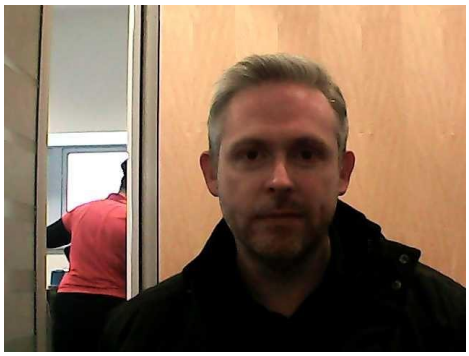
The use of starters to reinforce KS 1-3 skills gaps to improve understanding of KS 3/4 topics



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OUR PARTNERS

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

About CfEM

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

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

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Summary

Our aim was to understand and investigate our action groups belief that the primary reason many learners do not make sufficient progress when completing post-16 GCSE maths resit programmes, is due to weak/absent skills and/or misconceptions in their lower Key Stage attainment. Specifically, that by focussing on these areas, we can accelerate their understanding and progress with KS3 & 4 topics, preparing them for future success in exams.

We devised two methods to address this: completing starter activities in all sessions and a series of small group intervention sessions. We identified approximately 80 learners to be part of the study, across two vocational areas - Sport and Art & Design (ADM).

We allowed the ADM groups 10 minutes to complete 10 questions, with a further 10 minutes to mark and briefly discuss answers. For Sport learners, they were allowed 10 minutes to answer, with a further 30 minutes to mark and discuss. The discussions were a deep-dive approach, giving time to fully dissect the origin and meaning of the mathematics.

The results of these were recorded for both groups and compared; Sport learners achieved consistently higher results in both starters and other weekly assessments.

We also analysed the results of our Teacher Assessed Grades assessments as these were a timely and effective resource.

These showed a clear achievement gap between the cohorts of 23 marks, or approx. 10% of the total for 3 papers (240 marks).

This uplift therefore represents two-thirds of the step between grade boundaries 3 and 4 and would see a significant number of learners achieving a grade 4 in an exam scenario.

In summary, learners spending significant time addressing skills gaps and misconceptions at KS1-3 achieved assessment results far better than those that did not, all other factors being equal; ADM achieved 44% high grades, and Sport achieved 74% high grades than last year.

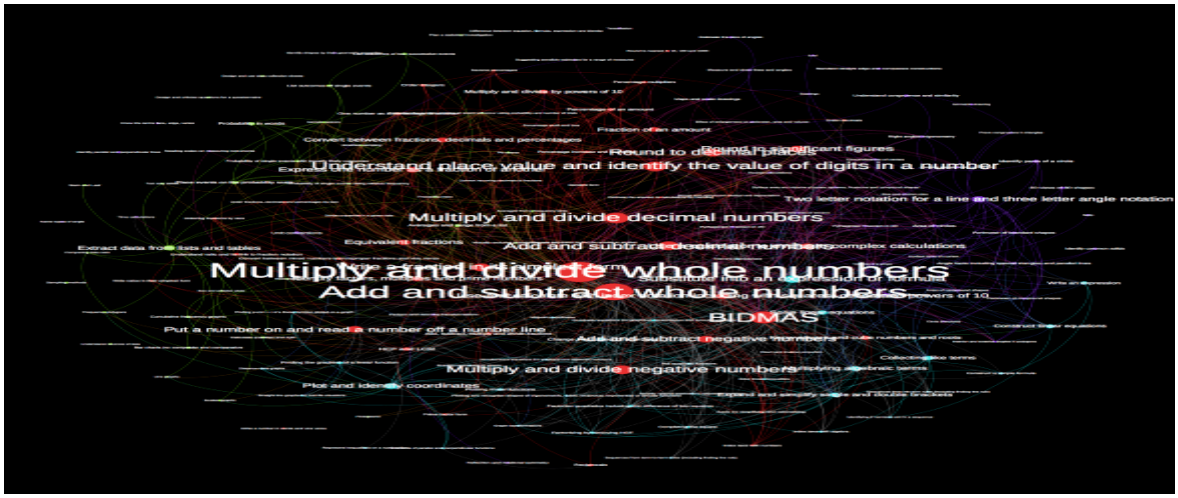
We are trying to investigate how addressing skills gaps/misconceptions with Key Stage 1-3 basic number topics helps learners to develop the skills needed to achieve at GCSE standard.

Specifically, that the ability to apply AO1 (Process) is key to the development of AO2/3 skills (interpreting, reasoning, communicating & problem-solving) and this is a key reason why many learners do not make progress during GCSE resits.

We decided to investigate whether addressing skills gaps in lower key stage attainment could have a positive effect on learners' progress with KS3 topics, by having learner's complete starter activities over the academic year – the consistency of this exposure to basic topics could be measured against their ability to perform against assessments specifically focussed on AO1 and, separately, AO2/3 skills.

Initial Method

Intervention programme – 6 weeks after Easter (proof of concept); drop-in Sessions (20 min) short-term exposure to KS1 level skills to demonstrate that learners can make progress with topics they otherwise find difficult.



What you are looking at is the GCSE Mathematics curriculum. Each node represents a topic, e.g. transformations, ordering decimal numbers, frequency polygons etc. There are 164 nodes in the diagram representing all topics on both the foundation and higher tier curriculum. The nodes are connected by 935 links. Each link represents a connection between two topics whereby one is the prior learning required to be able to access the other. For example, equivalent fractions is linked to adding fractions because you need to be able to do the former before you can learn how to do the later.

I created this diagram using Gephi to investigate which topics are the 'essential skills' required to access as many topics on the GCSE as possible. If pupils need to completely master certain topics in KS3 in order to be able to learn as much of the GCSE syllabus as possible, what are those topics? I have scaled the node size based on how many links they have, i.e. how many topics they are prior learning for. The larger the node, the more topics it is prior learning for. The largest nodes are the essential skills needed to be able to access the full GCSE.

