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EDUCATION & TRAINING FOUNDATION
CENTRES FOR EXCELLENCE IN MATHS

How does using a Maths hub, with specialist Maths software and timely intervention from in-class Maths specialist study-mentors, impact how students engage with Functional Skills Maths as they transition back to onsite delivery post-pandemic?

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About CfEM

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

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

Summary

The aim of the 2021-2022 action research (AR) at New College Stamford was to investigate how using a Maths hub approach supported by technology could positively impact upon students' engagement with Functional Skills Maths as they transition back to onsite delivery post-pandemic.

A weekly intervention and a monthly reflective participation by one Lecturer and four MSSMs (Maths Specialist Study Mentors) offer insights into how students adapted to the interventions that were put in place, namely: the introduction to in-lesson MSSM support, Maths Master teaching and learning strategy and use of Maths specialist software (Century Software), for a period of six months October 2021 to March 2022.

The main quantitative research tools used to gather responses to the research questions will be as follows: Student diagnostics; MSSM reflective tools; student online and written work; student questionnaires and group interview and lecturer and MSSM focus group feedback

Results from the first AR cycle indicated that there is a place for MSSMs in the classroom. Equally, having MSSMs in the classrooms promotes a more meaningful collaboration with the Study Centre (a service within the college, where students go for extra tuition).

This collaboration between MSSMs and Maths Lecturers, for example, in the planning and delivery of FS Maths is beginning to enhance how support is sequenced in the Study Centre to reflect the way students are taught in the classroom.

Equally, the Study Centre staff are becoming increasingly experienced in strategies to support students in line with exam standards.

Data also points to students gaining a deeper understanding of identified exam topics that they find difficult through Maths Mastery approaches to learning. The issue of time allocated in a lesson has continued to be a challenge in how students access Maths Specialist Software.

Contents

Background

The Covid-19 pandemic swept across continents towards the end of 2019/20 and the whole of 2020/21 academic year. The majority of students found themselves attending their school/college lessons on-line and at home. Colleges have not yet recovered from the aftermath of this.

COVID-19 pandemic and the social distancing measures that many countries implemented have caused disruptions to daily routines. Students and young people's mental health has been left poorer for it (The Lancet; Mental health effects of school closures during COVID19). This academic year, 2021/22, continues to be impacted by the Covid-19 pandemic situation and the Further Education sector has had to respond swiftly to supporting students integrating back into a more traditional educational setting.

The on-going lockdown of schools and colleges has meant the educators are left without benchmarks for this academic year. The FS Maths department at New College Stamford, England, conducted a sampled data analysis[i] which identified exam topics that students consistently failed to achieve at level 1 and 2. The data demonstrated that the most failed topic in the FS Maths exam is working out percentage questions. 81% of students at FS level 2 failed and could not solve 'increase and decrease percentage questions' and for L1 FS Maths students, only 5% of students could calculate simple interest in multiples of 5%. These data markedly emphasized a direct correlation of a knowledge gap of percentage scenarios at both L1 and L2 FS Maths.

This AR will focus on identified failed exam topics at FS Maths L1 and L2. Please find them listed below:

L1

- SCS18: Calculate simple interest in multiples of 5% on amounts of money
- SCS14: Calculate percentages of quantities, including simple percentage increases and decreases by 5% and multiples thereof
- SCS3: Multiply and divide whole numbers and decimals by 10, 100, 1000[ii]

L2

- SCS06 Calculate percentage change (any size increase and decrease), and original value after percentage change.

The above findings are consistent with the last few years' achievement patterns, where students have shown poor results in questions to do with percentages, fractions and decimal work.

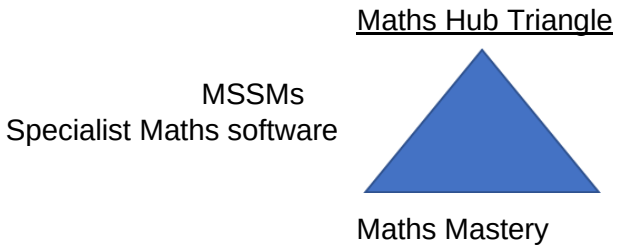
The models of teaching and learning in the last few years have steered away from the traditional forms of teacher-centred delivery into more student-centred approaches and more recently, with the advent of COVID-19 pandemic, has seen blended learning propel to the forefront.

