCSE grade 2**	**Quals on Entry No of learners GCSE grade 3**
Class Group A	1	3	4	8
Class group B	6	2	9	0
Class group C	3	6	11	2
Total number	10 (-1W/D)	11 (-2W/D)	24	10 (-1W/D)
Target Grade	Grade 1 GCSE	Grade 2 GCSE	Grade 3 GCSE	Grade 4 GCSE
Notes	55 learners 4W/D = total 51			

Fig 1: Qualifications on entry profile

Four learners were withdrawn during the course. One of these was aiming for grade 1, another for a grade 4 and two were aiming for grade 2.

Taking these withdrawals into account, the qualifications on entry show that 42 out of 51 learners in the study or 82.35% were aiming to make progress and gain a grade 3 or below in maths GCSE, only 9 learners or 17.64% of the cohort in the research were expected to gain a grade 4 in their GCSE examinations. The retention rate across the three groups is 92.7%.

Learners from class group ‘C’ were invited to attend a focus group which was conducted by someone representing CfEM rather than by their teachers or anyone associated with the College. This gave an air of authority and objectivity to the process which was beneficial. This process was truly useful in teaching and learning providing some real insight into the learners. The sample transcript of the focus group and the specific questions posed are available in the appendices (see Appendix 1)

During this focus group learners discussed their feelings about maths in general and their feelings related to confidence levels and failures or successes. They also provided opinions on one of the tools developed and used as part of the research process, the skills success slips.

Ethics

Learners were informed at the start of the research process in a verbal discussion that their class group would be part of the research, what the scope of the research was, that this would not negatively impact on them and that they could opt out at any time. All data and information would be anonymous and no photographs of either themselves or their work would be taken/used without their express consent. The same information was then presented later with a consent form for learners to sign, these have been safely stored and acted on by the researcher who is bound by the content and consents.

Scope of research

One teacher has researched individually with support from CfEM and 51 learners represent the sample. This is not a large sample; however, the research has some depth which would have been difficult to maintain with a larger sample. It's expected that after the first phases and on completion of the research it would however be easy to replicate most of the methods and use the tools developed with any number of learners at any appropriate level with minimal costs involved.

Methods

The research is based in a qualitative tradition starting with the supposition that if you want to know something about subjects as varied, diverse and difficult to explain as confidence, perception or skills in maths, then the methodology may need to be divergent and organic in its discipline to be able to respond to the things we learn as we research, enabling action from that research.

A focus group was conducted part way through the research process to investigate if initial assumptions on confidence and self-perceptions had been correct and to minimally evaluate tools developed. This was singularly valuable and informative as a way of communicating effectively with learners and gaining a rich insight into a group dynamic and individual opinions.

A printed survey was conducted at three points, beginning, middle and end in the research process. These surveys were used as a tool to gauge changes over time with the use of developed tools, they were also used to gain information on learner preferences and overall positive and negative stances. Most of the questions were repeated to enable checking for change over time.

Aims and objectives

The main aim of this research is to create a positive impact on the self-confidence and resilience of learners in maths GCSE resit classes in FE. This lack of confidence is a barrier that we need to overcome if we are to teach our learners anything that they can use in the future.

This involves providing the opportunity to master individual skills and then build these up to demonstrate success and create skills sets that can be re-constructed to address larger tasks.

The objectives to achieve this aim are broken down into:

- Establish how learners feel towards maths GCSE resit
- Establish their self-perceptions and confidence levels surrounding this subject
- Monitor any change in their confidence or perceptions
- Create and utilise tools that build up a body of evidence of skills/knowledge
- Create and utilise tools & strategies that boost confidence & resilience

Interventions, Results and Discussion

Interventions

The interventions that form the mainstay of this research revolved around tools and strategies designed to have a positive impact on confidence, develop resilience and build up a body of evidence of skills for learners. Focus groups and surveys were useful for collecting data but were not part of the actual interventions designed to have a positive impact. Learners in classrooms work through classes for GCSE maths that can look deceptively similar to the classes they have worked through in school previously. In FE resit classes we need to do something different to gain a different result.

The interventions completed are split into two sections, tools and strategies.

Tools

The first tool developed was a 'Skills Success strip'. This is a strip of paper that contains maths questions on one specific skill only and in only a very small amount. The strips are designed to fit 4 on an A4 piece of paper so need to be cut to provide a strip for each learner. The strips contain the word 'success' at the top, providing the assumption that the learner will be successful with the task. The tasks are very small, for example, choose 3 prime numbers from a list of numbers or identify all the factors of 36. Learners can complete these tasks as part of a lesson at any time, as an extension task or starter task and either as part of a themed lesson, revision or as part of an interleaved approach to delivery, reviewing previously learned skills, so they have inbuilt flexibility. These tasks are designed to take up very small amounts of time but build up to provide a body of skills that have been evidenced over time with the advantage that they can be accumulated by the learners very quickly. (See Appendix B2)

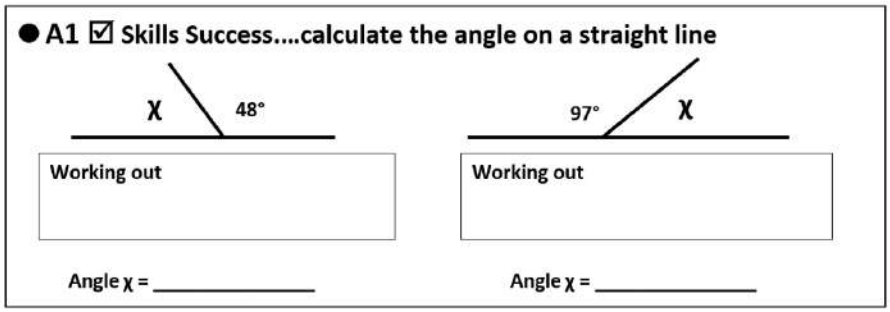


Fig 2 – First Skills Success strip

Skills success strips were used and developed over time so that some skills could be repeated with slightly different tasks and others could be scaffolded with some instructions at the top of the slip (also see appendix B3)

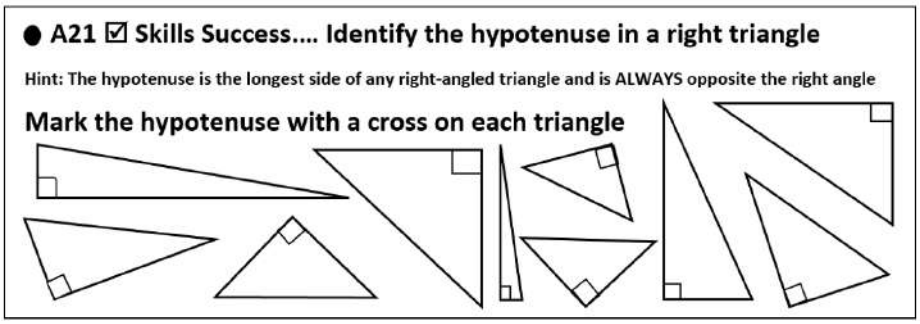


Fig 3 – Skills Success strip with a 'hint' to scaffold learners

Skills Success strips were also consolidated into a revision sheet (see appendix B4) to be used at intervals during the course or within revision style lessons. Each sheet contains eight questions based on eight individual skills. This provides evidence for the learner that they can be successful with multiple skills. Familiarity is important for this to raise confidence. The learners need to have completed individual success skills strips initially so that they are familiar with the presentation and the methods and have had the opportunity to complete the same type of work previously. This familiarity improves the chances of the tasks being completed correctly and reinforcing the idea that the learner is far from a failure in this subject.

The second tool developed for the classroom was the Emoji slip. This was not an entirely original invention so the researcher cannot and would not claim credit for this idea in its entirety. The emoji is a modern idiom that is universally understood by generation Z. the emoji slip contains emoji's that depict several different possible states from tears to blossoming hearts on a continuum. Learners rate their feelings about a subject at the start of a class by circling the appropriate emoji and then rate their feelings at the end of the class on the same slip by again circling the appropriate emoji. This is open to experimenter bias in that the learners know that the most favourable outcome is a positive shift in the emojis that they choose from the beginning to the end of the lesson and may want to please their teacher by presenting that outcome. They are not under any obligation to present a change however and in some cases do not complete the slips or only complete one emoji, demonstrating no change but the opportunity is there in a tangible form for them to consider how they feel and if their feelings have changed (and ultimately their level of confidence) within the class time.

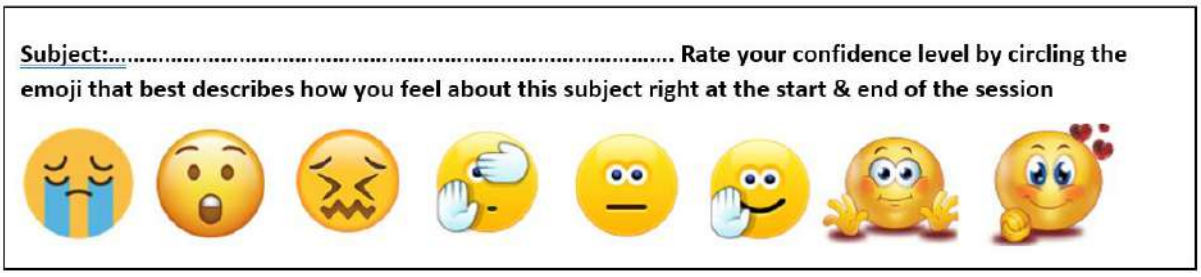


Fig 4 – Emoji progress slip

The Emoji strip helped to identify where learners felt they had been successful in terms of an improvement in how they felt about a subject in maths. As previously acknowledged, this could be open to the type of bias where the learner knows the desired outcome and so attempts to create the positive situation. However, this bias is not necessarily negative for the research. The learner knows the desired outcome and wants to produce that.

It would be important to question why the learner would want to create this positive situation if it were not true. Emoji slips were given out with the following instructions;

- It is OK to have a negative starting point or negative emoji at the start of the lesson.
- It is also OK to have a negative emoji at the end of the lesson, if that is how you feel.

It is OK to have the same emoji at the start and end of the lesson if you feel that you have not progressed in your confidence level.

It is important to note that the slips are mapping possible progress only in confidence levels and positive feelings, not progress in level or perceived ability. The learners are not commenting on their 'progress' in terms of assessment or in terms of their ability to understand or use the subject. Learners are examining progress in a different way with these slips to form a 'self-dialogue' which is more positive and productive in nature.

Another tool developed was the small task. Small tasks are based on the bigger tasks that may be part of a class generally. Match cards and jigsaws for example. It was clear that although learners do take to these tasks, they often find that the task is too big and give up very quickly if they reach an obstacle. Learners are easily distracted from a task that they find too lengthy. Small tasks reduce the length of time taken to complete a task and focus in on individual skills. A jigsaw where 10% is the focus and only has 15 pieces for example will be quickly completed and represents a 'doable' task.

Some difficulties were experienced when trying to create small tasks. Because there are less options to choose from in a jigsaw or match cards, the task can be circumvented if presented in the wrong way. Several tasks were tried out and failed because they could essentially be matched by a pattern on the cards and the way they had been cut out rather than by calculating the correct answers. Although this represents a form of problem solving, it was not the required outcome and did not promote the development of skills or confidence.

Match cards were the most appropriate form of small task along with categorising in listing tasks. Simply smaller versions of larger tasks were also effective and this had the added advantage of creating different question sets for differentiation in terms of skill levels and abilities. Smaller versions of jigsaws focussing on specific single skills and categorising by splitting into a maximum of three categories proved to be the most effective.

Strategies

The strategies developed over the course of the research do rely on some prior experience in FE teaching for maths resit and have been developed more clearly and with emphasis on how they can be clearly communicated to be used in classrooms easily. These strategies are not new and do not represent a magic wand for maths results but they are the strategies that have been selected through the research as those which appear to impact positively on confidence growth, resilience and skills development.

Knowing that our learners are often disadvantaged both socially and economically is not enough. Knowing that our learners have failed and have internalised that failure to become

an expectation is not enough. Knowing that learners often cover their lack of confidence in their maths skills with difficult behaviours or a negative 'bravado' is not enough, we have to act on that knowledge. We need to use strategies to enable our actions to have a positive impact.