The nodes have also been colour-coded based on the part of the curriculum they relate to:

In rank order, the most important topics for students to master, based on the number of topics they are prior knowledge for are as follows:

Multiply and divide whole numbers (90 topics this is prior knowledge for)

Add and subtract whole numbers (73)

BIDMAS (50)

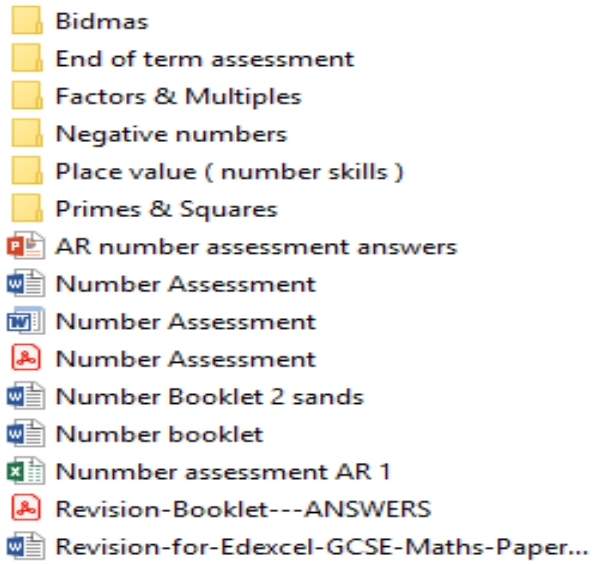
Multiply and divide decimal numbers (43)

Understand place value and identify the value of digits in a number (38)

Add and subtract decimal numbers (34)

(Emeny, 2015)

The research above allowed us to focus directly on the basic skills required to underpin the higher-level topics for our students. We developed a six-week program with 1-2-1 dinner time drop in sessions, A drop in session during lunch breaks was not always feasible due to commitment from students and would often reduce drop in size to two or three students. Further evening and or alternative drop-in sessions were required for catch up purposes. We wanted to reinforce the concept of weekly sessions and the repetition of topics at lower levels would help them.



(Fig 1) Range of selected topics

L3
Progression: Light

Place Value Words

Number	Millions	Hundreds Thousands	Tens Thousands	Thousands	Hundreds	Tens	Units
Four hundred and twenty seven							
Five thousand three hundred and thirty							
Six million four hundred and eleven							
Seven hundred and five thousand and two							
Four hundred and nineteen thousand and forty one							
Seven million thirty two thousand six hundred and five							
Five million three hundred thousand and twenty seven							
Two million forty three thousand two hundred and ten							
Four hundred and sixteen thousand and eighty two							
Seven million and sixty two							
Two hundred and forty six thousand and two hundred							
Five hundred and seventy four thousand and eight							

(Fig 2) Basic place value

Negative Numbers Codebreaker 1

A	B	C	D	E	F	G	H	I	J	K	L	M
−6	−7	1	−1	−12	3	11	15	−4	13	0	9	−10

N	O	P	Q	R	S	T	U	V	W	X	Y	Z
10	2	−5	6	7	−15	−2	−9	−14	8	−3	−11	−18

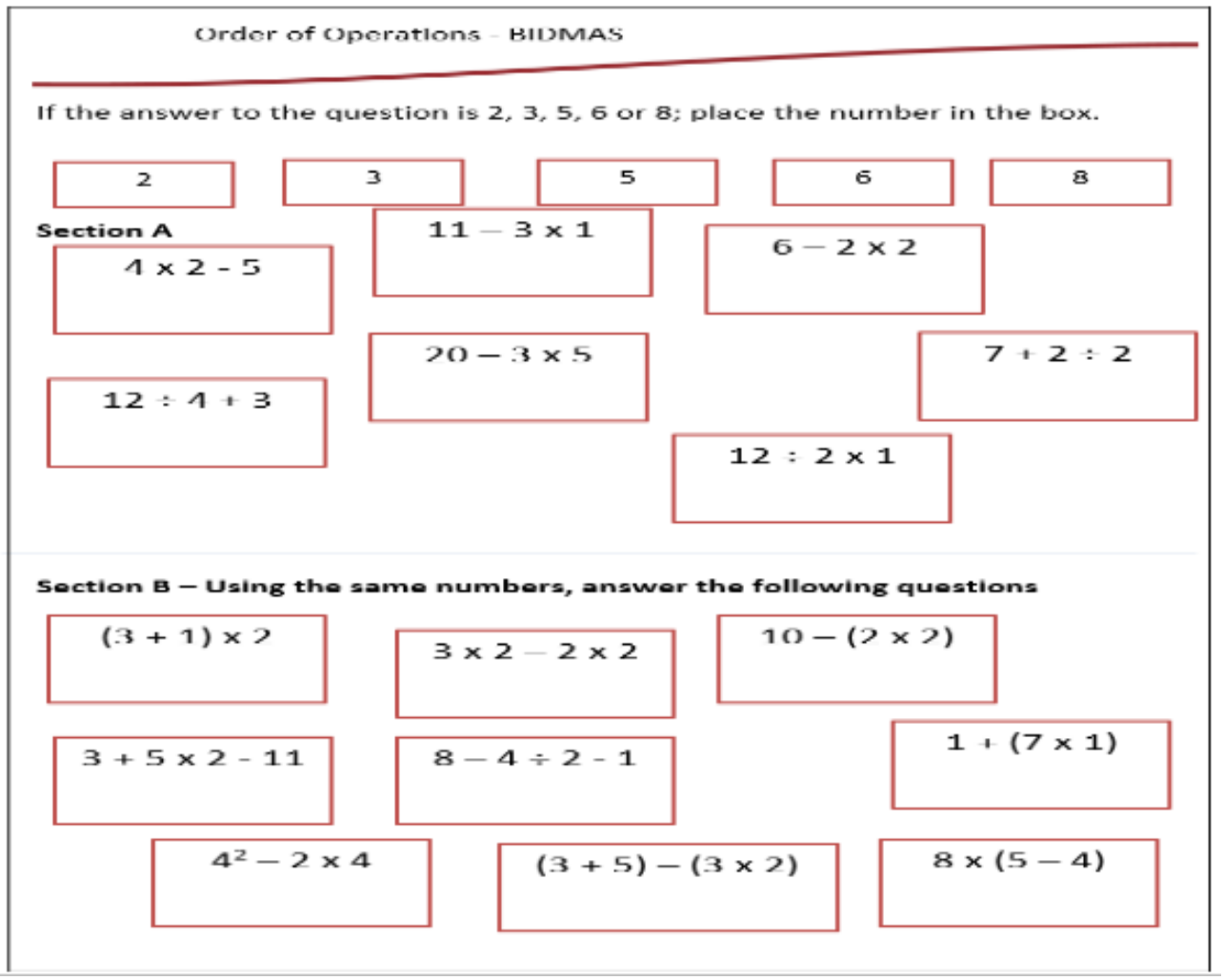
Calculate the problems below, link your answers to the table above to reveal why the police desperately wanted to solve the "Digestive Murders":

$3-7$	$-10+8$	$-3+11$	$-2-4$	$-7-8$	$4-10$

$(-6)-(-7)$	$(-5)+(-7)$	$(+5)-(-2)$	$(-15)-(-3)$	$(+2)-(+8)$	$(+4)-(-5)$

$2-7+3+2$	$-5-2+3$	$-2+7+4$	$(+3)-(-7)+(-1)$	$(-3)+(-7)+(-2)$	$(-2)-(-3)-(-6)$

(Fig 3) Basic negative numbers



(Fig 4) Basic BIDMAS

Background

College context / information re Students.