This standalone Action Research (AR) investigated how using Maths specialist software and timely intervention from maths specialist mentors will impact how students engage with FS Maths as they transition back to onsite delivery. The use of the in-lesson Maths hub initiative

bridged identified knowledge gaps, namely solving percentage and fraction type questions. Data will be collected, analysed, conclusions drawn, and findings shared.

The in-lesson Maths hub at New College Stamford places emphasis on Maths Mastery, student support from MSSMs and use of Specialist Maths software on targeted topics drawn from last year's FS Maths exam results[iii]. The idea of the hub was to triangulate within the classroom the MSSMs support of students on targeted topics and apply Maths mastery as a learning strategy. Students also had opportunities to consolidate their learning through the use of Century software.

Fig 1



The aim of the 2021-2022 stand-alone AR at New College Stamford was to investigate how using an in-lesson Maths hub of Maths software and timely intervention that applies Maths mastery by in-class Maths Specialist Study Mentors (MSSM) impact how students engage with Functional Skills Maths as they transition back to onsite delivery.

Introduction and College Participation in CfEM

New College Stamford (NCS), Further Education college is part of the IEG (Inspire Education Group) having officially merged with Peterborough Regional College in 2021. On average New College Stamford enrols 2500 student in a single academic year. Of those, about 850 students will undertake their Maths and English at either, A level, GCSE or Functional Skills (FS). In the current academic year an average of 150 students will sit their FS Maths, either at Entry Level 3, Level 1 or Level 2.

New College Stamford's Maths department is on its third year of participation in the CfEM (Centres for Excellence in Maths) initiative. In past research models, the department has researched embedded and blended learning.

One of the key contexts of the 2021/22 standalone AR is based on FS Maths exam results data for level 1 and 2. The data analysis demonstrated a consistent under achievement in specific topics, within the exam standards. Two of the topics are fractions and percentages. The idea of a Maths hub with Maths specialist learning support staff was organised with an aim for closer collaboration with the college Study Centre department, where students register for extra tuition on subjects that they are falling behind with in lessons. The students also enjoy Maths specialist software, and this standalone AR is interested in exploring to what extent this triangle of support will help students to gain improvements in the identified topics.

Literature Review

Maths Hubs

In England, Maths hubs, first introduced in 2014, have come to mean a partnership of 40 schools, colleges and other organisations working together to provide support for maths teaching (Shanghai-style maths hubs revealed by government, TES, 2014). At the core of the programme is the promotion of sharing good practice (TES, 2014: ETF, CfEM, Principles and Practice, 2020).

For the purpose of this AR, an in-lesson Maths hub was set up to meet learning needs of our students who find Maths a challenge and certain topics problematic. Students enrol with us having failed to achieve Maths GCSE (Grade 4) in school and often lack confidence in their ability to understand the subject (National Numeracy, 2020; pg. 4 & 14) and in some cases, they have built up barriers to engage with maths delivery which makes achievement impossible for them.

Maths Mastery

Since 2015, the National Centre for Excellence in the Teaching of Mathematics (NCETM) has been advocating a mastery approach to teaching Maths, heavily influenced by high-performing international education systems, notably in Shanghai and Singapore (ETF, CfEM, Principles and Practice, 2020).

The phrase 'teaching for mastery', describes the elements of classroom practice and school organisation that combine to give students the best chances of mastering Maths. Achieving mastery sees a student acquire a solid enough understanding of the maths that has been taught and moves the student on to more advanced material (NCTEM, 2020).

Adopting a mastery approach in a post-16 setting is not without challenges. Students in college with Maths knowledge gaps have gone through the secondary school Maths experience of rote learning, usually compounded by time pressures to complete curriculum agendas.

One of the delivery challenges within this standalone research that we are encountering has been time deficiency. However, succinctly targeted topics, targeted planning and delivery has allowed students to gain understanding and proficiency in solving tasks (Askew et al. 2015).

Maths Specialist Support Mentors

COVID-19 pandemic and the social distancing measures implemented have caused disruptions to daily routines and has come to be a detriment to students and young people's sense of wellbeing (The Lancet; Mental health effects of school closures during COVID-19). This standalone AR has sought to introduce SMMS in the classroom to further support students and promote confidence as students return to the classrooms.