Ten specific strategies have been identified and used in the classroom through this research.

Identify the overlap between classroom strategy and examination strategy (1)	Point out directly every time, where an assessment strategy can be implemented in a classwork task. For example, 'do all the 'easy' or one-mark questions first in an exam can translate to worksheets in the classroom, do all the easier questions first. Point out this link clearly and directly. Learners are then practicing this exam technique every time they do a practice worksheet, tell them that is what they are doing, it's not a secret, they want to pass the exam and they are being prepared for that, they *feel* more prepared if they *know* they are being prepared.
Identify transferable or repeated skills (2)	Identify transferable skills and share these with learners. Clearly point out overlaps where they occur. A line of best fit being used to estimate a value overlaps with reading a value from a conversion graph as the skill of reading across and down or vice versa is the same for both. Co-ordinates plotting, straight line graphs plotting and a vector for translation involve the X co-ordinate coming first or on top each time, the knowledge required is the same.
Give small amounts of work at a time (3)	Give small amounts of work at a time. There is a movement towards booklets for learning, having a learner booklet of work for the lesson appears to indicate planning and preparation but for the learner faced with a set of work that's an inch thick, there's no hope of completing this successfully in the next two hours. Give the work piece by piece and task by task indicating at the end of the lesson the massive volume of work that has been completed.
Modify language to use more positives than negatives (4)	Modify language to use more positives than negatives – avoid indicating what has been missed or is wrong and focus instead on what can be corrected or improved.
Avoid pointing out mistakes in favour of pointing out ways to find positive changes (5)	Avoid pointing out mistakes in favour of asking open ended questions like 'what has happened here, can you see how your answer is different, why is that, can you find where your method has changed from the example' for example; can you follow this example which we know has the right answer, and see where yours is different?
Give positive, rather than negative instructions (6)	Give positive, rather than negative instructions, tell learners what you want them to do – do not tell them what you want them to avoid. If you ask someone not to think of a pink elephant – guess wildly what their next thought is!
Work with lower achieving learners in the same way as higher achieving learners (7)	Higher achieving learners tend to have more confidence. For the lower ability or lower achieving learners we need to raise or create that confidence. Work with lower achieving learners in the same way as higher achieving learners, indications of this could include; • Give homework and expect completion • Give extra work, additional or extension tasks • Plan a varied and full lesson, expecting a high work rate

Provide 'booster' messages (8)	Postcards home with a 'booster' message are popular in some schools but may not be suitable for colleges, as the learners are older. An e-postcard could be used or the individual colleges messaging system. A text message, a letter, etc all of these can be used for boosting up the learners.
Use questions where learners can vote to provide safety (9)	Use questions where learners can vote. Give a thumbs up, use a mini whiteboard to show their answer safely or give their opinion – so they can get involved with the lesson without fear of failure. Gather positive feedback, with the emphasis on positive, some examples follow; • 'Here's a sticky note – write down one good thing about the lesson or one good thing about what you have learned today – give no option for any bad things about the lesson or learning today. • You have worked on averages today – quickly write down one thing you can calculate for averages (notice only elements that you can do are expected) • Here is a question on averages from an exam paper – can you identify one place where you could get a mark for this question • Which of these three things can you do? • Which of these three things are you most confident with?
Indicate to learners where their confidence is raised (10)	Use a method that will improve confidence for example, teaching learners where Pi comes from and then using this to explain the formula for the circumference of a circle. The diameter fits around the circumference approximately three times. If you know this you can work out a rough answer for the circumference of any circle, given the diameter simply by multiplying it by 3. When learners complete something like this point out to them that they are confident. Point out that they are able to complete this calculation roughly, quickly and easily and often without a calculator (by rounding). Indicate to learners where their confidence is raised.

Some of the strategies are based on removing barriers and providing 'safety' like strategy 9 where learners provide answers in a positive way and the teacher provides the opportunity for learners to assess their own progress through safe activities which are positive, focussing on what the learner can do instead of identifying openly what the learner cannot do. Other strategies are about the promotion of positivity, like strategy 6.

Results

There are two different sets of results to take into account for this research and they are not clear and dichotomous, there is an overlap between the results of the research methods employed and the results of the tools and strategies used or interventions. The results are linked because the two situations are linked. Results for each method are presented and the results for each tool or strategy are also presented. It is important to view the results as a whole of interlinked elements rather than isolated components.

The learners focus group, conducted midway through the research process was enlightening and did lead to modifications in delivery. The learners gave food for thought and we should be eager to eat the meal that they offer.

Focus group results

The focus group was transcribed (see Appendix A1 for a sample) in full and then analysed in two ways. Initially word frequency was examined with 'feel' being the highest frequency word with 67 mentions, followed by 'can' with 65 mentions and 'think' with 62 mentions.

The whole experience was evaluated immediately which included the picking out of the main themes that were immediately apparent to the facilitators. This was completed on the same day from notes over the session and provided an overall 'feel' for the information that learners had provided.

A word cloud was created which creates a visual representation of the frequency from the whole focus group. See Fig 5 below

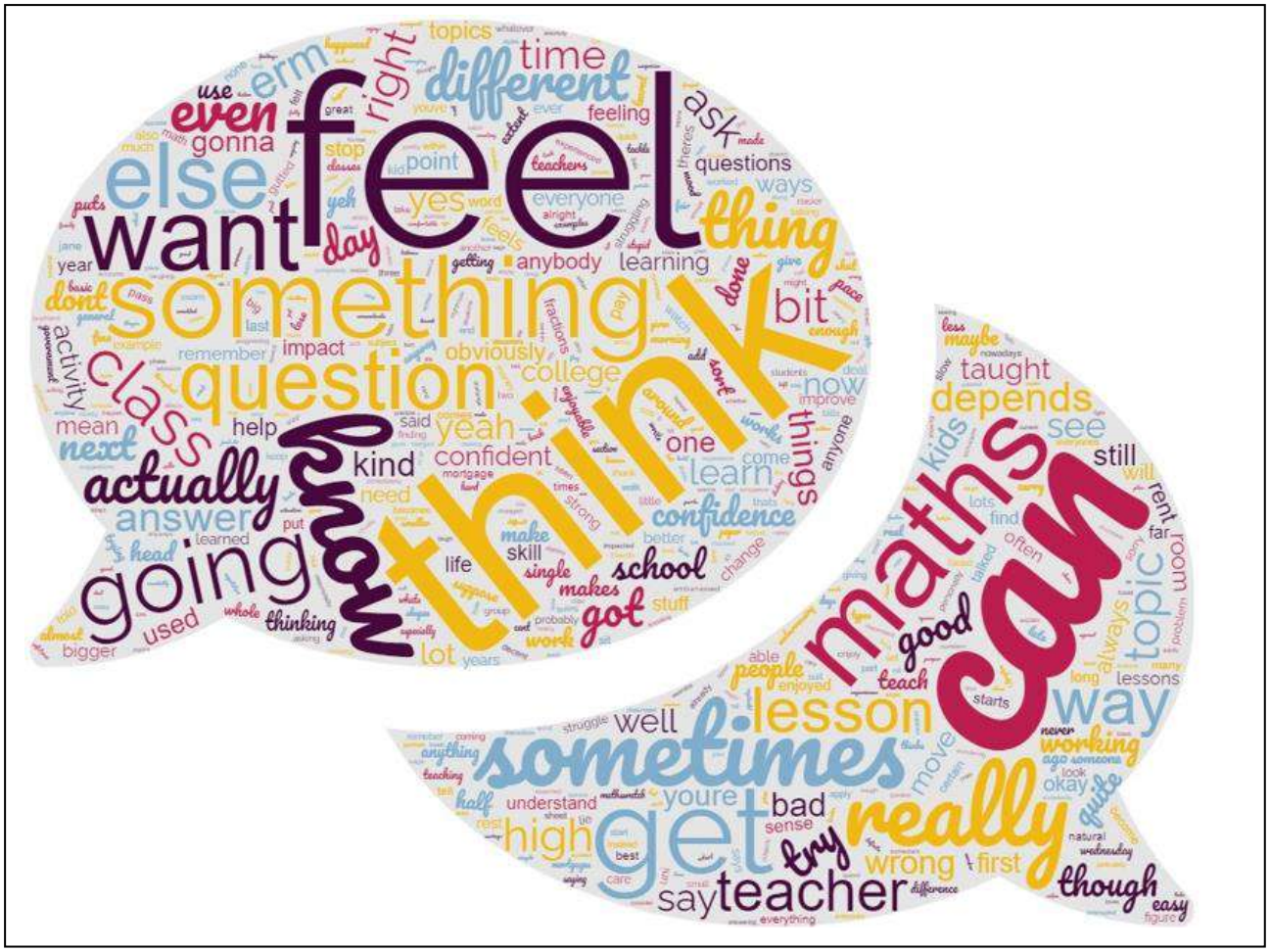


Fig 5 – word cloud frequency from focus group 1

Immediately after the focus group, notes were compiled on the main themes that had been the strongest coming through from the information as it had happened, a type of live evaluation of the discussion that had taken place. These were noted down by the focus group facilitator and the researcher when present.

"There are three big take homes I have from today's session. Learners want more 'useable' maths in college, things they feel they can use in real life; they generally felt better about maths in college compared to high school - in the sense that they are more willing to try, or

understand that they need to pass; and finally, they still feel strongly that confidence relies on topics and the scenario that day." Reflection on focus group 11/2/22

"The learners presented the idea that once they get one thing right, they can move on to other things but that the feeling didn't last and so they needed to get something right every time for this to continue, they needed a 'win' in each lesson." Reflection on focus group 11/2/22

"Unsurprisingly, learners mentioned that they had negative experiences in school and that these followed them through to maths class in college and if they were successful and got something right, this came as a surprise to them." Reflection on focus group 11/2/22

Results of the surveys

The survey produces quantitative results which are supportive of the research premises but are open to criticism and must be viewed in context.

	Survey questions	Term 1	Term 2	Term 3
		3 -5 stars	3 -5 stars	3 -5 stars
A1	You completed some single skills slips this year for maths - please rate them, t	N/A	N/A	
(Extra)	The more you liked them.	N/A	N/A	71%
A2	You also completed some 'emoji' slips this year in maths - please rate them, tl	N/A	N/A	
(Extra)	the more you liked them.	N/A	N/A	67%
Q1	How much do you like maths?	42%	52%	67%
Q5	what do you think of the activities (like cards or games you have used for most of y	88%	95%	90%
Q9	What do you think of your level of confidence in maths?	32%	39%	87%
Q10	do you complete homework for maths class or do extra maths when you are not ir	29%	26%	41%
Q11	how much have you enjoyed your class?	59%	69%	72%
Q12	how difficult is maths? The more stars you shade, the more difficult it is	72%	69%	67%
Q13	do you think you are making progress in maths?	38%	56%	82%
	NB Cohort size is variable between survey 1,2 and 3			

Fig 6 – Summarised survey results

Although this looks very positive the number of students completing the questions varied across the three surveys. This was due to attendance fluctuations across the year, a small number of withdrawals and the final survey had a very small cohort of learners who were attending for the final sessions of the year to revise for their exams. By their very nature these learners are likely to be more confident, assess themselves as having made more progress, completed more homework and essentially produced a strong positive bias in the data. These learners were not representative of the full cohort from the first survey as they were the most positive and motivated learners from each teaching group.
The percentage change between the first and second surveys is more representative and more realistic as this avoids the obvious skew of any favourable results in the third survey. This demonstrates a small increase in question 1 referring to 'liking' maths, a small increase in reported confidence for question 9, a ten percent increase in enjoying the maths class for question 11 and an eighteen percent increase in the perception of progress for question 13. The most interesting result here is for questions 12 where the perception of the difficulty of maths has not decreased significantly regardless of any bias's or skews in the data. The subject is not perceived by the learners as any 'easier' over time.