This research was conducted at a large, multi-site, general FE college (Gateshead) in a city in the North East, UK. The college is one of the two largest in the North East, with approximately 5000 students enrolled, of whom 2400 are on full-time courses. Provision is offered to students aged 14 or over, with no upper age limit. The college provides a broad curriculum, vocational and academic, across subjects, industries, and the arts, at levels ranging from pre-entry all the way to degree-level qualifications. The college has several campuses across the region as part of its estate, with the research conducted across all campuses.

Socioeconomic deprivation is a characteristic of the city, influenced partly by the

economic recession and subsequent central government austerity measures. Within Gateshead, socio-economic inequalities exist as illustrated by the 2019 Index of Multiple Deprivation (CLG). Gateshead is ranked 47th most deprived out of 317 local authorities in England. Within Gateshead there are 21 areas which fall within the 10% most deprived areas in England, equating to almost 32,700 people or 16% of the population of Gateshead. Much of this deprivation is based within the central and eastern urban areas of the borough. Around 94,300 or 73.6% of working age (16-64) Gateshead residents are in employment which compares with an average of 75.8% for England as a whole (ONS Annual Population Survey Y/E Jun 2019), and around 5,620 or 4.4% are unemployed claiming jobseekers' allowance or universal credit (DWP Oct 2019), with 14% of residents classified as long-term unemployed (Census 2011), the eighth most deprived conurbation in the UK. When compared to the national picture, the city has higher numbers of lone-parent households and a higher number of residents with no qualifications; those who are employed are more likely to take up low-skilled, routine occupations.

The percentage of pupils achieving grade 4 or above in English and Maths GCSEs (similar to a high-grade C or low-grade B in the old grading) in Gateshead is 42.2%. The National Average based upon all schools is 39.8% (DfE School Performance Tables 2018/19). 'Attainment 8' is a score based on how well pupils have performed in up to 8 qualifications. In Gateshead, the score was 46.8 compared with the national average of 44.5 (DfE School Performance Tables 2018/19).

Further education was subject to a 'reduction in funding of 25%' (BIS 2012, 6) after the 2011/12 recession, with further austerity measures following that were coupled by an increasingly measurement-focused culture, fiercer competition for students and funding

linked to learner outcomes. Success, retention and achievement rates are more important than ever in FE in general and maths resits in particular.

Gateshead College offers a fast-track 30+-week GCSE course to learners aged 16-plus who have not yet achieved a full level-2 qualification, which has achieved considerable academic success with these students. This success has been achieved within a context of recruiting students from schools identified as some of the poorest performing in the country, where behaviour has been reported as poor and underachievement is high.

This research seeks to explore how these learners' school experiences affected their motivation and whether the Colleges success could be linked to motivational teaching strategies and underpinning of the ever-increasing skills gaps, the use of underpinning the Ks1-2 skills through interventions, drop-in sessions and a front loaded SOW with pre-set resources aimed solely at reinforcing these skills, they could re-engage and re train learners who had previously failed GCSE qualifications.

Research Aim

The starting point for this research was that the mathematical issue of gaps in learning is an obstacle to academic progress. The reasons for these gaps/obstacles are very important to inquire into but have not always been possible to address. The gaps is exposed in the students during the early mathematics classes. It has been found that standard of the students has become hampered depending on the severity of previous lack of learning in mathematics, the teaching methods of teachers, teacher-student relationships, use of technical words, etc (Nwoke, 2016).

It can be said that the mathematics of the Basic Education and the Core curriculum is very important for the development of the human mind. It enables a person to think logically and systematically, analyse various problems or situations, anticipate, plan, make decisions, solve problems, and apply mathematics in everyday life. Mathematics is the means of sharpening the individual's mind, shaping his reasoning ability, and developing his personality, hence, its immense contribution to the general and basic education of the people of the world. The Pedagogical Approaches in Mathematics Education (PAME) explored the responsibility of mathematics teachers to find out the problems and challenges to the integration mathematics and pedagogical knowledge (Das, 2019). It is an approach to finding out the error in the teaching and or learning process to determine whether infilling of basic knowledge enables a student to engage in higher-level problem-solving skills in order to attain a given qualification in a resit curriculum. This research report builds upon the idea of PAME.

Underachievement at GCSE level has significant effects on an individual's life chances. Each year, around half of 16-year-olds leave school without having achieved a full level-2 qualification (five GCSE sat 9*–1 including English and maths). Many of these students enrol on a programme of study at local further education (FE) colleges. Recent government reforms, including raising the participation age and compulsory English and Maths study up to aged 19, have reaffirmed FE as an agent to improve students' life chances and act as a catalyst to reduce youth unemployment. Further education colleges provide a 'second chance' for learners who have been let down by the school system.

Literature Review

Case Studies Annotated.

1: 'Does Repetition with Variation Improve Students' Mathematics Conceptual Understanding and Retention?'

This piece of literature provides insight into the opposite sides of the learning scale, differentiating between Western and Asian cultural implementation, while one believes that repetitive learning is the opposite of deep learning and understanding, the other considers repetition as an important route to understanding. The research refers to 27 different resources used in conjecture; these journal articles were peer reviewed.

Laila S. Lomibao[1], Santos O, Ombay[2] "Does Repetition with Variation Improve Students' Mathematics Conceptual Understanding and Retention?" ISSN(Online): 2319-7064, 2017, DOI: 10.21275ART20174479.

The authors conducted case studies of two approaches teachers can use to contribute to student learning within the Philippines. Western educators oppose the concept of repetition and emphasize the need for students to construct a conceptual understanding of mathematical symbols and rules before they practice the rules (Li, 2006). Similarly, many Western educators hold the view that students should be encouraged to understand rather than to memorize what they are learning as they believe that understanding is more likely to lead to high quality outcomes than memorizing (Dahlin & Watkins, 2000).The article describes the difference between repetition and repetition with variation, concluding that repetition with variation is the more substantial process. Our teachers were therefore advised to use repetition with variation within word questions.