The college benefits from a students' Study Centre to which learners register to receive extra support in varied subjects including Maths. They attend sessions outside of their timetabled lessons. One of the benefits to the study centre is that the SSAs (Study Support Assistants) working in the Study Centre have Maths Specialism (qualifications and experience). It is from this group of SSAs, that MSSM were recruited to join the lecturer in the classroom. They were also able to collaborate with the lecturer in the teaching and support of Maths Mastery within the classroom.

Debates on the role and use of having TAs (Teaching Assistants)/LSAs (Learning Support Assistants) within classrooms in inclusive schools and colleges have continued. Support for the view that individual support and a smaller adult–pupil ratio could help improve achievement has been found in a range of studies (Muijs & Reynolds, 2003) quoting (Mortimore et al., 1988; Iacovou, 2001; Wenglinsky, 1997; Mosteller, 1995). The role of LSAs is predominantly supporting teachers in educating and teaching students in a classroom. A study published by the European Journal of Special Needs Education in 2021 found that there is a negative relationship between LSAs' support and students' academic progress and a correlation between lack of qualification requirements in subject areas that LSAs work in (Breyer, et al., 2021).

Caution is needed when implementing such support measures, because it does not always equate to students' achievements and progress. The specialism in Maths of the SMMS, within this standalone AR, has fostered a level of confidence and efficiency from which the students are reaping benefits.

Maths Specialist Software

Further Education providers have continued to be highlighted for their "under-use of technology in schools and lack of good quality mathematics software". This can still be identified as a key issue in the teaching of maths in Further Education which has been predominantly focused on traditional classroom taught sessions (NCETM, 2010). The Office for Standards in Education (Ofsted, 2008) highlighted the lack of use of digital technology in mathematics in classrooms. The report from Curtis in 2019 supports this view as he considers that Government control of the curriculum and examinations has been increasing with little focus on using digital technology in secondary mathematics curriculum or examinations.

Following 2020-21 AR, promotion of blended learning that includes integration of specialist online Mathematical software has continued with the Maths and English department in the college. This, however, has not been without some challenges brought by the covid-19 pandemic. Students have found it somewhat difficult to settle down following lockdown disruptions. Effective training and allowing time to review practice is essential for widespread adoption of online technologies and their teaching opportunities. This is certainly true of a digital environment that is constantly evolving at speed which also affects the role of the tutor. The NMC/CoSN Horizon report (Freeman et al. 2017) highlights the difficulties faced by teachers today. The college has continued to invest in Maths specialist software, CPD for Maths lecturers, availing them with knowledge and skill of delivering blended learning (McKinsey, 1997). The success of using technology in the classroom is dependent on a teacher's skill set (McKinsey & Company 1997).

This theme continues in later articles such as Benning, I. et al (2018), some 20 years on, that identifies ''teacher disposition towards ICT is very positive with strong belief about the importance of ICT in the classroom. However, with limited knowledge, skills and time, the teachers found difficulty implementing ICT in ways they had hoped.'' While Curtis (2019)

identifies that without support, training and raising of the digital technology profile in curriculum and examinations as a teaching aid, progress will continue to remain constrained and in addition, Preston also reported on the breakdown of equipment acting as a disincentive to using digital technology (Preston et al, 2000).

Promotion of blended learning following last year's lockdown, which resulted to students learning 100% on-line has meant that students have returned to the classroom with increased IT skills and more likely to further engage with Maths software. The 59 students who took part in this current AR engaged with Century Maths specialist software. The use of the specialist Maths software consolidated and assessed students' knowledge and skills on topics learnt in lessons. Bar modelling was used to teach percentages and fractions which is also found within the Century software.

Methods

Research design

The same methods were used in two cycles applied in this AR.

Our AR project took place over two cycles. The project used a mixed method approach, utilising both quantitative and qualitive data. 59 students took part, 1 lecturer and 2 MSSMs.

The main quantitative research tools used were as follows

- **Students' diagnostic questionnaire**, which was used to assessment students' confidence in topics covered. The students' questionnaire used modified language, colour and images to differentiate and include students with varied learning needs to participate. Participating students responded well to the diagnostic questionnaire and all questions were completed.

- In addition, to capture students' engagement on specific areas of difficulties and to identify barriers to learning in-line with identified key topics, **MSSMs wrote lesson reports** after every lesson and used the information to complete monthly report.