	Summary of learner progress from assessment			
	Improvement from first recorded assessment	**made above expected progress**	**made above or expected progress**	**stayed within the same grade boundary**
Class Group A	83%	8%	33%	50%
Class group B	64%	29%	53%	23%
Class group C	71%	10%	43%	24%
Total from cohort	72% (rounded)	16% (rounded)	44% (rounded)	30% (Rounded)
Notes	51 learners 1W/D = 50 total			

Fig 7 – Summary of learner assessment scores in research

If we examine the actual progress made from the learners taking part in the research, we can see that learners have made progress in assessment scores between their first recorded score and their final recorded score before examination with 72% overall, and a small percentage of the cohort (16%) have made more than their expected progress. Above or expected progress is 44% overall. These figures are difficult reading after a year of work, however those learners who have stayed within the grade boundary have the potential to have progressed within that boundary and the figures do support that proposition. We also cannot mitigate for external factors, (for instance the effects of Covid 19) on the learners' qualifications on entry (CAG or centre assessed grades & TAG or teacher assessed grades) which are often discussed but not easily pinned down. If we compare the data from surveys to the data from assessment we can see that it is likely those learners who perceived that they gained confidence and perceived that they were making progress essentially did so as their assessment results followed a general and approximate upward trend as did the survey results. A positive correlation would be observed despite any bias, skew or non-mitigated factors.

Results of the tools used in the classroom

The skills success slips proved to be most useful as a starter activity and as a very quick review activity in the classroom. These resources did promote more independent learning as they often did not require significant amounts of explanation and when learners had completed a few of these they were familiar with the process and they could be handed out to complete. The learners self-identified in the focus group that these were 'starters' and viewed them as small tasks to start the lesson. This is how they were used but it had never been referred to in those terms initially.
Most of the slips were easy to use and the actions required were easy to comprehend. Whilst in use, one or two slips had small errors or presented information in a way that wasn't as clear as expected when interpreted by learners. In any replication it would be essential to check how clear any slip or small task was before using in the classroom.
Overall, they created a record of completed tasks or skills that could be referred to when trying to boost learner's confidence. From the focus group at the midpoint of research:

"Learners identified the skills success slips as a starter type activity and evaluated them as an opportunity to work on something small for a while before trying something bigger, they were described as stopping a 'jumbling up feeling'." Reflection on focus group 11/2/22

"…they liked the repetitive small skills activities and recognised the benefit and how they can make them feel, even if they can sometimes find the repetition boring when they've mastered a skill." Reflection on focus group 11/2/22

Emoji slips were popular, easy to use and provided a clear checking method in the plenary for learners to check in with themselves in relation to their progress through the lesson. They also had the capacity to add to the skills success slips to build up a sheaf of paper indicating that learners were successful and made progress in maths.

Emoji slips were not provided for every subject in every lesson (to reduce any adverse effects of repetition) and randomly presented to the different teaching groups, A, B or C.

Subject area	Number completed	No change recorded	Improvement recorded 1 step	Improvement of more than 1 step recorded
Circles	8	2	1	5
Straight line graphs	7	6	0	1
Factorise and expand	3	1	1	1
Negative numbers	18	3	7	8
Assessment work	17	4	2	11
Congruence and similarity	8	2	2	4
Co-ordinates	15	8	1	6
Spurious – 'maths' 'fractions' blank or 'life'	6	4	2	0
Totals	82	30	16	36

Fig 8 – Results of Emoji slips

52 of 82 completed showed an improvement, demonstrating that the majority of learners (63%) felt more confident at the end of a lesson than they had at the beginning.

30 out of 82 recorded no change in their feelings towards a subject between the beginning and the end of the lesson. This demonstrates that learners did not feel under pressure to produce indications of a change if they felt that none was present since they were able to indicate no change.

The subject where the most recorded response was no change was co-ordinates – a subject where learners already felt confident at the start of the lesson.

The highest recorded positive change was in an assessment session where learners were tasked with working through assessment questions with support and exam tips and strategies. This occurred at the end of the course where the emoji slip had become more familiar and the learners had possibly gained in confidence.

Circles as a subject had a record of 6 of 8 (75%) positive improvement recorded in total, a subject where learners were given an overt confidence building task.

Results of the strategies

The strategies in the classroom were easy to implement in isolation, using one strategy in a class for example, but more difficult to use if paired with other strategies and did require a prompt. Ideally these would be openly included in planning to make it a definite way of working with learners that isn't missed due to time or curriculum constraints. Over time a combination of the strategies can become the normal way of working for the teacher, especially as many teachers reviewing this list of strategies will identify several that they already employ in a classroom effectively. Others may select a strategy that they then plan into lessons and evaluate its effectiveness with their own learners.
Each strategy had its merits which included creating a safe and comfortable space for learners to be wrong. In addition, a safe way to provide answers to questions that didn't leave learners open to peer pressure or negative feelings. The strategies included ways to make confidence an accepted part of the classroom by pointing out clearly where we are now more confident than we were before.
Some of the strategies directly supported the tools development in the research process. Giving small amounts of work for instance in strategy three supports the idea of skills success slips and smaller tasks as activities in the classroom. In this way tools and strategies are interlinked rather than separate. The tools are the things we use and the strategies are the way that we use them in the classroom.

Discussion

The way that maths is taught in a classroom, discovered, learned, enjoyed or hated in a classroom is directly related to how the subject and the class is perceived by the learners and the teacher in it.

The perceptions of the teacher will be clear over time to the learners. Psychological clues are always available to point them in the direction of the teacher's perception. Any learner in a classroom could tell you, if asked, who always does their homework, who gets the best marks, which table is for lower ability learners, who needs learning support in the group, who is the teachers biggest challenge and which learner is clever but lazy. They can also tell you if the teacher always plans the lesson for them, if the teacher is interested in them as learners or individuals or not and how interested the teacher is in the subject they are teaching. Either the learners have psychic powers or they are getting subtle cues from the teacher and from the rest of the group which are reinforced by their own experiences in the room. We cannot approach the learners as passive in either the teaching and learning or research process or will be ignoring this type of information.

Learning elements in an area which requires abstract thought from the outset is more difficult than learning in an area resting on elements which are more concrete. Learning what numbers 'are' is a complex process and mathematics is often seen as difficult and associated with occupations that require lengthy study and cognitive development, for example doctors, chemists, engineers and anything related to scientific occupations requires a higher level of mathematics qualification or knowledge base.

Thinking skills and abstract concepts are not easy to explain, teach or learn even at a foundational level. Illustrating an abstract concept can require substantial command of language and metaphor to be entirely clear. Unfortunately, this also requires a level of comprehension from the learner. Learners are often not encouraged to understand why accepted algorithms work, only how, technically to use them. When only the 'how' of mathematics has been learnt without the 'why', only technical proficiency can be achieved, rather than the thorough and clear comprehension required to use mathematics effectively. A model for conceptual teaching was provided by DeCecco and Crawford (1974)

demonstrating that the more complex the concept, the more attributes it will have, and the more difficult it will be to communicate that concept. Learners find maths a difficult subject and assume that they cannot 'do it' because they have completed school and entered FE without a grade 4.

Learners themselves reinforce a negative self-perception in maths which is directly related to their cognition and emotional responses, Swain et al, (2005). To be able to influence this negative perception we need to make learners active participants and address their fear of failure which is at the heart of a fear of maths (Wadsworth, 1996) and evidence their success to them to be able to breed more success for them. Although learners may see themselves as being failures in mathematics, this perception is often unfounded. In reality, learners may be proficient in terms of their abilities in maths. Coben (2000) described a situation where people did not see themselves as having any ability in maths but were in fact working numerically every day. Jones (2005) identified that if we address the learner as an individual rather than chasing the 'correct' answer then we can positively affect learning outcomes.

Conclusions and Recommendations

Conclusions

During the focus group, learners did clearly identify negative self-perceptions of their own abilities in maths, negative past experiences and a lack of confidence and self esteem that stops them from trying tasks that appear difficult or lengthy. They also identified a 'jumbled up' feeling that comes from attempting questions in maths, it could be suspected from multi-step and cross curricular themed areas.

Learners still have to attempt these questions in an exam and require preparation. Improving confidence and resilience in maths provides the opportunity to move past the 'I can't do it' mind set whilst breaking down tasks and skills into small component parts can also remove the feeling of being overwhelmed and confused or 'jumbled up' as learners themselves described it.

The premise of this research appears to be correct, a lack of confidence is a barrier that promotes negativity and halts progress and achievement. Measures to increase confidence can counteract this and promote a more positive (and arguably more realistic) self-perception for the learner, promoting higher gains in achievement and progress.

The tools and strategies developed and utilised within this research have generally increased confidence levels over an academic year.

Recommendations

Several definite recommendations can be made from results of the research interventions completed.

Skills Success slips

Success promotes confidence. Success breeds success. If learners are provided with small successes or small ‘wins’ each lesson this can improve confidence. Larger and more involved tasks are likely to be draining in terms of confidence and self-efficacy and have a negative effect. Breaking down maths into its component parts, working on those parts and then putting them together to work on larger tasks has proved effective.

- Break down larger tasks into component parts (like the individual skills presented on a skills success slip)
- Work on the component parts individually giving the opportunity for success
- Build the larger task back up to completion and refer back to the individual skills to demonstrate successful outcomes for the learner

Emoji slips

The opportunity to evaluate and consider whether learners have changed self-perceptions of ability or knowledge through a lesson provided by emoji slips to rate feelings at the beginning and end provides a vehicle for more tangible progress. Learners make very slow progress through assessment scores generally in a linear qualification, spending most of the year within the same grade boundaries before being able to demonstrate stronger skills towards the end of the course. Being able to identify that they feel they are making progress without assessment or grades being the foundation of that decision is helpful.

- Ask learners how they feel about a subject (possibly using a tool like an Emoji slip)
- Ask them to rate their confidence or feelings on a scale allowing them to confront their negativity if it is present
- Check if progress has been made without referring to assessments or grades

Strategies

Linking teaching to assessment strategies and to assessment criteria so that learners feel more prepared and informed about the process of their qualification also improves confidence.

- Select strategies aimed at raising confidence or resilience
- Plan selected strategies into lessons for specific groups
- Use and evaluate the strategies

“Yeah, surprises me, I can actually do maths”

(learner in focus group 2022)

References

Askew M , Brown M , Rhodes V , Wiliam D and Johnson D (1997) *The contribution of professional development to effectiveness in the teaching of numeracy*, Teacher Development: An international journal of teachers' professional development, 1:3, 335-356

Abrams Y. (2013) *Measure Intelligence by Math Capabilities.* Available from: http://www.hamodiya.com/2013/02/08/learners-measure-intelligence-by-math-capabilities/ [Accessed 12/7/15]

ACME (Advisory Committee on mathematics education) **(2002)** cited in: **Coben et al (2003)** *'Adult numeracy; review of research and related literacture'*. National research and development centre for adult literacy and numeracy.

Ashby B. (2009) in Joubert, M. (Ed.) *Exploring Children's Attitudes towards Mathematics.* Proceedings of the British Society for Research into Learning Mathematics 29(1) March 2009

Assiter A. (Eds) (1988) *Transferable skills in higher education*. London: Kogan Page Ltd.

Coben D. (2003) 'Adult numeracy; review of research and related literacture'. National research and development centre for adult literacy and numeracy. [online] available at;www.nrdc.org.uk last accessed; 20/03/12. p 72

Coghlan D and Brannick T (2010) *Doing Action Research In Your Own Organization.* Sage publications Ltd. London.

Cole P (2002) 'The theory of knowledge' London: Hodder and Staughton. p3

The Cockcroft report (1982) **Cockcroft (1982)** Contained in **Orton and Frobisher,(1996)** *Insights into teaching mathematics.* London: Continuum.

De Cecco,J.P.& Crawford. W. R (1974) *The Psychology of Learning and Instruction: Educational Psychology* Prentice-Hall.

Dunne, E., & Zandstra, R. (2011). *Students as Change Agents*. New Ways of Engaging with Learning and Teaching in Higher Education. Bristol: Escalate.