2: 'Effects of Repetition Learning on the Associative Recognition over Time: Role of the Hippocampus and Prefrontal Cortex'

This article refers to the effects of the Hippocampus and the Prefrontal Cortex. It argues that when stimuli are learned by repetition they are remembered better and retained for a longer time. However, their current findings are lacking when it came to associating the Media temporal lobe (MTL) and other regions of the brain with the learning process.

Lexia Zhan[1], Dingrong Guo[1], Gang Chen[2], and Jionggjiong Yang[1*] "Effects of repetition Learning on Associative Recognition Over Time: Role of the Hippocampus and Prefrontal Cortex" Original research Published: 11 July 2018 : DOI: 10.3389/fnhurn.2018.00277

3: 'Repetition is the First Principle of All Learning'

This article describes the need for teachers to allow students to return to certain links in their learning which would yield a deeper meaning in a new context.

Robert F. Bruner: University of Virginia. First Published April 28, 2000

The article describes the ways to deliver content in a variety of ways for students to come to a Eureka moment of clarity. The process requires a much deeper thought process in its planning and development. The teacher must be led by an overwhelming need that, repetition is primarily important to learning, rather than teaching. The case to be made for building repetition into your teaching is that it supports several highly important educational goods: self-paced discovery, ability to reflect, consistency and clarity of thought – all these promote deep learning.

Conclusion

Though there are cultural differences and brain science is not yet conclusive, repetition has a strong role to play in learning. It appears apparent that whilst utilising repetition to promote learners' retention of mathematical concepts, this leads mainly to memorisation rather than understanding. By adding in variation to the process of learning through repetition, we can promote true conceptual understanding. We therefore decided to allow extra time in class after the procedural process of marking the starter activity, to discuss answers, alternative methods and common misconceptions arising from the questions. We expect that this will allow learners to develop their AO1 (procedural) knowledge and apply it to AO2/3 contexts (reasoning & problem solving).

Our research shows that students who have previously attended low-performing schools arrive at our FE College with low motivation, low levels of self-efficacy and a negative perception of education. Focus group discussions with GCSE resit students studying at an FE college, followed by individual interviews, revealed that school experience of unprofessional teacher-pupil relationships, a lack of discipline, inconsistently applied sanctions, a lack of academic support and prevalent low-level disruption all contributed to demotivating the students.

The introduction of a noticeable skills gap in their learning is reinforced by the data revealing that the curriculum content covered during Key Stage (KS) 1 & 2 (I.e. 5 to 11 year olds) is severely lacking in the majority of GCSE resit students at Gateshead College. The introduction of front-loaded lessons involving revisiting KS1&2 topic related skill set has helped our learners' experience at college. Classroom management strategies leading to learner ownership and autonomy, consistently applied behaviour management practices and

visible senior leadership have enabled learners to re-engage in their mathematical education at FE and successfully produce evidence towards their GCSE journey.

Methodology

Two interventions were developed.

Intervention 1 – Group Sessions

The participants were drawn from the 500+ students enrolled on a fast-track GCSE programme. Most of the possible participants were aged from 16–18, but the sample.

group also had students aged 19 and over, with the largest group being 16-year-old school leavers.

'Purposive sampling' was used (Punch 2005) to select the final participants. The sampling approach was carried out through analysis of performance in end of lesson 'exit tickets and previous starter scores carried out in term 1, enabling the inclusion of males and females, across a range of ethnicities, all achieving below the average of their peers. The final sample group of 80 learners was representative of the 16–18-year-old students in the complete cohort of 500+ students.

Interviews were conducted a third of the way through their GCSE course, in January 2021, giving the participants both an opportunity to adjust to a new learning environment and to benefit from 6 weeks intervention programme. The full cohort were given access to all the resources during interventions but only the selected 80 were given the opportunity to attend smaller group sessions focussed clearly on the identification and re teaching of Ks1-2 skills.

The unexpected arrival of Covid-19 almost halted the process of 1-2-1 interventions but due to an online delivery system in place and preparations for such interruptions we managed to maintain at least 85% of our study group. they would consistently attend a separate lunch break (20 Min +) delivery of basic concepts, with a 100% completion of study worksheets and or multiple resources.

This intervention took place over a period of approx. 6 weeks during March and April. The original plan was to carry out this activity over a longer time frame but the impact of the Covid pandemic meant learners were working remotely until March, which reduced our window.

Intervention 2 – Starter Activities

To investigate the conceptual understanding through repetition, comparison was made between two vocational groups. These were chosen as they both belonged to the main researcher and allowed for a seamless implementation whilst minimising other differences in delivery methods. They were Art, Design & Media (ADM) and Sport. We believed that the specific vocational area was largely irrelevant to the intervention and any cohort of learners would be able to fully participate in the research.

Learners in ADM classes would continue to answer the starter questions (10 basic AO1 questions across a range of topics) and the answers would be given by the teacher, with brief explanation & discussion; 10 minutes for completion followed by 5 – 10 minutes for answers. Sport learners would carry out the same activity but would be given an extra 15-20 minutes to discuss the answers. This discussion centred on proof, alternative methods and investigating misconceptions. This led to a richer learner experience.

This intervention lasted between January and April and was not as affected by the pandemic as the sport learners still completed the starters whilst working remotely.

Results and Discussion

Our aim was to understand and investigate the belief that the primary reason many learners do not make sufficient progress when completing post-16 GCSE maths resit programmes, is due to weak/absent skills and/or misconceptions in their lower Key Stage attainment. Specifically, that by focussing on these areas, we can accelerate their understanding and progress with KS3 & 4 topics, preparing them for future success in exams.

It became apparent that learners completing a one-year programme would not have enough time to focus exclusively on teaching and learning methods aimed only at addressing these skills gaps. We would need to explore strategies that allowed them to continue learning the KS3/4 GCSE course whilst concurrently developing their KS 1-3 skills.

We devised two methods: completing starter activities in all sessions and a series of small group intervention sessions. Both would be aimed at number skills at lower key stages. We identified approximately 80 learners to be part of the study, across two vocational areas - Sport and Art & Design (ADM). Due to the impact of Covid, the physical group sessions were not as viable and though the impact appeared positive, the starter activities became the main focus.

For these starters, we allowed the ADM groups 10 minutes to complete 10 questions, with a further 10 minutes to mark and briefly discuss answers. For Sport learners, they were allowed 10 minutes to answer, with a further 30 minutes to mark and discuss. The discussions were a deep-dive approach, giving time to fully dissect the origin and meaning of the mathematics. They explored alternative methods and misconceptions, not just procedural (AO1) answers. They gave learners a chance to fix skills gaps and create links to other topics, whilst promoting reasoning and problem-solving skills (AO2 & 3).