- the first cycle 12 out of the 59 **students also completed an additional questionnaire with open-ended questions and an interview** that allowed them to reflect on the 3 lessons delivered.

- At the end of the first cycle, the **lecturer and 2 MSSMs took part in a focus group** and reflected on the first AR cycle and outlined lessons learnt; they also discussed plans for the second cycle in January.

Confidentiality matters were considered and applied all throughout the AR. All players were approached in this regard, especially the students who were informant and their consent requested. Data will held in line with the college's data policy.

The first cycle took place took place in October-December 2021 with conclusion and review in end of December 2021. The second cycled commenced in February 2022 after a review of actions from cycle one.

Thematic Coding

The qualitative data results from the first cycle were derived from the lecturer and MSSMs reflective monthly reports and from their focus group. Equally, student feedback was gathered from a group interview which consisted of three open ended questions. The data harvested was thematically coded. Interview was transcribed and later theme coded.

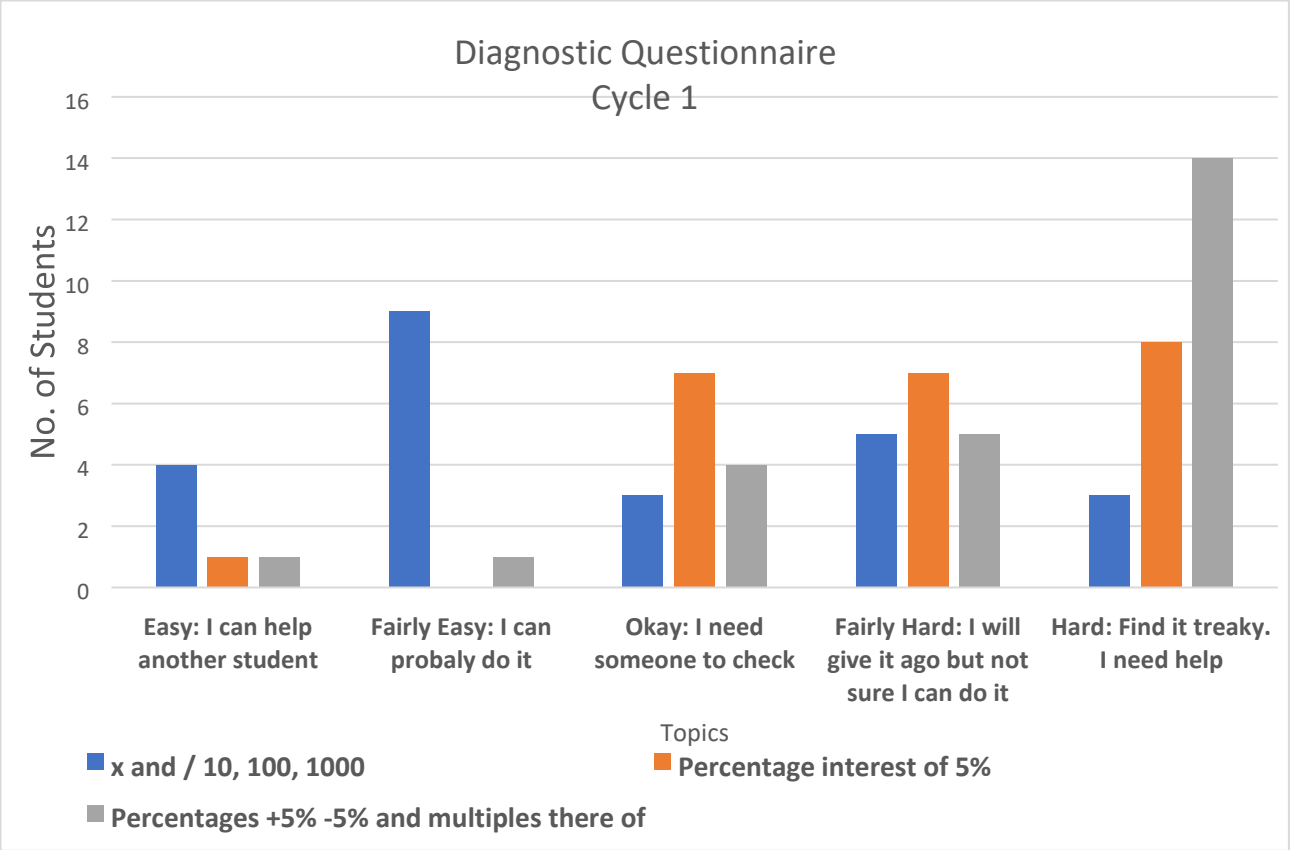
Words, phrases and ideas that are similar were grouped in colour codes with an aim of identifying patterns and results presented on a table format. Overlapping ideas were identified and frequency of themes outlined, from most frequent to the least frequent; where necessary, language was cleaned up, for example, 'coz' into because.