Hancock. M. (2014) *Minister of State for Skills and Enterprise Matthew Hancock's written ministerial statement on improving post-16 numeracy and literacy.* Department for Education, Department for Business, Innovation & Skills, and The Rt Hon Matt Hancock MP. Published 2 July 2014

Hoyles. C. (1982) *The Pupil's View of Mathematics Learning* Author(s): Source: Educational Studies in Mathematics, Vol. 13, No. 4 (Nov., 1982), pp. 349-372 Published by: Springer Stable URL: http://www.jstor.org/stable/3482321

Hirsh W. (2007) *Developing and Delivering a Learning Strategy*. Corporate Research Forum, (CRF) May 2007. London, available online: www.crforum.co.uk [Accessed 26/6/15]

Jones. C. A. (2005) *Assessment for learning*.Published by the Learning and Skills Development Agency. Available at: www.LSDA.org.uk last accessed 3/10/2019

Kirby J. and Sellers T. (2006) *Using learning styles in adult numeracy; an exploration of their value and potential in teacher training.* National research and development centre for adult literacy and numeracy. p32

Lucas B and Claxton G (2011) *New kinds of smart – how the science of learnable intelligence is changing education*. Open University press, Mcgraw Hill Education, Berkshire, UK.

Locke 1632 – 1704 Cited in Cole (2002) op cit. p 10

Lancashire County Council (2019) *The English Indices of Deprivation, 2019 – key findings for the Lancashire-12 and Lancashire-14 areas. Available at www.lancashire.gov.uk. Last accessed 2/5/2022*

Maasz J. (2005). 'A new view of mathematics will help mathematics teachers'. *Adults Learning Mathematics, an International Journal*. London: Fitzsimons(eds) Vol 1 (1) pP. 6 - 18. ALM.

'maths anxiety trust' available at http://mathsanxietytrust.com/ last accessed 14/12/21

McKimm J. (2007) Curriculum design and development. Imperial College Centre for Educational Development. London.P4

McNiff. J. and Whitehead. J (2005) *Action research for teachers, a practical guide*. Oxon: David Foulton publishers.

Ollerton M. (2003) *Getting the buggers to add uP.* London:Continuum. p8

RAND mathematics study panel (2003) p 2 [online] available at: http://www.rand.org/multi/achievementforall/math (last accessed 23/02/07)

Randsom. P. (2012) How can schools help change negative attitudes to maths? Published: 22 November 2012 SecEd [Online] last accessed 15/3/2022

Robertson. J. (2000) *The three Rs of action research methodology: reciprocity, reflexivity and reflection-on-reality* Published 1 June 2000. Educational Action research. Vol 8

Rosenshine. B. (2012) 'Principles of Instruction, research based strategies that all teachers should know. American Educator. Spring 2012. Pg 12-19

Rummelhart D. and Norman D. (1981) *Analogical processes in learning*. Found in: **Anderson JR. (ed.)** *Cognitive Skills and their Acquisition*. Hillsdale New Jersey: Erlbaum.

Sam LC. (2002) Public images of mathematics. Philosophy of mathematics education journal number 15 (2002) Available at: http://people.exeter.ac.uk/PErnest/pome15/public_images.htm [Accessed 29/4/15]

Schwartz S. (1996) *Value priorities and behaviour: Applying a theory of integrated value systems.* Psychology of Values, Ontario Symposium. Volume 8. P 119-144. Lawrence Earlbaum. Jerusalem.

Swartz E. (2004), 'Casing the self: a study of pedagogy and critical thinking'.*Teacher development.* Volume 8. No 1. P45 - 66.

Swan M and Swain J (2007) Thinking through mathematics research report. National research and development centre for literacy and numeracy (NRDC). London.

Vorhaus J. (2006) *Four years on - findings and messages for policy and practice*. NRDC. London. [online] available at; www.nrdc.org.uk last accessed 23/03/10 p38

Wadsworth J. (1996) *Piaget's theory of cognitive and affective development; foundations of constructivism, fifth edition*. Longman. New York. USA. p164

Appendix/Appendices

Appendix A1
Focus group 11/2/22
Learners in maths GCSE resit class at Blackburn College

All learners are 'moving on' – have gained grade 1 or 2 GCSE maths previously, have no maths qualifications or have gained an entry level 3 functional skills qualification in maths.

Transcript sample of focus group one:

- …So, first question, tell me a little bit about when you enjoyed doing maths.
- when you sleep? OK have you taken part in maths though when you sleep?!
- in maths in general, in college, anytime
- probably most when you are with your mates
- so you feel more comfortable when you're with your friends?
- probably, yeh
- yes because when I'm sat with you we crack on, you know what I mean
- why would that be different than if you were with your friends
- just head down, more comfortable with your friends than you are with just... people
- and that makes you want to do maths more?
- Some people are not as comfortable with asking the teacher either about questions, obviously your friends are on the same kind of wavelength as you. So where as a teacher, Realistically, a teacher would kind of in the head they would be like: Oh my god. How could you not do this question? but they still have to help you anyway and so they still have that in their heads so they'll just turn to their friends.
- I think erm activity as well where you have to do maths questions together. I think it's easiest to do it. Because that way, erm you're going to do more things erm, or within the class that you would on your own when you try to figure out yourself,
- so that makes it more enjoyable?
- Yeah. doing it
- Can you think of an example of an activity that you've done where it's been enjoyable?
- erm, I'd say like, when like they've given out an activity like when I was in another teachers class before I moved into jane's I think erm, we had like a sheet, and then we have to like do questions to help you find the answers
- Anybody else? can Think of an example when they've enjoyed their maths lessons?
- I've got an idea but I'm not saying
- you can say
- nah
- Curious
- We're all very curious now. erm, How often do you feel like you enjoy your maths lesson?
- I never really like, used to like them to be honest. In school. I feel like proper ahead

- Right.
- Just like they explain it way easier, there's like shortcuts to stuff, in school that just tell you the hardest way possible.
- but here its not too bad
- does anybody else feel like there's a difference between college and school?
- Yeah 100%.
- Or the other way around,
- The other way around - how come?
- I think in college I've had a definite maths teacher for nearly 3 years, a different maths teacher every year. I think 2 or three
- Do you think that's impacted you then
- potentially yeah
- You have to get used to them don't you, can I get up and start asking questions all the time really? when you don't know them
- You agreed though with this gentleman?
- Yeah.
- How come
- Because like, I feel like in high school, you just get taught everything all at once and you're expected to learn things like that. But obviously, you can't take in if you really struggle with it . So I feel like in college you learn it at..
- A slower pace..
- Yeah, slow pace but like, in a sense. erm I do feel like some teachers teach too quick, or they don't stay on a topic too long. So, I feel like it's easier to learn in college, but I think the pace that they teach it at a college is a lot faster than high school. It's just a bit too quick. Sometimes they only teach one topic or maths lesson and then the change it completely. But obviously if we really struggle they don't stay on the topic.
- anybody else feel a difference between college and school?
- yeah, I just, get along with the teacher better than I have done in school with like every single set four teacher that I've had
- I'm getting the feeling erm that...sorry, I just interrupted you
- it's alright, no
- I'm getting the feeling. Teachers have an impact on whether you enjoy.
- I think sometimes Jane's a bit different to what I've had in my college where sometimes completely different there. They just to teach, It's a job and you get paid at the end of it
- yeah, no, jane cares
- 99% of the teachers, even 100s they come in to get paid. sometimes it helps when you know a teacher enjoys their job too many teachers there they're working there the working and you know they don't want to be there, my joinery teacher does not want to be there
- Jesus Christ!
- he does not want to be with us, Jane does
- what makes you think he doesn't want to be there?
- He talks really really slowly, so I think...
- robot voice!
- Jane knows we're not particularly like that, but she kind of works her way around it almost you won't expect us to go out there, finish the whole sheet. She's not, there's something who could not do the sheet and they have a go at you and then they lose the kid, Jane

doesn't want to lose us cos it will come about after, after some kind of works around it. I think I've seen that bit. As I gone a little bit more.

- She can just kind of work to adapt a bit.
- or some are stuck in their own ways, Change don't change what they're teaching
- I also think some teachers styles as well, the way they teach or savings has an impact throughout life. I've had different teachers over the course of being at college. And like some teachers have been really slow. erm took their time, ask questions, fantastic. So that we'll understand whereas some teachers just do it. Turn around for everyones there So just like

Appendix A2

Focus Group Questions – Blackburn

During the first set of questions I will ask you to think about enjoyable experiences you've had in maths lessons, and situations when you've not enjoyed maths or feel you haven't learned during a lesson.

Tell me about a time when you've enjoyed doing maths

a. Can you tell me more?
b. Why do you think that was enjoyable?
c. How did you feel?
d. How often do you enjoy maths?

What helps you learn in your maths class?

a. Why?
b. Is this different to past experiences? Why?
c. Tell me more.

Tell me about a time when you've not enjoyed your maths lesson.

a. Why do you think that is?
b. Can you expand?
c. What could have been done differently?
d. How did it make you feel?
e. What did you do afterwards?

What stops you learning in your maths class?

a. How does that make you feel?
b. Can you expand?
c. Is this something you can change?

This next set of questions will ask you to think about what you do when you're faced with a difficult situation in maths, and how you deal with problem.

When you get an answer write, how do you feel?

a. Can you expand?
b. How does that impact the rest of the lesson?
c. How often do you feel this?
d. Is it easy to remember how that feels? Why?

So, then, if you don't get an answer right, how do you feel?

a. Can you explain in more detail?

b. How does that impact the rest of your lesson?
c. Is this a strong feeling?
d. Why?

If you don't know how to answer a question, or solve a problem, what should you do?

a. Why?
b. Is that what you actually do?
c. Why/Why not?

I'm going to show you an example of something I know you've used in class where you have been asked to work on a single skill, and you've practiced that skill over and over again.

Thinking about this activity - does working on single skills improve what you can do with bigger questions? Why?

Does working on single skills improve your speed in answering questions? Why?

Does working on single skills get boring if you do too many at once? Why?

which is better, doing something small and getting all of it right or doing something bigger and getting half of it right?

a. Why?
b. How does it make you feel?
c. Is that a good thing? Why?
d. Is that a bad thing? Why?

This last set of questions will ask you to think about your own confidence in maths lessons, and your own maths skills; and I will ask you to consider what you understand by the work confident.

Tell me what makes you feel confident in maths?

a. Can you expand?
b. Why?
c. How often do you feel like this? Why?
d. How do you know you're confident? Why?

How can you improve your confidence in maths?

a. Have you tried this?
b. Why?
c. Can you tell me more?
d. What help do you need to do this?
e. How do you know that this will make you more confident? Why?

Lastly, what does 'confident' mean for you?

a. Is it the same for everyone?
b. Is that a feeling?
c. Is it a physical thing? For example, knowing the answer?
d. Why?
e. Tell me about when you're confident outside the maths classroom?
f. Why?

Appendix A3 Consent & research information form

RESEARCH CONSENT FORM

Title of research project: Developing tangible positive thinking tools and strategies to enable maths GCSE post-16 learners to master mathematical content and conceptions: can positive action create impactful outcomes in mathematical progression at GCSE maths resit in an FE setting?

Name of researcher: Dr Jane Kay

I confirm that I have read and understand the information sheet for the above research project and have had the opportunity to ask questions (please tick response).	Yes	No
I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason (please highlight response).	Yes	No
I agree to take part in this research project and for the anonymised data to be used as the researcher sees fit, including publication (please highlight response).	Yes	No
I agree to allow photographs of my maths work to be used for research purposes	Yes	No
I agree to allow photographs of myself in the maths classroom to be used for research purposes	Yes	No

Name of participant:

Signature: Date:

INFORMATION SHEET

Title of research project: Developing tangible positive thinking tools and strategies to enable maths GCSE post-16 learners to master mathematical content and conceptions: can positive action create impactful outcomes in mathematical progression at GCSE maths resit in an FE setting?

Name of researcher: Dr Jane Kay

The College is taking part in some research into maths teaching and how we can improve confidence in maths classes. I want to involve you in that research work.

I will be examining ways we can grow in confidence in maths class and will be using different activities and tasks to use in maths class to help me gain more information.

Some of the worksheets or activities that you complete in class will be related to the research project but will not hold back your learning in any way.