The results of these were recorded for both groups and compared *(Fig.1);* Sport learners achieved consistently higher results in both starters and other weekly assessments - 'Prove Its' -, designed to explore AO2/3 skills *(Fig.2).*

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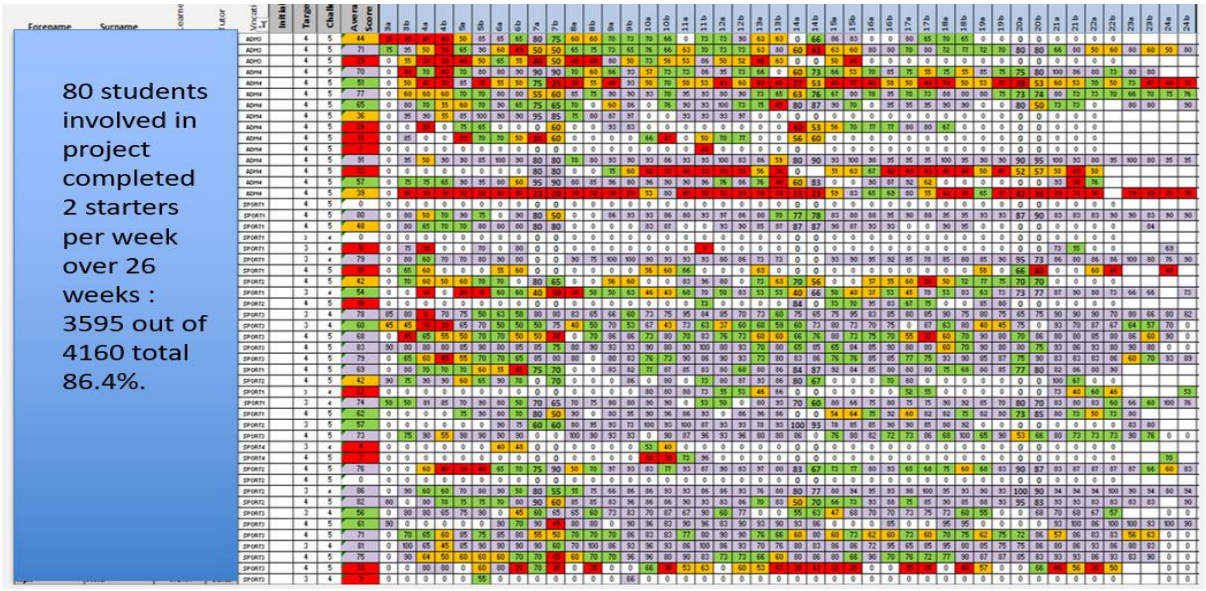

Figure 1: results of starter scores for ADM vs. Sport.

The rows above show one group at the top with standard use of starters with a range of red and amber colours (Traffic light) where towards the bottom of the graph you see the sports groups colours green to platinum much earlier on in the year.

Grade Boundaries:
5 > 80%
4 > 65%
3 > 50%
2 > 35%
1 > 20%

Target Grade 3	≤1	2	3	≥4	Target Grade 4	≤2	3	4

								TERM 1														TERM 2									
								Number					Stats		Geometry							Algebra						Comp. Meas.				
Vocational Area	Initial Assessment	Target	Challenge	Prove It Average	EoTA Average	EoTA Indicated	Outstanding Prove Its	Week No.	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
									Basic Number Skills	Primes/Factors/HCF/LCM	Probability & Venn	FDP	EoTA - NUMBER	Charts & Graphs	Averages	Angles	2D & 3D Shapes PAV	Transformations	Pythags & Trig	EoTA - STATS & GEOMETR	Simplifying Algebra	Expanding & Factorising	Equations	Sequences & Inequalities	Algebraic Graphs	EoTA - ALGEBRA	Ratio & Proportion	Proportion & Scale	Percentage Change	EoTA - RATIO & SCALE
ADM3		4	5	60	79	4	0		40	76	70	47	65	55	45	60	48	45	31	80	69	92	53	70	80	88	57	54	79	83
ADM3		4	5	48	63	3	14		40	45	73	47	60			65	18			65										
ADM3		4	5	47	53	3	12		33	65	73	39	73	75	53			1	40							32				
ADM3		4	5	55	73	4	8		55	90			75	70	40	35	40	16	55	65	74	75				80				70
ADM3		4	5	48	59	3	0		55	28	57	39	75	45	46	45	48	73	50	45	47	32	26	55	38	65	52	58	66	50
ADM4		4	5	76	71	4	0		52	92	69	83	78	83	46	50	59	56	80	43	86	88	100	100	66	63	95	70	95	100
ADM4		4	5	39	44	2	13		41		31	70	60			50	40	39		28								0		
ADM4		4	5	60	70	4	11		75	65	65	74	70	63	64		63	56	73									0		
ADM4		4	5	63	72	4	0		44	52	96	78	65	87	57	85	59	84	50	80	48	36	43	60	57	75	71	87	42	67
ADM4		4	5	46	61	3	7						60		63	20	37		40	65	57	57	25	53	42	53	60	50		66
ADM4		4	5	56	70	4	0		48	30	61	47	73	79	60	60	62	67	83	47	47	36	43	70	47	65	61	58	45	96
ADM4		4	5	46	45	2	14				76		57		60					33	44	38	55					0		
ADM4		4	5	64	65	4	0		51	75	68	73	59	68	78	60	44	78	22	68	74	56	57	78	71	65	76	50	66	67
ADM4		4	5	67	84	5	7		56	52	76	78	88	66	68	35	81	78	90	80						75		0		93
ADM4		4	5	47	57	3	6			47	60		38		50	60	33	23		55	64	64	50	59	50	76		0		60
ADM4		4	5	48	46	2	0		37	26	38	47	50	50	54	15	37	78	63	35	62	33	48	66	52	47	52	66	41	53
ADM3		4	5	42	55	3	1		45	20	46	26	68	70	46	45	33	44	31	43	43	40	33	48	33	60	61	45		50
ADM4		4	5	58	68	4	4		41	52	53	65	70	75	50	60	51	73	90	57	51	56	40			78	80	33		
ADM4		4	5	64	59	3	3		48	72	80	83	50	90	54	45	70	66	63	63		78		44	76	65	35	63		56
ADM4		4	5	69	66	4	1		59	87	62		70	85	53	65	40	38	76	48	85	76	70	82	62	73	62	97	67	74
ADM3		3	4	33	25	1	11		25	13	26	17	25	66	40	45	40	34	22											
ADM3		3	4	39	58	3	11		44		35	52	72	63			20		23	68						50	38			40
ADM4		3	4	37	69	4	0		20	35	31	30	88	75	28	30	15	56	45	50	39	32	13	52	66	65	24	29	46	73
ADM4		3	4	19	29	1	11			24	20	44	60		7	30	11			0						30		0		27
ADM4		3	4	27	27	1	0		10	25	15	20	35	25	31	30	44	17	34	18	32	38	26	26	20	26	20	33	36	30
ADM4		3	5	42	43	2	6			48	77	55	65	58	43	35	30	34	23	25		42				43	60	0		40

Figure 2: weekly ‘Prove It’ assessments for ADM groups.