Results and Discussion

Results and Findings Cycle 1

Diagnostic Questionnaire

A student diagnostic questionnaire was given to the 59 participating students prior to the mastery lessons and allowed them to reflect on how confident they felt in identified course topics. There was a need for the lecturer to explain what each topic meant; this helped students to understand the diagnostic questionnaire before completing it. The graph below demonstrates the results: ***Fig 2***



The first lesson 'x10, x100, x1000' was included in the survey for two reasons. This topic was included firstly because an end-of-term summative assessment identified 83% of FS level 1 students and 46% of FS L2 failed questions to do with multiplying by 10, 100 and 1000. Secondly, this topic sequences well as a prerequisite for working with percentage. The graph above demonstrates that students feel confident in multiplying/dividing 10, 100 and 1000, but a deeper dive into students' work showed that the disconnect is to do with multiplying/dividing 10, 100 and 1000 decimal numbers and not with integers.

Also noted is the correlation of data between the last year's exam results and students' diagnostic analysis. This demonstrates that 14/15 (93%) students felt that percentage questions 'hard, tricky and need help to solve them' which is in line last year's data where only 5% of L1 and 18.75% of L2 could solve exam questions on percentage.

Use of mastery teaching and learning strategies has allowed students to explore deeper to find the connection between percentages, decimals and fraction numbers. Extended work has been done to this and Century software has been used to consolidate knowledge e.g.,

evidence of completed tasks and in the assessment of understanding. Cycle 2 explored the extent to which students used Century software to consolidate knowledge.

Below are the 3 reflective open-ended student questionnaires.

The questions were:

1. Which skills have you mastered today, give examples of how you've mastered them?
2. Which skills do you still need to master?
3. Give examples of your targets in the next lesson.

Below is the result of the data in percentage after theme coding by student expression-answers. A sample of 15 students out of the 59 who took part.

Fig 3

Open Ended Questions	Themed answers	5 points for each answer	percentage
Which skills do you have you mastered today, give examples of how you've mastered them….	**Percentage/ tile/ bar model 10 boxes=12**	60	19%
	Tile/Some equivalences=6	30	9.5%
	. Jnderstand fractions=3 U	15	4.8%
	How to Multiply=3	15	4.8%
Which skills do you still need to master…	Division/Multiplying Decimals=12	60	19%
	Converting fractions into decimals=2	15	4.8%
	Need more work on my bar models=2	15	4.8%
Give examples of your targets in the next lesson….	Understanding the value of each box which is 10%=9	45	14.3%
	Not completed=6	30	9.5%
	Doing more fractions=3	15	4.8%
	Bar models for percentages=3	15	4.8%

Looking at the above data, the teaching of percentage through Maths mastery is helping students to gain confidence in their ability to work out percentages and fractions. The questions have been given a traffic light system, green indicating highest level of confidence. The bold highlight indicates the closeness of the 2 themes with a combination of 28.6%. This compares favourably against the example of L1 last year's exam 5% pass rate and L2 81.25% of students could not work out percentage questions to do with increase and decrease

The third question is colour coded red signifying what students felt that they still did not understand and wanted to continue learning, with 14.3% of students still feeling less confident in working out the value within a bar model, see examples below:

Fig 4

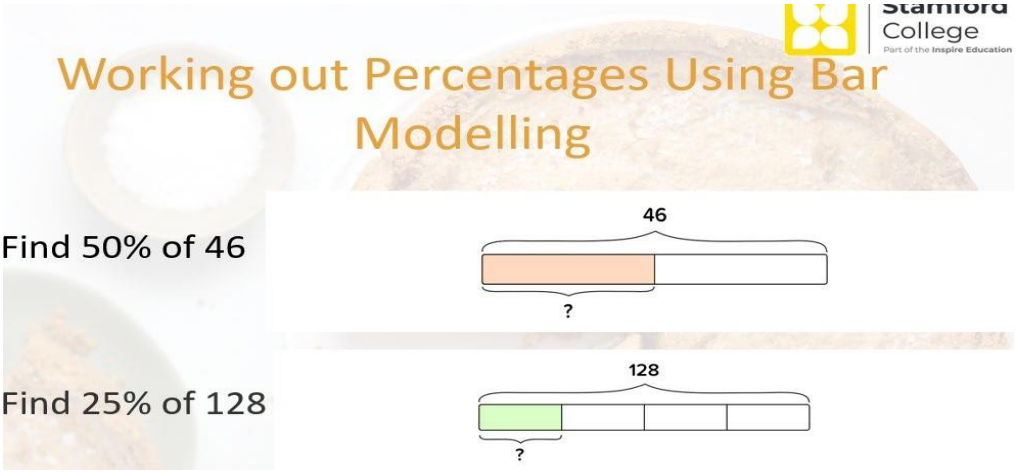
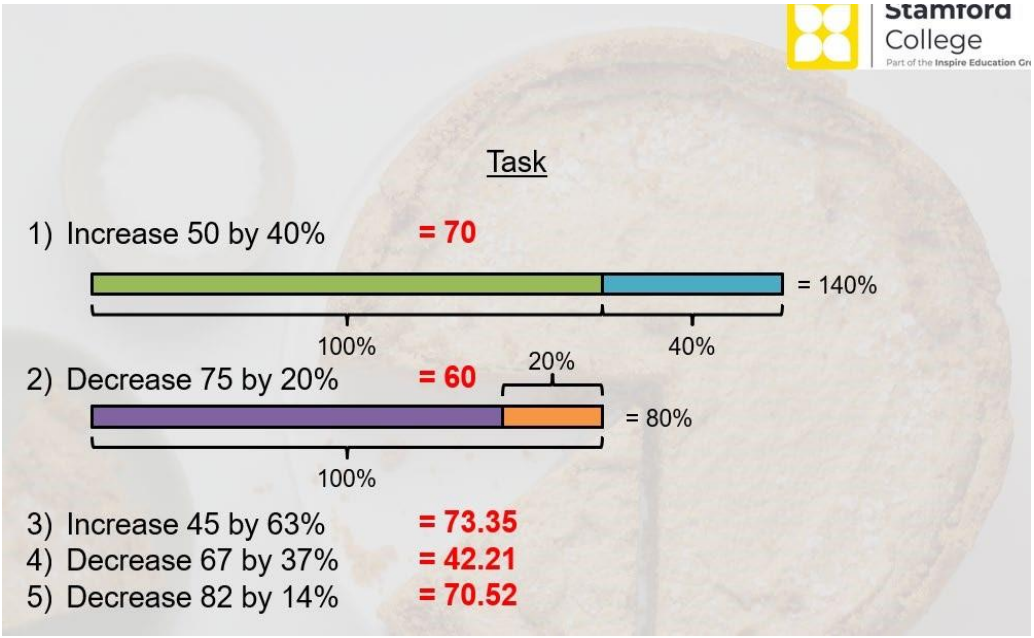


Fig 5

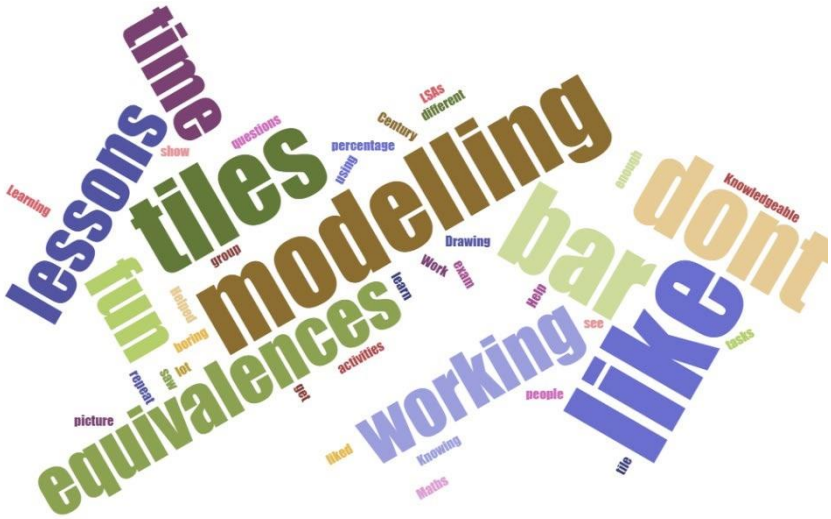


Students' Feedback Interview

6 students out of 59 were interviewed for 10 minutes on how they experienced the mastery lessons. Students were not cajoled into answering the questions, but the lecturer left enough time between questions, for students to respond.