I will ask you to complete some small surveys or take part in focus groups which you can at any time contribute to or not without consequence, depending on your feelings and opinions.

I will be taking photographs of maths work completed and of people working, using the research activities in class. You can still be involved in the research even if you don't want your photograph to be taken.

You will not have to make any contribution other than what you would normally do in maths classes.

The research will be happening throughout the year whilst you are learning maths.

All the information collected from your work, surveys or focus groups, observations and photographs will be completely anonymous. Your name or any other personal details about you that could be traced back to you will never appear in any research work.

I hope you will be happy to be part of the research and hopefully help me to gain some ideas about how to improve learning in maths at College. If not, you do not need to take part and can indicate at any time that you are not happy to continue.

This information was communicated in October 2021 and is now being renewed.

If you have any questions about this research please do ask me, I am happy to answer all questions at any time.

Thank you

Dr Jane Kay

A4 – Survey 1 (baseline)

SRVEY

Please answer the following questions by circling your answer, selecting the number of stars or writing a few words to tell us about your maths course in the first half term.

You don't need to write your name on the survey.

What's the name of your maths teacher?

…….

What other courses have you completed in College this year?.....

……

Date……Last maths grade…….

How much do you like maths? The more stars you shade the more you like maths.

What do you think of the classroom you have used for most of your maths sessions? (circle your answer)

Very Good **Good** **OK** **Bad** **Very bad**

What do you think of the worksheets you have completed for most of your maths sessions? (circle your answer)

Very Good **Good** **OK** **Bad** **Very bad**

What do you think of talking or discussing maths in your maths sessions? (circle your answer)

Very Good **Good** **OK** **Bad** **Very bad**

What do you think of the activities (like cards or games you have used for most of your maths sessions? (circle your answer)

Very Good **Good** **OK** **Bad** **Very bad**

What were your favourite activities in your maths sessions? (circle as many as you like)

☺ Maths jigsaws

☺ Learning by questions on tablets

☺ Exam questions

☺ Worksheets

☺ Power points

☺ Videos

☺ Talking and questions

☺ Cards to match

Did you really like something that's not on the list? Write it here

Did you do any maths learning online in lockdowns? YES / NO

Did you receive work through the post for maths in lockdowns? YES / NO

What do you think of your level of confidence in maths? Rate yourself with the star rating by shading the number of stars you are giving yourself

Do you complete homework for maths class or do extra maths when you are not in class?

How much have you enjoyed your class? Rate your enjoyment of maths

How difficult is maths? The more stars you shade the more difficult it is.

Do you think you are making progress in maths?

What's the main thing you remember about maths this year so far? (write a few words or a sentence here)

……

……

……

……

What's the main thing you would change about maths this year? (write a few words or a sentence here)

……

……

……

……

Thank you for completing the maths survey today.

A5 – Survey 2 (midpoint)

SURVEY

Please answer the following questions by circling your answer, selecting the number of stars or writing a few words to tell us about your maths course in the second term.

You don't need to write your name on the survey.

What's the name of your maths teacher?

……

What other courses have you completed in College this year?.....

……

Date……Last maths grade……

How much do you like maths? The more stars you shade the more you like maths.

What do you think of the classroom you have used for most of your maths sessions? (circle your answer)

Very Good **Good** **OK** **Bad** **Very bad**

What do you think of the worksheets you have completed for most of your maths sessions? (circle your answer)

Very Good **Good** **OK** **Bad** **Very bad**

What do you think of talking or discussing maths in your maths sessions? (circle your answer)

Very Good **Good** **OK** **Bad** **Very bad**

What do you think of the activities (like cards or games you have used for most of your maths sessions? (circle your answer)

Very Good **Good** **OK** **Bad** **Very bad**

What were your favourite activities in your maths sessions? (circle as many as you like)

☺ Maths jigsaws

☺ Learning by questions on tablets

☺ Exam questions

☺ Worksheets

☺ Power points

☺ Videos

☺ Talking and questions

☺ Cards to match

☺ Single skill strips

☺ Assessments

☺ Assessment feedback and walk throughs

Did you really like something that's not on the list? Write it here

What do you think of your level of confidence in maths? Rate yourself with the star rating by shading the number of stars you are giving yourself

Do you complete homework for maths class or do extra maths when you are not in class?

How much have you enjoyed your class? Rate your enjoyment of maths

How difficult is maths? The more stars you shade the more difficult it is.

Do you think you are making progress in maths?

What's the main thing you remember about maths this year so far? (write a few words or a sentence here)

……

……

……

……

What's the main thing you would change about maths this year? (write a few words or a sentence here)

……

……

……

……

Thank you for completing the maths survey today.

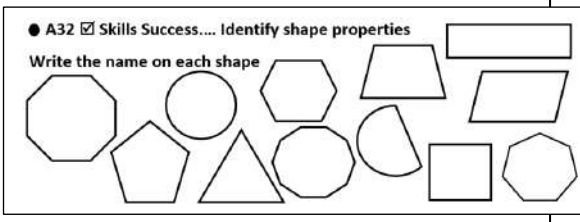
A6 – Survey 3 (evaluative)

SURVEY

Please answer the following questions by circling your answer, selecting the number of stars or writing a few words to tell us about your maths course in the past year.

You don't need to write your name on the survey.

You completed some single skills slips this year for maths – please rate them, the more stars, the more you liked them



You also completed some 'emoji slips' this year in maths – please rate them, the more stars, the more you liked them

How much do you like maths? The more stars you shade the more you like maths.

What do you think of the classroom you have used for most of your maths sessions? (circle your answer)

Very Good **Good** **OK** **Bad** **Very bad**

What do you think of the worksheets you have completed for most of your maths sessions? (circle your answer)

Very Good **Good** **OK** **Bad** **Very bad**

What do you think of talking or discussing maths in your maths sessions? (circle your answer)

Very Good **Good** **OK** **Bad** **Very bad**

What do you think of the activities (like cards or games you have used for most of your maths sessions? (circle your answer)

Very Good **Good** **OK** **Bad** **Very bad**

What were your favourite activities in your maths sessions? (circle as many as you like)

☺ Maths jigsaws

☺ Learning by questions on tablets

☺ Exam questions

☺ Worksheets

☺ Power points

☺ Videos

☺ Talking and questions

☺ Cards to match

☺ Kahoot!

☺ Assessments

☺ Assessment feedback and walk throughs

Did you really like something that's not on the list? Write it here

What do you think of your level of confidence in maths? Rate yourself with the star rating by shading the number of stars you are giving yourself

Do you complete homework for maths class or do extra maths when you are not in class?

How much have you enjoyed your class? Rate your enjoyment of maths

How difficult is maths? The more stars you shade the more difficult it is.

Do you think you made progress in maths?

What's the main thing you remember about maths this year? (write a few words or a sentence here)

……

……

……

……

What's the main thing you would change about maths this year? (write a few words or a sentence here)

……

……

……

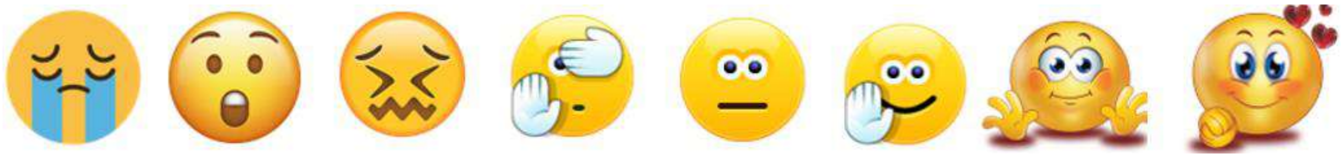
……

Thank you for completing the maths survey today.

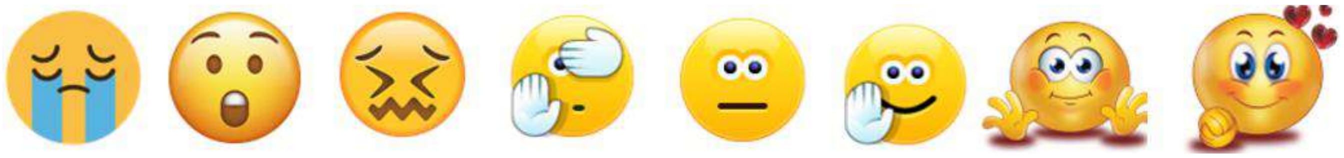
Appendix B1

Emoji progress slips

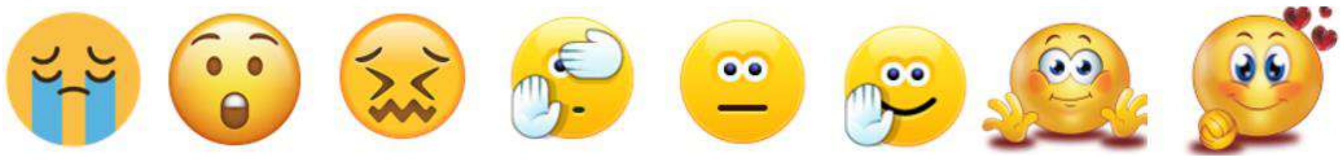
Subject:……………………………………………………………………………… Rate your confidence level by circling the emoji that best describes how you feel about this subject right at the start & end of the session



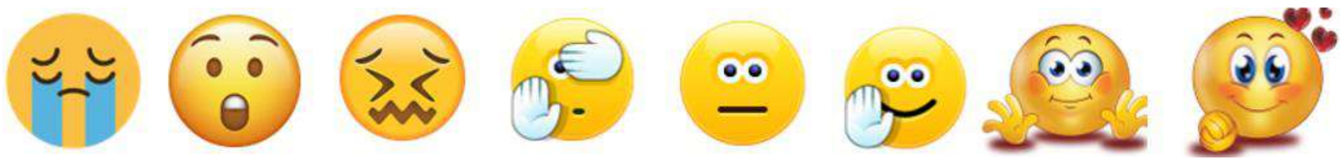
Subject:……………………………………………………………………………… Rate your confidence level by circling the emoji that best describes how you feel about this subject right at the start & end of the session



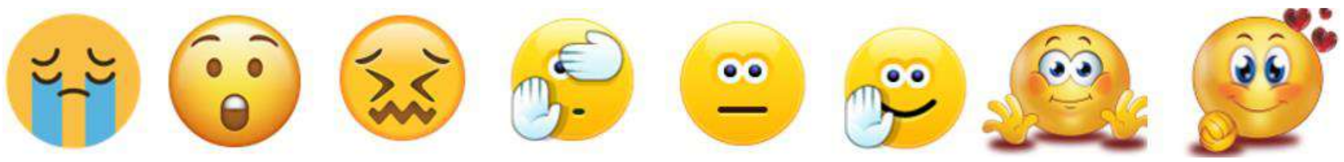
Subject:……………………………………………………………………………… Rate your confidence level by circling the emoji that best describes how you feel about this subject right at the start & end of the session



Subject:……………………………………………………………………………… Rate your confidence level by circling the emoji that best describes how you feel about this subject right at the start & end of the session



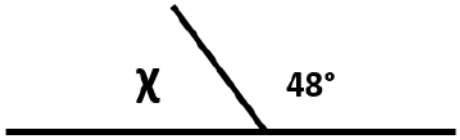
Subject:……………………………………………………………………………… Rate your confidence level by circling the emoji that best describes how you feel about this subject right at the start & end of the session