Grade Boundaries:
5 > 80%
4 > 65%
3 > 50%
2 > 35%
1 > 20%

Target Grade 3	≤1	2	3	≥4	Target Grade 4	≤2	3	4	5

								TERM 1													TERM 2													
								Number					Stats		Geometry						Algebra						Comp. Meas.							
Week No.								3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
Vocational Area	Initial Assessment	Target	Challenge	Prove It Average	EoTA Average	EoTA Indicated	Outstanding Prove Its	Basic Number Skills	Primes/Factors/HCF/LCM	Probability & Venn	FDP	EoTA - NUMBER	Charts & Graphs	Averages	Angles	2D & 3D Shapes PAV	Transformations	Pythags & Trig	EoTA - STATS & GEOMETF	Simplifying Algebra	Expanding & Factorising	Equations	Sequences & Inequalities	Algebraic Graphs	EoTA - ALGEBRA	Ratio & Proportion	Proportion & Scale	Percentage Change	EoTA - RATIO & SCALE	Fake Mock Calc	Fake Mock Non-Calc	Fake Mock Average
SPORT3		4	5	62	71	4	0	65	31	95	39	65	46	80	30	60	66	70	75	85	60	80	70	60	50	70	65	50	95	49	56	5
SPORT4		4	5	52	60	3	0	56	52	65	86	75	60	46	80	0	50	18	33	45	50	54	60	85	75	80	0	54	56	65	70	6
SPORT4		4	5	41	67	4	0	55	48	26	53	73	25	28	35	37	90	64	65	57	42	55	66	0	48	62	0	0	83	61	66	6
SPORT4		4	5	36	68	4	15					68			35	96	84									0	0	0		47	65	5
SPORT3		4	5	62	63	3	0	52	40	70	52	58	90	85	80	40	72	68	50	53	30	40	75	61	82	80	73	58	63	61	69	6
SPORT3		4	5	55	46	2	0	37	30	70	56	40	70	42	45	40	61	50	30	56	66	45	51	61	57	80	58	70	58	54	60	5
SPORT3		4	5	63	76	4	0	55	43	45	55	77	87	86	75	63	100	81	72	70	45	53	74	38	80	48	66	58	76	68	58	6
SPORT1		4	5	64	70	4	6			73	91	70		95	100	30	77	50	63	48	32	77	48		68		50		80		76	
SPORT3		4	5	79	80	5	3				78	72	87	75	80	85	100	86	77	73	75	70	85	42	88	85	83	75	83	79	74	7
SPORT1		3	4	46	59	3	10	48	34	15	50	56				40	77	50	50						40	57			90	61	53	5
SPORT1		3	4	53	64	4	0	40	43	30	34	78	83	64	65	37	66	45	53	65	52	33	78	48	53	47	88	38	73	44	58	5
SPORT4		3	4	63	60	3	1	40	39	69	91	52	87	61	60	59	95	46	64	70	79	80	59	52	65	71	79	0		57	84	7
SPORT4		3	4	63	64	3	0	63	57	69	78	70	58	54	55	63	66	63	48	57	58	60	70	77	70	62	67	58	67	51	73	6
SPORT3		3	4	68	55	3	9	60	39	62	48	43	88	71	90	59	88	72	73						48					82	55	6
SPORT1		3	4	68	65	4	0	63	60	76	78	65	83	64	70	56	33	50	40	74	64	66	69	81	58	90	75	72	97	88	71	7
SPORT1		3	4	70	64	4	0	62	61	69	45	60	92	75	60	48	70	81	57	80	48	50	88	71	70	85	89	83	70	55	75	13
SPORT3		3	4	48	47	2	14	44		50		50		60							30	53	52		44							
SPORT2		3	4	77	82	5	0	47	40	69	65	75	83	71	75	75	100	68	75	96	88	90	93	86	85	86	80	71	94	82	74	7
SPORT3		3	4	67	56	3	0	44	39	65	40	40	87	89	75	48	100	81	65	70	50	50	74	66	70	85	79	62	50	74	71	7
SPORT3		3	4	51	48	2	4	51	43	50	86	50	71	43	45	20	27	37	45	68		53	52		43		63		53	63	63	6
SPORT3		3	4	36	46	2	4	18	30	34	52	35	46	35	10	15		27	60	47		60			60	52	46	34	30	56	46	5
SPORT4		3	4	41	24	1	16	44			47	24			30	45	40													34		
SPORT2		3	5	76	63	3	3	95	75	85	95	60	79	78	70	81	50	54	66	69	75	50	100	90	62			66		70	63	6
SPORT3		3	4	66	70	4	2	41	30	57	35	60	87	57	85	77		68	78	78	75	56	85	66	63		83	75	80	79	63	7
SPORT1		3	4	46	45	2	5	48	35	88	30	38	70	46	45	14	55	40	55			23			45	57	45		43	55	58	5
SPORT4		3	4	83	66	4	0	33	61	65	86	68	96	89	95	96	98	60	42	85	90	83	92	90	63	95	87	87	90	86	83	8
SPORT1		3	4	#######	40	2	19					48							40						33					33	46	3
SPORT4		3	4	52	58	3	8	41	22	46	57	68	71			48	36		43	64		33	67		63			86		47	50	4

Figure 3: weekly ‘Prove It’ assessments for Sport groups.

The colour code remains the same showing a steady increase of retention with the other groups and a stronger retention from four weeks into programme with the sports groups.