The lecturer asked the same questions, with slightly modified language, a second time and directing it to the 'quiet' students. This encouraged students with ideas but hesitant to say something to contribute to the interview. The lecturer wrote key responses and theme coded key phrases.

Please see below a word cloud showing the key themes found in students' responses: ***Fig 6***



Students' responses pointed to the use of tiles, especially familiarisation with equivalences and bar modelling as being helpful in mastering how percentages work.

Fig7 Below are the questions and the main themes in their responses.

Interview Questions Asked to students	Answered by Student
Give examples of some aspects of the lessons that you've enjoyed….	Working with tiles to get equivalences using tile activities. Learning bar modelling – you see because it's like a picture Help in lesson from people who like Maths More time to learn tiles and bar modelling
Has anything changed your understanding of percentages…	Drawing percentage was fun Knowing equivalences
How would you link this to your Century work (Maths Specialist Software) ….	Some working out is different I liked when I saw bar modelling in the tasks I don't like that there is not enough time in lesson to do Century. It repeats a lot, it's boring.
How does support from MSSMs compare to LSAs in lessons	I liked it. Helped us in our group with tiles and bar modelling Knowledgeable LSAs don't show me what to do
How would you like to see these lessons progressing	Work more on tiles More fun and exam questions
Do you have any other comments….	No. When supported my work is better.

There are more points to be made from the above data. One is the issue of time that was pointed out several times. There was not enough time in lessons to learn using Century software which is preferred by most of the students interviewed. Some prefer the lecturer's feedback to that of the online recourse. A few pointed out that it is boring while some said that they liked seeing examples of bar modelling in the test. They also did not like that the recourse has 'too many questions that go on and on' and therefore boring.

MSSMs Monthly reflections

Fig 8

Maths Hub Triangle

The MSSMs monthly reflection was based of their participation in lessons and observation of how the students were working. The approach to this was based on already discussed teaching and learning strategies within this current AR. Please see the diagram below:

The table on fig 7 demonstrates the themes that have come out of the SMMS's reflective data from a total of 9 lessons that they took part in. The themes are coded following the above diagram model; that is- reflection on the role of MSSMs, approaches to Maths Mastery as already discussed and students' use of the specialist Maths software.

9 reflections were completed over a period of 2 months. Below is a table of the themes that the data produced.