Appendix B2

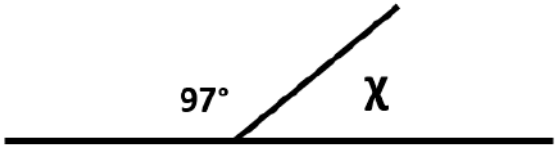
Skills success slips 1 - 18

● A1 ☑ Skills Success....calculate the angle on a straight line



Working out

Angle χ = _____



Working out

Angle χ = _____

● A2 ☑ Skills Success...change a decimal to a percentage

Complete these changes

Decimal	Working out	Percentage
0.37		
0.03		
0.99		

● A3 ☑ Skills Success....Divide an amount in a ratio

Divide £75.00

in the ratio 2 : 3

Working out

Answer

Divide £48.80

in the ratio 3:5

Working out

Answer

● A4 ☑ Skills Success....find 1 percent of an amount

£752.49

Working out

1% = £ _____

£23.98

Working out

1% = £_____

● A5 ☑ Skills Success....find 10 percent of an amount

£456.00

Working out

10% = £ _____

£991.99

Working out

10% = £_____

● A6 ☑ Skills Success....find 20 percent of an amount

£152.20

Working out

20% = £ _____

£235.98

Working out

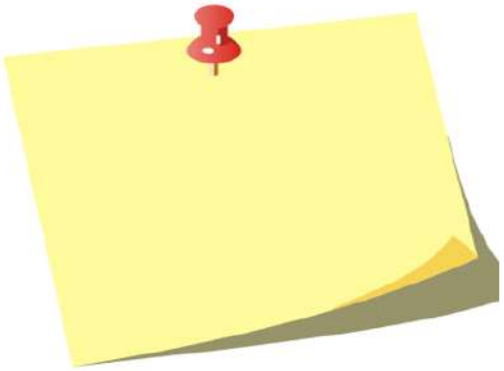
20% = £_____

● A7 ☑ Skills Success…find a fraction of an amount

What is 1/3 of 150? _____

What is 1/5 of 200? _____

What is 2/3 of 150? _____

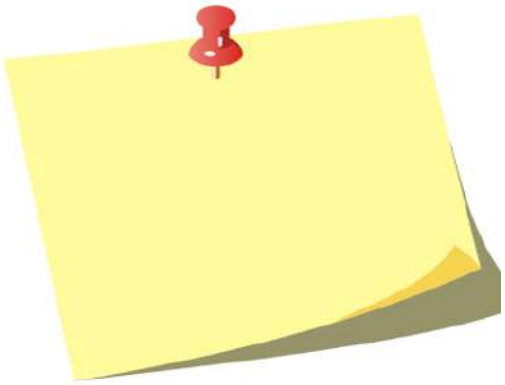


● A8 ☑ Skills Success….find the cube of a number

What is 7^3? _____

What is 5^3 ? _____

What is 12^3? _____

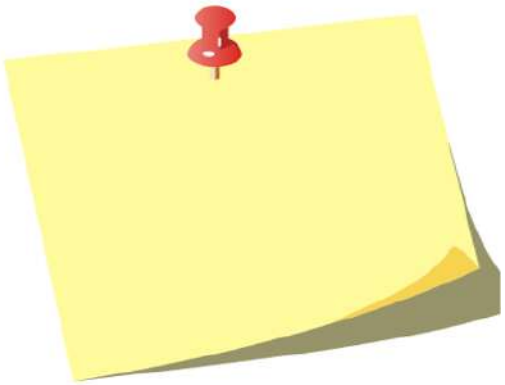


● A9 ☑ Skills Success….find the square of a number

What is 8^2? _____

What is 9^2 ? _____

What is 11^2? _____

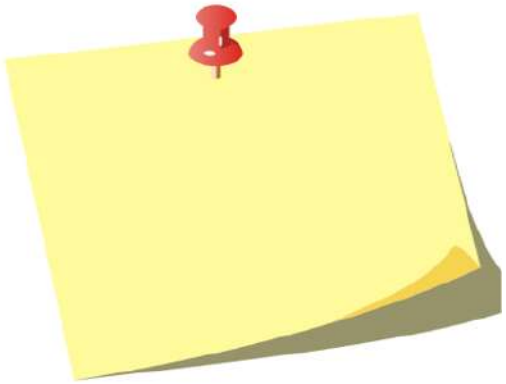


● A10 ☑ Skills Success....find the square root of a number

What is $\sqrt{81}$? _____

What is $\sqrt{49}$? _____

What is $\sqrt{144}$? _____



● A11 ☑ Skills Success...change a fraction to a decimal

Complete these changes

Fraction	Working out	Decimal
$\frac{1}{2}$		
$\frac{1}{4}$		
$\frac{2}{5}$		

● A12 ☑ Skills Success....change a fraction to a percentage

Complete these changes

Fraction	Working out	Percentage
$\frac{3}{5}$		
$\frac{5}{6}$		
$\frac{2}{3}$		

● A13 ☑ Skills Success…identify prime numbers

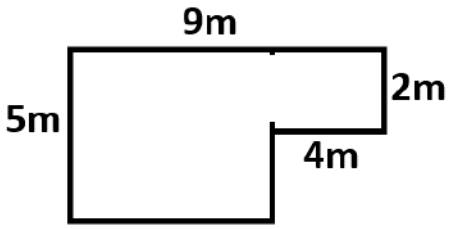
Fill in the blank: "A prime number has ___ factors. One and Itself."

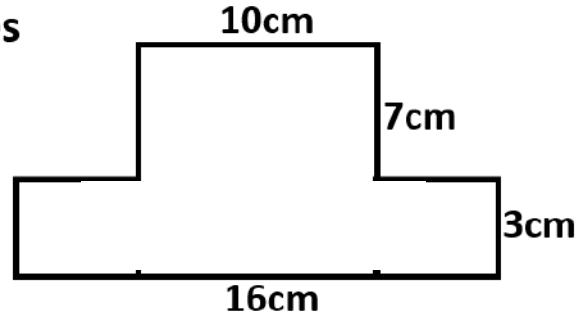
Identify 3 prime numbers from this list and circle them:

0 1 2 5 21 7 9 11 4

● A14 ☑ Skills Success…calculate the perimeter of compound shapes

Calculate the perimeter of these shapes

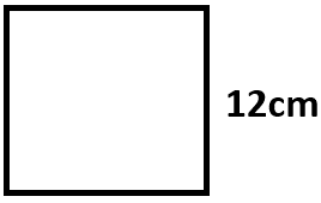


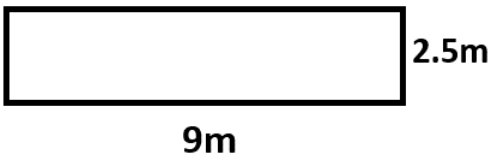


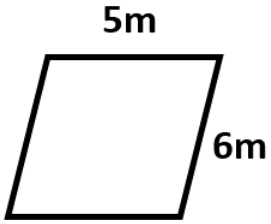
Perimeter = …… **Perimeter = …….**

● A15 ☑ Skills Success…calculate the perimeter of quadrilaterals

Calculate the perimeter of these shapes







Perimeter = …… Perimeter = ……. Perimeter = ……

● A16 ☑ Skills Success...Round to 2 decimal places

Match each number with a line to its rounded answer

79.891

7.9891

798.91

798.911

79.89

7.99

Match each number with a line to its rounded answer

21.21

2.30

2.1111

212.26

2.299

21.212

2.11

212.2595

● A17 ☑ Skills Success...Round to the nearest 10

Match each number with a line to its rounded answer

79.8

9.4

10

12

80

10

Match each number with a line to its rounded answer

15

2

0

10

6

4

20

0

● A18 ☑ Skills Success....use BIDMAS rules

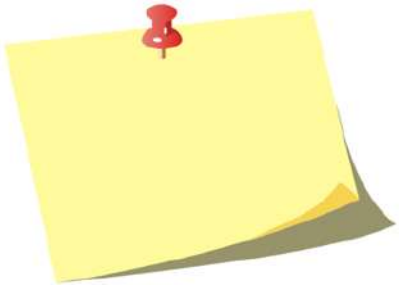
Complete these calculations, circle the correct answer

(2 x 3) + 15 x 2 = ____ 36 OR 42 OR 27

3^2 + 6 x 2 = ____ 30 OR 21 OR 17

5^2 + (2 x 3) – 1 = ____ 80 OR 30 OR 15

(2 x 9) ÷ 6 + 6 = ____ 10 OR 9 OR 1.6



Appendix B3

Skills Success Slips 19 - 36

● A19 ☑ Skills Success…. find the factors of a number

Factors can be multiplied together to form a number. Factors will 'fit' into a number without any remainders. 1 x 15 and 3 x 5 form 15. The factors of 15 are 1,3,5,15

What are the factors of 36?

1 x ____ = 36 2 x ____ = 36 3 x ____ = 36 4 x ____ = 36 6 x ____ = 36

Factors of 36 are ____ ____ ____ ____ ____ ____ ____ ____ ____

● A20 ☑ Skills Success…. find the prime factors of a number

What are the prime factors of 40?

1 x ____ = 40 2 x ____ = 40 4 x ____ = 40 5 x ____ = 40

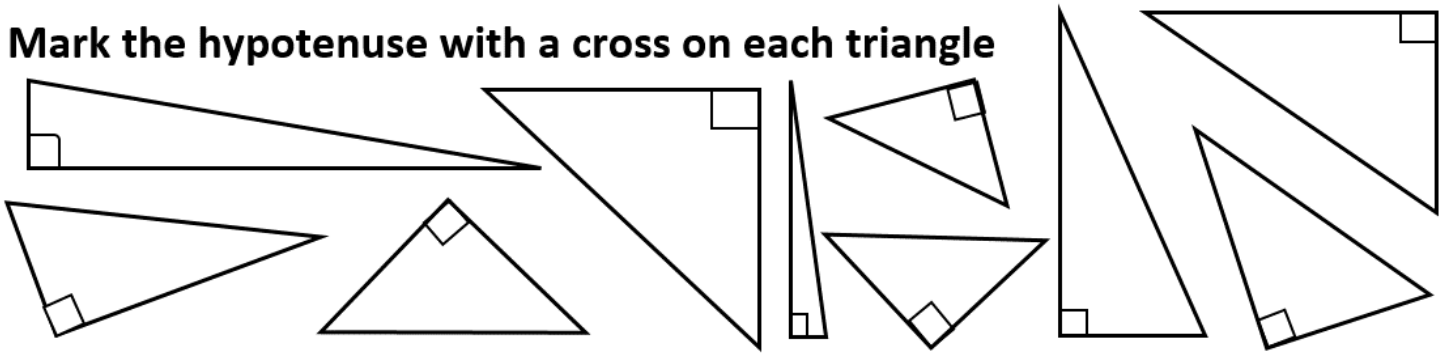
Prime factors of 40 are ____ ____

What are the prime factors of 18?

● A21 ☑ Skills Success…. Identify the hypotenuse in a right triangle

Hint: The hypotenuse is the longest side of any right-angled triangle and is ALWAYS opposite the right angle

Mark the hypotenuse with a cross on each triangle



● A22 ☑ Skills Success…. Identify a common factor

Hint: A common factor is one that will divide into all the numbers or letters with no remainder

Find the highest common factor for each set of numbers

5 + 10 common factor =

2X - 4 + 6 common factor =

200 – 50 + 100 common factor =

4X + 8 – 16 common factor =

60 + 20 + 30 common factor =

X + 2X + X common factor =

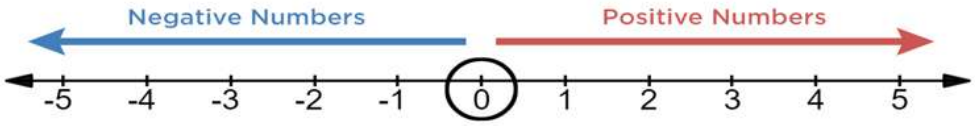
● A23 ☑ Skills Success…. subtract negative numbers

Hint: A minus and a minus is a plus, two minus signs next to each other means add

Subtract the following positive and negative numbers

5 - - 5 =	**12 - - 4 =**	**7 - - 8 =**	**27 - - 4 =**
5 - - 6 =	**12 - - 1 =**	**8 - - 8 =**	**21 - - 6 =**
9 - - 5 =	**1 - - 14 =**	**7 - - 3 =**	**30 - - 4 =**

● A24 ☑ Skills Success…. add negative numbers



Add the following positive and negative numbers

5 + - 3 =	**-12 + 4 =**	**- 7 + - 8 =**	**-27 + 4 =**
5 + - 6 =	**-2 + 1 =**	**- 3 + - 2 =**	**-21 + - 6 =**

● A25 ☑ Skills Success…. Plot co-ordinate pairs

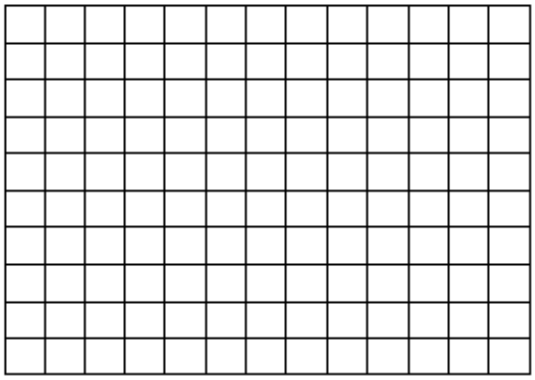
Mark the following co-ordinates on the grid

(1,5) (2,9) (3,3)

(4,2) (5,2) (6,2)

(7,3) (9,5) (8,9)

Hint: X co-ordinate always comes first



● A26 ☑ Skills Success…. Identify the next number in the pattern

Hint: look at the gaps between the numbers

Complete the next numbers in each pattern

2, 4, 6, 8, …. …. ….