TERM 3 - TAG Assessments																
	1			2			3			4			5	6		7
	Number Ratio NC	Number Ratio C	OVERALL	Number Ratio NC	Number Ratio C	OVERALL	Algebra A	Algebra B	OVERALL	Number Ratio NC	Number Ratio C	OVERALL	Geomtery	Number Ratio NC	Number Ratio C	OVERALL	Statistics/Probability
	100	100	100	100	72	80	92	66	86	58	63	60	68	80	83	81	90
	100	100	100	100	92	94	93	100	95	100	96	98	95	92	94	93	95
	89	48	68	100	56	68	77	42	66	58	81	69	61	68	82	74	73
	76	76	76	78	40	50	27	33	29	76	76	76	66	72	77	74	33
	89	89	89	88	66	68	46	53	49								
	47	24	35	40	32	35	27	0	20	37	13	26					
	71	41	56	60	64	65	42	75	53	42	81	60	44	60	53	57	45
	71	53	62	66	52	56	54	33	49	74	63	69	48	52	35	45	68
	83	75	79	88	68	74	82	78	80	74	94	83	45	85	67	80	55
	65	65	65	56	44	47	93	79	83	90	75	83	58	88	100	93	80
	94	100	97	100	64	82	55	100	66	85	94	89	79	96	100	98	75
	76	41	62	89	44	56	35	78	46	26	31	29	61	84	35	64	45
	94	100	97	89	96	94	88	83	92	87	100	89	75	72	77	74	88
:	65.8	55	60.6	73.2	52.7	58.1	56.6	42.7	51.6	44.3	55.5	49.3	49.7	61.3	53.4	58.1	61.5

TOTAL 56%

Figure 4: TAG results of all cohorts *except* Sport, showing average per assessment and overall average

We also analysed the results of our Teach Assessed Grades assessments as these were a timely and effective resource. They were comprised of two sections: section A containing AO1 questions only and section B containing AO2 & 3 questions only. Papers were focussed on either Number & Ratio, Algebra, Geometry and Statistics. For this research, we only looked at the results for Number & Ratio, though all topics showed similar results.

These showed a clear achievement gap between the cohorts *(Fig.3, Fig.4);* Sport learners achieved an increase of 5.4% when looking only at section A (AO1) *(Fig.5)*. This is the equivalent to approx. 12 marks across a suite of 3 exam papers (or 6 marks of the available AO1 questions).

However, when looking at AO2/3, the gap is more pronounced *(Fig.6)*; Sport learners achieved 14.2% more marks compared to ADM, which is up to 34 marks over 3 papers (or 17 marks of the available AO2/3 questions). Combined, this is a potential increase of 23 marks, or approx. 10% of the total for 3 papers (240 marks).

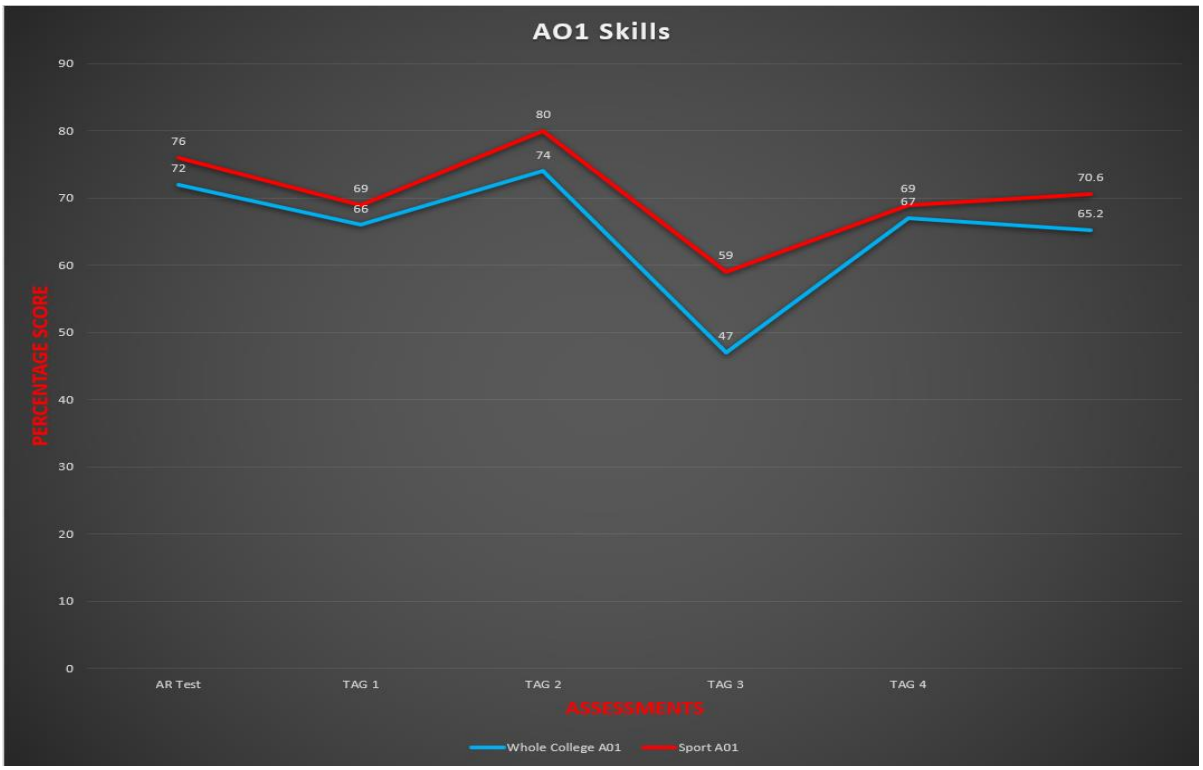

Figure 5: TAG results of Sport cohorts vs. all others, showing average for each of 6 assessments for AO1 Process components.
The red line represents the sports student average figures across a six week period of end of year Tag results, the line is consistently above the college average across all subjects.

Since the introduction of the new 9-1 specification, the average step between grade boundaries 3 to 4 has been 14.6% (42% to 56.6%).

This uplift therefore represents two-thirds of the step between grade boundaries 3 and 4 and would see a significant number of learners achieving a grade 4 in an exam scenario.

It should be noted however, that these results were not obtained in standardised exams but in a TAG assessment scenario, which also affords other advantages to learners not associated with formal exams.

In summary, learners spending significant time addressing skills gaps and misconceptions at KS1-3 achieved assessment results far better than those that did not, all other factors being equal; ADM achieved 44% high grades, and Sport achieved 74% high grades.