3, 6, 9, 12, …. …. ….

1, 2, 4, 8, 16, …. …. ….

1, 3, 5, 7, 9, …. …. ….

4, 8, 12, 16, …. …. ….

90, 45, 22.5, …. …. ….

● A27 ☑ Skills Success…. Identify the next number in the sequence

Hint: remember that 'n' is the number of the term

Identify the tenth number for each of these

2n + 3 tenth number in this sequence will be ……

5n -1 tenth number in this sequence will be ……

3n +5 tenth number in this sequence will be ……

What is the twentieth number in each of these sequences?

2n twentieth number will be……

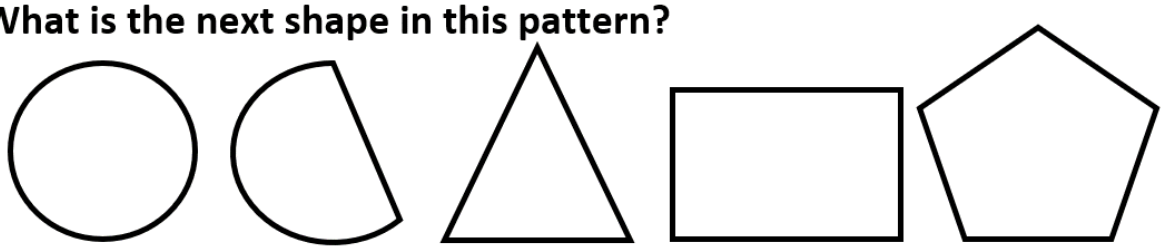
5n twentieth number will be……

10n twentieth number will be……

7n twentieth number will be……

● A28 ☑ Skills Success…. Identify the next shape in the pattern

What is the next shape in this pattern?



Explain why this is the next shape in the pattern……

……

A29 ☑ Skills Success…. Plot a straight line

Use this table of values to plot a line for the

Equation Y = X + 2

X	*-1*	*0*	*1*	*2*	*3*
Y	*1*	*2*	*3*	*4*	*5*

● A30 ☑ Skills Success…. Complete a table of values

Complete this table of values for the

Equation Y = X + 3

X	*-1*	*0*	*1*	*2*	*3*
Y					

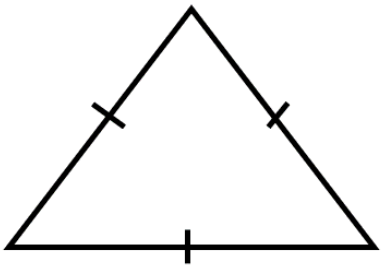
Complete this table of values for the

Equation Y = X - 1

X					
Y					

● **A31 ☑ Skills Success…. Identify triangles**

Identify each type of triangle



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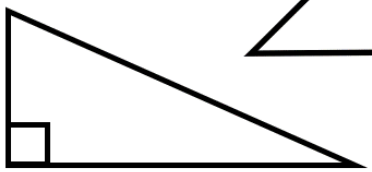

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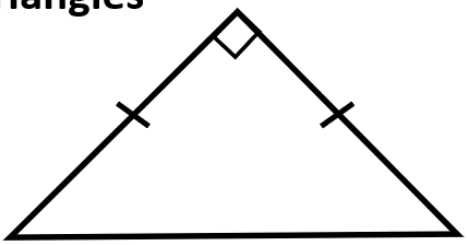

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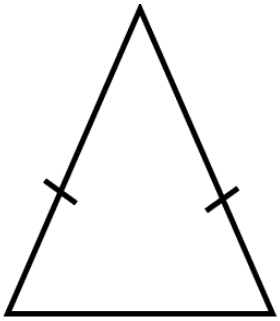

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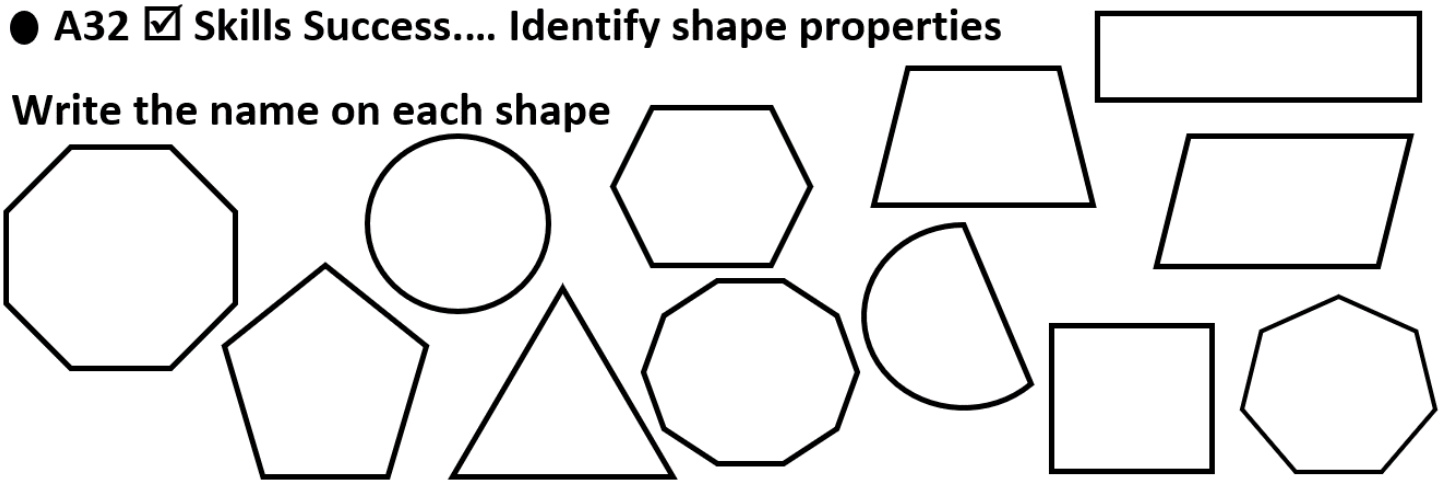
● **A32 ☑ Skills Success…. Identify shape properties**

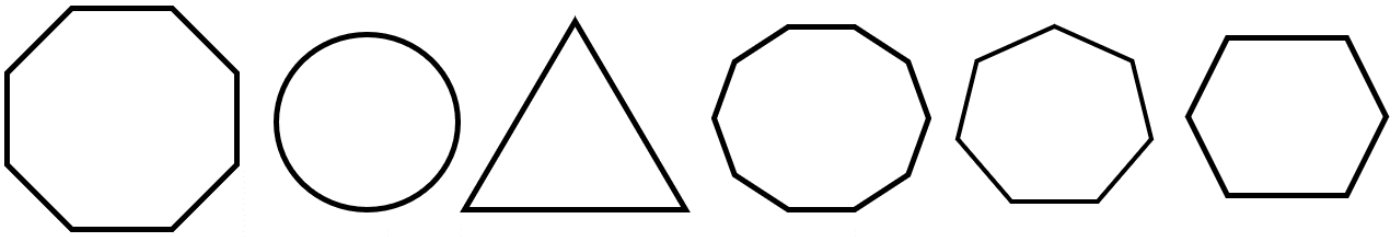
Write the name on each shape



● **A33 ☑ Skills Success…. Identify rotational symmetry**

Write the rotational order of symmetry for each shape

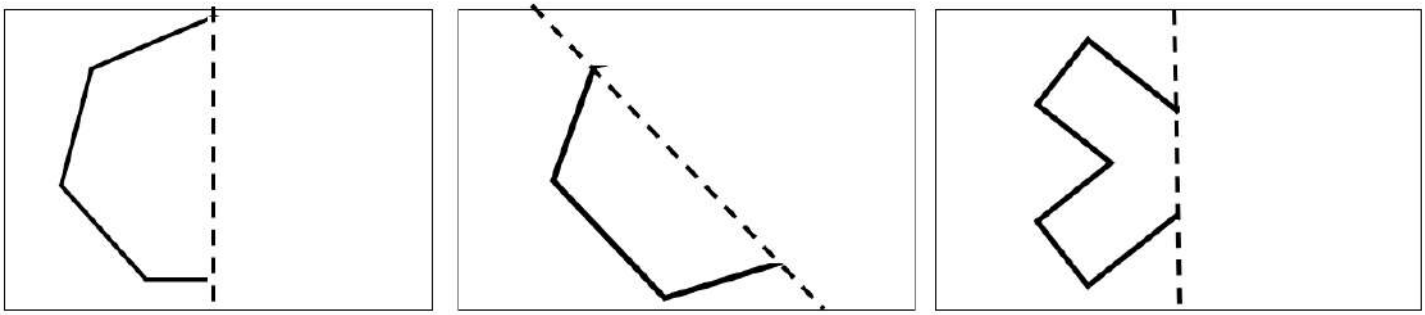
……



…… …… …… …… …… ……

● A34 ☑ Skills Success…. reflect a shape

Draw the reflection for each shape (use a ruler to help you)



● A35 ☑ Skills Success…. identify algebraic terms

Match each term to its explanation by joining with a line

X^2	An unknown amount			
An unknown amount multiplying a bracket	An unknown amount multiplied by 2	X, Y, Z, A or B	A + B	
An unknown amount cubed	X(2 + 3)	Y^3	2X	An unknown amount added to a different unknown amount	An unknown amount squared

● A36 ☑ Skills Success…. identify formula/equation/expression

Add the correct letters under each word to show which of these is an expression, an equation or a formula

An expression	An equation	A formula

d) $2X + X - 15$

e) $3Y + 2X - 1 + 4$

f) $A = \frac{1}{2} b \times h$

c) $2X + 3 = 13$

b) $V = b \times h \times l$

a) $Y - 2y = -Y$

Appendix B4 revision sheet from slips one (Number)

A2 ☑ Skills Success...change a decimal to a percentage

Complete these changes

Decimal	Working out	Percentage
0.33		
0.07		
0.91		

A3 ☑ Skills Success....Divide an amount in a ratio

Divide £37.00

in the ratio 2 : 3

Working out

Answer

Divide £63.80

in the ratio 3:5

Working out

Answer

A6 ☑ Skills Success....find 20 percent of an amount

£1341.20

Working out

Answer

20% = £ _____

£23.98

Working out

Answer

20% = £_____

A5 ☑ Skills Success....find 10 percent of an amount

£46.00

Working out

Answer

10% = £ _____

£231.99

Working out

Answer

10% = £_____

A7 ☑ Skills Success...find a fraction of an amount

What is 1/5 of 150? _____

What is 1/8 of 200? _____

What is 2/6 of 150? _____

A9 ☑ Skills Success....find the square of a number

What is 7^2? _____

What is 12^2? _____

What is 15^2? _____

A10 ☑ Skills Success....find the square root of a number

What is $\sqrt{225}$? _____

What is $\sqrt{76}$? _____

What is $\sqrt{121}$? _____

A11 ☑ Skills Success...change a fraction to a decimal

Complete these changes

Fraction	Working out	Decimal
1/8		
2/3		
3/9		

Appendix B5 Revision sheet from slips two (number)

A13 ☑ Skills Success...identify prime numbers

Fill in the blank: "A prime number has ___ factors. One and Itself."

Identify 3 prime numbers from this list and circle them:

0 1 2 23 19 9 104 27

A20 ☑ Skills Success.... find the prime factors of a number

What are the prime factors of 60?

1 x = 60 2 x ___ = 60 4 x ___ = 60 5 x ___ = 60

Prime factors of 60 are ___ ___

What are the prime factors of 20?

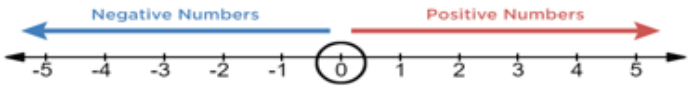
A23 ☑ Skills Success.... subtract negative numbers

Hint: A minus and a minus is a plus, two minus signs next to each other means add

Subtract the following positive and negative numbers

2 - - 7 =	124 - - 4 =	73 - - 8 =	270 - - 4 =
57 - - 6 =	121 - - 1 =	18 - - 8 =	211 - - 6 =
92 - - 5 =	19 - - 14 =	17 - - 3 =	300 - - 4 =

A24 ☑ Skills Success.... add negative numbers



Add the following positive and negative numbers

50 + - 3 =	-12 + 84 =	- 71 + - 18 =	-27 + 43 =
5 + - 96 =	-2 + 61 =	- 3 + - 12 =	-210 + - 62 =

A16 ☑ Skills Success...Round to 2 decimal places

Match each number with a line to its rounded answer

79.891 7.9891 798.91 798.911 79.89 7.99

Match each number with a line to its rounded answer

2.1111 21.21 2.30 212.26 2.299 21.212 2.11 212.2595

A19 ☑ Skills Success.... find the factors of a number

Factors can be multiplied together to form a number. Factors will 'fit' into a number without any remainders. 1 x 15 and 3 x 5 form 15. The factors of 15 are 1,3,5,15

What are the factors of 64?

1 x = 64 2 x ___ = 64 3 x ___ = 64 4 x ___ = 64 6 x ___ = 64

Factors of 64 are ___ ___ ___ ___ ___ ___ ___ ___ ___

A22 ☑ Skills Success.... Identify a common factor

Hint: A common factor is one that will divide into all the numbers or letters with no remainder

Find the highest common factor for each set of numbers

12 & 10 common factor =	2X & 4 & 6 common factor =
20 & 50 & 90 common factor =	4X & 16 & 80 common factor =
60 & 20 & 30 common factor =	2X & 4X & 6X common factor =

A17 ☑ Skills Success...Round to the nearest 10

Match each number with a line to its rounded answer

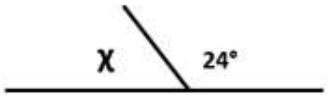
79.8 9.4 10 12 80 10

Match each number with a line to its rounded answer

2 0 10 15 6 4 20 0

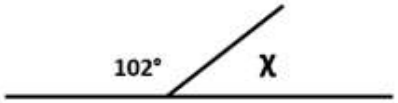
Appendix B6 Revision sheet from success slips one (Shape & Space)

● A1 ☑ Skills Success....calculate the angle on a straight line



Working out

Angle x = _____

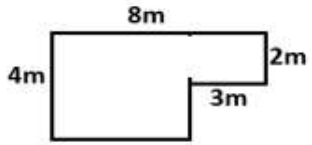


Working out

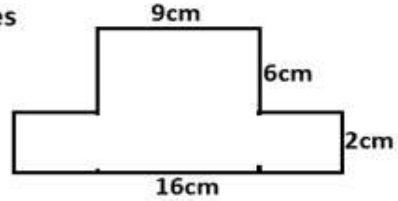
Angle x = _____

● A14 ☑ Skills Success...calculate the perimeter of compound shapes

Calculate the perimeter of these shapes



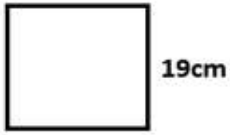
Perimeter = ...

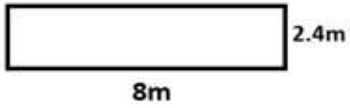


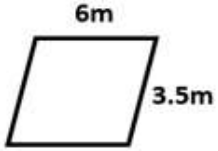
Perimeter = ...

● A15 ☑ Skills Success...calculate the perimeter of quadrilaterals

Calculate the perimeter of these shapes





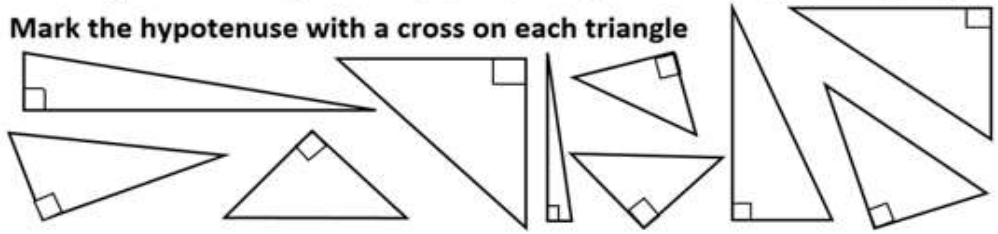


Perimeter = ... Perimeter = ... Perimeter = ...

● A21 ☑ Skills Success.... Identify the hypotenuse in a right triangle

Hint: The hypotenuse is the longest side of any right-angled triangle and is ALWAYS opposite the right angle

Mark the hypotenuse with a cross on each triangle



● A25 ☑ Skills Success.... Plot co-ordinate pairs

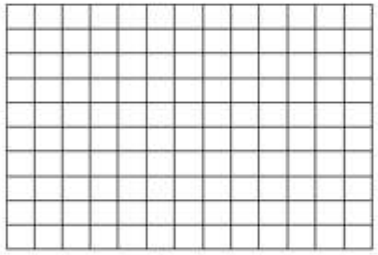
Mark the following co-ordinates on the grid

(1,3) (2,5) (3,1)

(1,2) (7,2) (9,2)

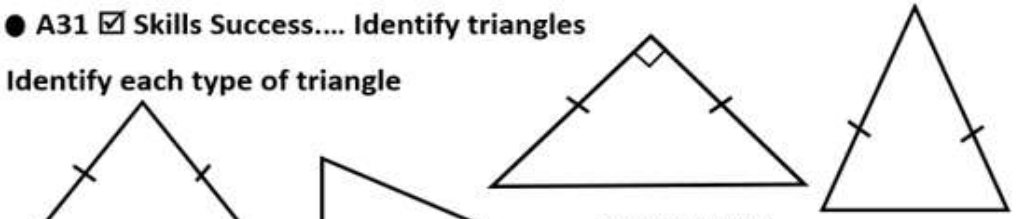
(0,3) (7,5) (8,8)

Hint: X co-ordinate always comes first



● A31 ☑ Skills Success.... Identify triangles

Identify each type of triangle



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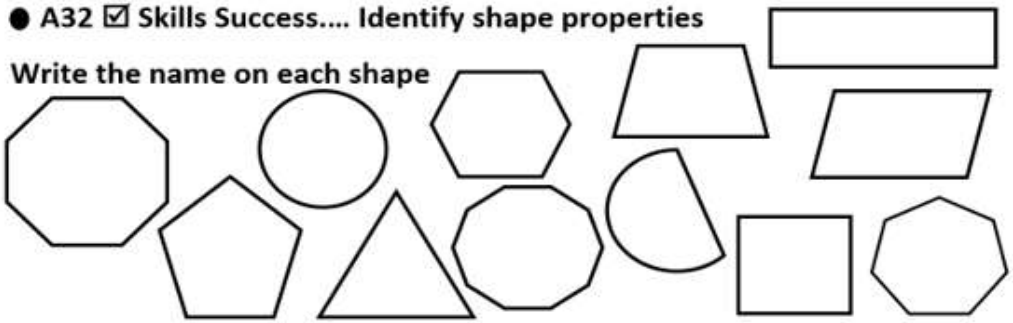
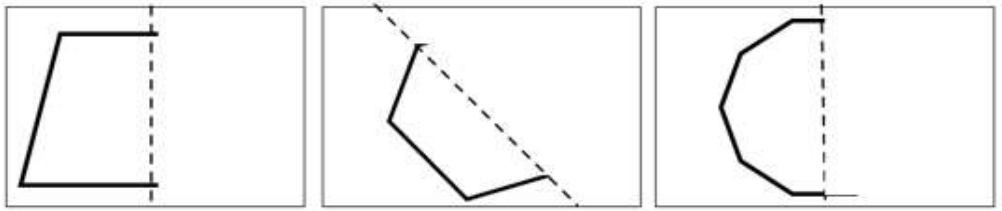
● A32 ☑ Skills Success.... Identify shape properties

Write the name on each shape



● A34 ☑ Skills Success.... reflect a shape

Draw the reflection for each shape (use a ruler to help you)



Appendix B7 revision sheet from Success slips (Algebra)

● A26 ☑ Skills Success.... Identify the next number in the pattern

Hint: look at the gaps between the numbers

Complete the next numbers in each pattern

8, 10, 12, 14, ...

7, 14, 21, 28, ...

1, 2, 4, 8, 16, ...

9, 11, 13, 15, ...

4, 8, 12, 16, ...

100, 50, 25, ...

● A18 ☑ Skills Success....use BIDMAS rules

Complete these calculations, circle the correct answer

(2 x 3) + 15 x 2 = ____ 36 OR 42 OR 27

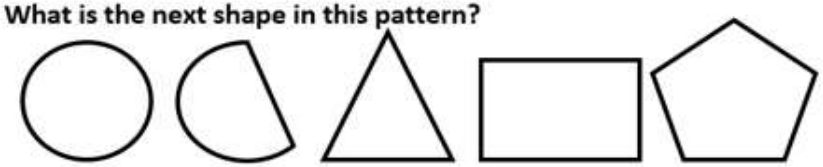
3^2 + 6 x 2 = ____ 30 OR 21 OR 17

5^2 + (2 x 3) – 1 = ____ 80 OR 30 OR 15

(2 x 9) ÷ 6 + 6 = ____ 10 OR 9 OR 1.6

● A28 ☑ Skills Success.... Identify the next shape in the pattern

What is the next shape in this pattern?



Explain why this is the next shape in the pattern.....

.....

● A30 ☑ Skills Success.... Complete a table of values

Complete this table of values for the Equation Y = 2X + 2

X	-1	0	1	2	3
Y					

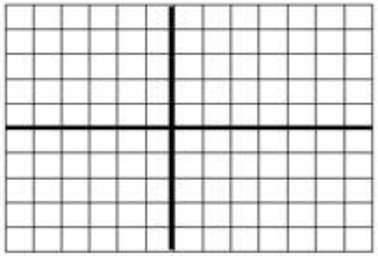
Complete this table of values for the Equation Y = X - 1

X					
Y					

● A29 ☑ Skills Success.... Plot a straight line

Use this table of values to plot a line for the Equation Y = 2X + 1

X	-1	0	1	2	3
Y	-1	1	3	5	7



● A27 ☑ Skills Success.... Identify the next number in the sequence

Hint: remember that 'n' is the number of the term

Identify the tenth number for each of these

n + 4 tenth number in this sequence will be .....

4n -1 tenth number in this sequence will be .....

3n + 6 tenth number in this sequence will be .....

What is the twentieth number in each of these sequences?

6n twentieth number will be.....

2n twentieth number will be.....

11n twentieth number will be.....

9n twentieth number will be.....

● A35 ☑ Skills Success.... identify algebraic terms

Match each term to its explanation by joining with a line

X^2

An unknown amount

An unknown amount multiplying a bracket

An unknown amount multiplied by 2

X, Y, Z, A or B

A + B

An unknown amount added to a different unknown amount

An unknown amount squared

An unknown amount cubed

X(2 + 3)

Y^3

2X

● A36 ☑ Skills Success.... identify formula/equation/expression

Add the correct letters under each word to show which of these is an expression, an equation or a formula

	An expression	An equation	A formula
d) $2X + X - 15$			
e) $3Y + 2X - 1 + 4$			
f) $A = ½ b \times h$			
c) $2X + 3 = 13$			
b) $V = b \times h \times l$			
a) $Y - 2y = -Y$			