TERM 3 - TAG Assessments

1			2			3			4			5	6			7
Number Ratio NC	Number Ratio C	OVERALL	Number Ratio NC	Number Ratio C	OVERALL	Algebra A	Algebra B	OVERALL	Number Ratio NC	Number Ratio C	OVERALL	Geomtery	Number Ratio NC	Number Ratio C	OVERALL	Statistics/Probability
94	100	97	100	87	91	100	80	93	89	57	74	91	88	79	86	93
94	47	71	100	96	98	81	86	83	69	69	69	95	56	52	55	82
71	77	74	78	60	65	70	40	58	37	63	49	50	60	65	63	63
58	12	36	55	32	37	31	20	26	32	6	20	18	40	12	41	30
0	0	0	0	0	0	0	0	0	53	38	46	48				
12	36	24	66	8	24	20	26	22				24	19	0	1	40
77	77	77	100	84	88	0	0	0	0	0	0		76	47	63	
77	94	85	88	60	68	76	66	73	53	82	66	73	56	88	69	78
76	76	76	88	64	71	50	73	58				48	88	65	78	73
77	30	50	44	72	65	23	53	34	26	62	43	33	64	79	71	62
100	89	94	100	88	92	96	93	95	100	94	94	83	91	100	95	95
77	77	77	66	48	53	46	48	46	32	63	46	43				65
47	58	53	78	48	56	23	40	30					72	56	66	40
88	88	88	88	100	97	93	86	91	95	100	97	60	94	88	90	100
66.8	67.2	67.9	78.5	66.6	70.3	58.6	61	59.2	58.7	67	62.3	61.5	69.2	64.4	67.4	73.7

TOTAL 66%

Figure 6: TAG results of Sport cohorts, showing average per assessment and overall average

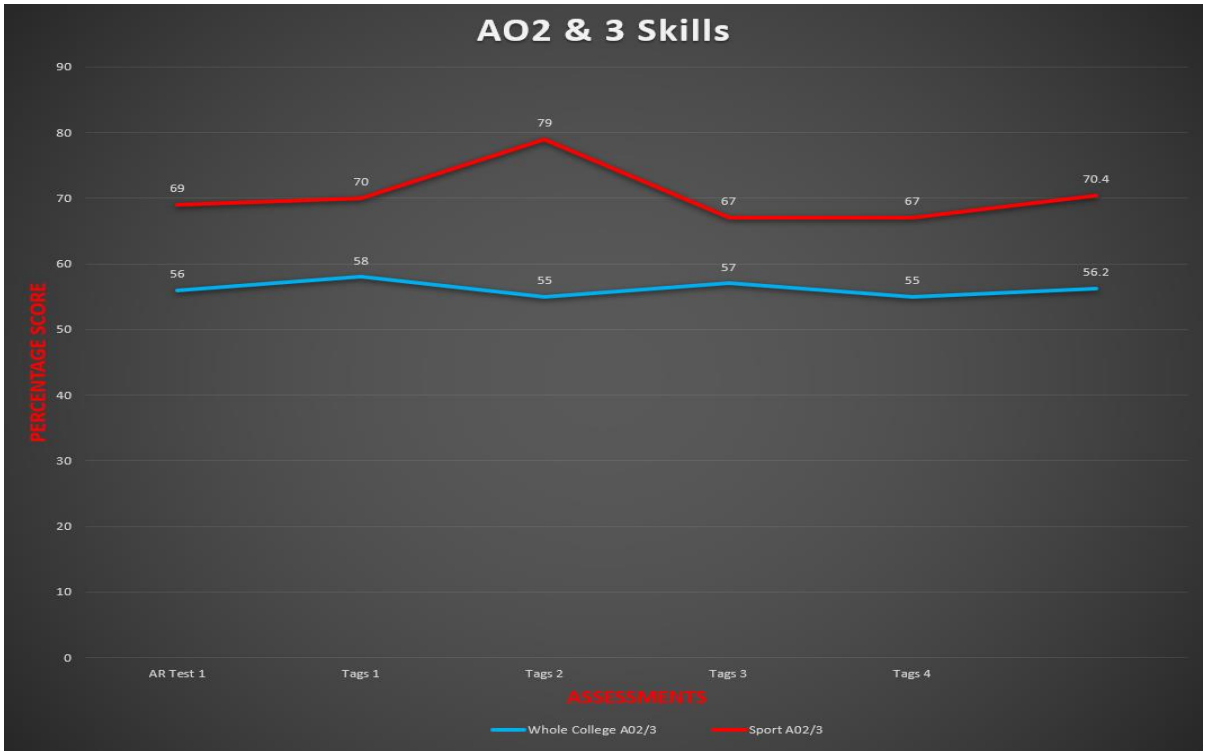

Figure 7: TAG results of Sport cohorts vs. all others, showing average for each of 6 assessments for AO2/3 Reasoning & Problem-Solving components.

Conclusions and Recommendations

Conclusions

This study addresses teaching and learning strategies for teachers to develop a deep understanding of students' progress through post-16 GCSE maths resit programmes. This study shows that attitudes towards the gaps in learning and its causes are significantly and positively correlated towards further achievement in mathematics. Our teachers found that interventions around the addressing of the gaps in learning at lower key stages are directly linked to behaviours and engagement in students and provide the positive emotional and motivational conditions necessary for deep learning.

In the FE sector, knowledge of the KS 1- 3 curriculum is too often overlooked and assumed to be present and correct. Many schemes of learning proceed with this assumption in mind and address only skills commensurate with higher KS3 and KS4. With such low numbers of 16-18 learners failing to achieve high grades if FE resits, perhaps it is time to include specific consideration for pedagogical approaches to include KS 1 – 3 skills to be discretely developed. Our research indicates that there is a potentially significant benefit to adding such goals to a broader curriculum.

Recommendations

Our delivery plan for following years will include discrete assessment of ‘assumed’ prior knowledge and delivery of strategies to address skill-gaps and misconceptions of the KS1 – 3 curricula. We recommend that other FE practitioners consider explicitly addressing the concomitant issues of poor KS1 – 3 attainments but;

1. do so in such a way that does not limit the ability of learners to access the KS3/4 curriculum in order that they can still progress and achieve in formal exams.
2. make learners are aware of the process and the reasons behind it
3. deliver interventions discretely from other topics
4. deliver interventions consistently across the length of the programme
5. build upon such interventions when delivering the GCSE curriculum by making links obvious and routine.

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Appendices

i. *Example of two TAG assessments, showing AO1 section A and AO2/3 section B, is attached.*

ii. *Data tracker showing weekly performance of ADM & Sports groups is attached.*

iii. *Data tracker showing weekly performance in starter activities is attached.*