Fig 9 **The Table Demonstrates the Main MSSM's Monthly Reflection Themes.**

Points made in reflection	MSSMs	Maths Mastery	Specialist Math s Software
	MSSMs is necessary. FDP is the one of the most challenging topics for all levels despite spending a large amount of learning time.	Repeating tile and (pictorial) Bar practising is improving patriation, confidence and proficiency.	Using IT skills alongside formal lessons always attract young learners and makes learning more fun.
	Able to support across all levels= High Level 1 and Level 2 students extended their work on interests and percentage changes and Entry 3 students continued practising in topics.	Tile etc…, Bar Modelling and the 100 Grid Sheet to visualise tasks and students found this activity made the concept easier to understand. Pictorial conceptual approach is especially familiar to lower attainers = Promotes inclusivity	students are always reminded to log in to their Mastery Software Century accounts to complete related assignments. This will be reviewed by the tutor and Mentor for further action.
	Some students misunderstood the difference between 0.2 and 0.02 as well as 20% and 2%. Interest rates were explained which are often used in worded tasks. A few students verbally feedback they would not have attempted such questions as they assumed they would not know the meaning of words to solve them mathematically.	Promotion of communication= 'What you talk about you know about' Students were encouraged to work out worded questions and explain their thought processes in their working out as part of the Maths Mastery initiative. Some further tasks were involved with greater depth especially for Level 2 students	Not enough time in lesson to work on using the software. Students are having to do this independently at home and some students are not completing and a few have no internet or/and laptop at home.
	MSSMs have a better grasp of Sequencing in Mathematics, unlike LSAs, which promotes understanding. The previous lessons were closely linked with the Fractions topic.	Sequencing= concepts between Fractions, decimals and percentages and realised different expressions for the same values.	
	Better understanding of learning styles and how to support= Learners are quite good to simplify the fractions. However, they are not used to increasing equivalency on purpose; e.g. when they don't remember 1/5 = 0.2, they preferred writing 1 ÷ 5 = 0.2 using the bus stop method to equivalent fractions. In this case, I would induce them to use 1/5 = 2/10 = 0.2 and further 2/10 = 20/100 = 20% using the decimal point movements following our first lesson. This will be a good example for the bigger denominators to find percentages such as 1/25 = 4/100 = 4 % rather using the divisions of 1 ÷ 25. Students are willing to accept the different methods depending on the purposes; especially the Level 2 students.	We continued to use our learning resources with bar modelling, blocks, Circular fractions pieces and Matching Cards for converting between FDP in Maths Mastery. Maths Mastery styles of learning were consistently carried over into the lessons, where ideas were presented concretely, pictorially and abstractly. Deeper ways of appreciating, portions/ proportions are being achieved. I'm looking forward to helping students to build on this especially when working with ratios.	
	More support is still needed in students' multiplying and diving skills.	After 3 weeks Mastery, they showed an improvement in the topics and deeper understanding of the relationships between values. They showed solid skills for the division and decimal numbers and seemed to prefer the Bus Stop method to convert from fractions to decimals/percentages. More practice will boost them to remember some common values like 2/5 = 0.4, 1/8 = 0.125 etc.	

		Students are developing high levels of proficiency, this is likely because of 'tiles' kinaesthetic, visual, tactile and groups discussions that students are being availed in lessons. The response from the students have been positive.	

Analysis of data from Fig 9 points to the advantage of the students' proficiency in Maths concepts through the promotion of Maths Masterly ideas. The 'why 'that' and 'how' in Maths which reduce the memorising of formulae that are often forgotten by exam day. The presentations e.g., through use of tiles, use of varied teaching and learning methods promotes fluency in Mathematical thinking and problem solving.

It is also crucial to sequence topics so that students can easily make connections.

The use of MSSMs in the classroom allows students struggling in the classroom to be efficiently supported. MSSMs specialism, promotes a deeper more meaningful collaboration with the Study Centre and promotes sequencing and standardises ways of supporting students. The role of MSSMs will enhance collaboration in planning and delivery of FS Maths within the department.

Maths Specialist Software is fairly received by the students and promoted by both the lecturers and MSSMs and identified as enhancing student learning. However, the main challenge is the issue of time within the 2 hours allocated for lessons. Logins, navigations and time needed to complete tasks often mean that students complete this part of their learning in their own time, and the 1:1 support is not availed.

Cycle 2

Areas listed below were identified in the conclusions and findings of cycle 1, as to be carried forward to our AR cycle 2 in January-March 2022. 105 students participated in cycle 2 and 83 completes diagnostic and questionnaire forms.

Course topics identified, i.e. Decimals, Fractions and Percentages, were continued in a restructured Maths lessons where 45 minutes of the lesson was allocated to the embedding of these three topics, as this is now thought to be crucial to the success of the students' FS Maths achievements.

1. Following the success of learning using 'tiles' and 'bar modelling' and because of the need for more time for students to improve on their knowledge of working on percentage, decimals and fractions, planning in January -March 2022 embedded the first 45 minutes working on the mentioned topics using 'tiles and bar modelling. It's especially in seeing equivalences that a better understanding of the identified topics will begin to take root. Data was gathered to evaluate students' progress on the abovementioned Maths' topics.
2. FS Maths planning included MSSMs as a way of promoting inter-departmental communication between the Study Centre and the Maths department, which promoted positive working experiences for all actors within the AR.
3. Promotion of specialist Maths software continued, and data was gathered which informed how students were interacting with Century software.

4. Also, in cycle 1, student's lack of knowledge and skills in multiply by x10, x100, x1000 and divide by 10, 100 and 1000 often derailed how they solved questions that involved percentage and decimals, please see paragraph 1 on page 12.
5. The promotion of Maths mastery continued to be promoted in cycle 1 and tiles and modelling was encouraged.

Parameters of methods and methodologies were retained as outlines as discussed in the first cycle.

Results and Findings Cycle 2

Diagnostics

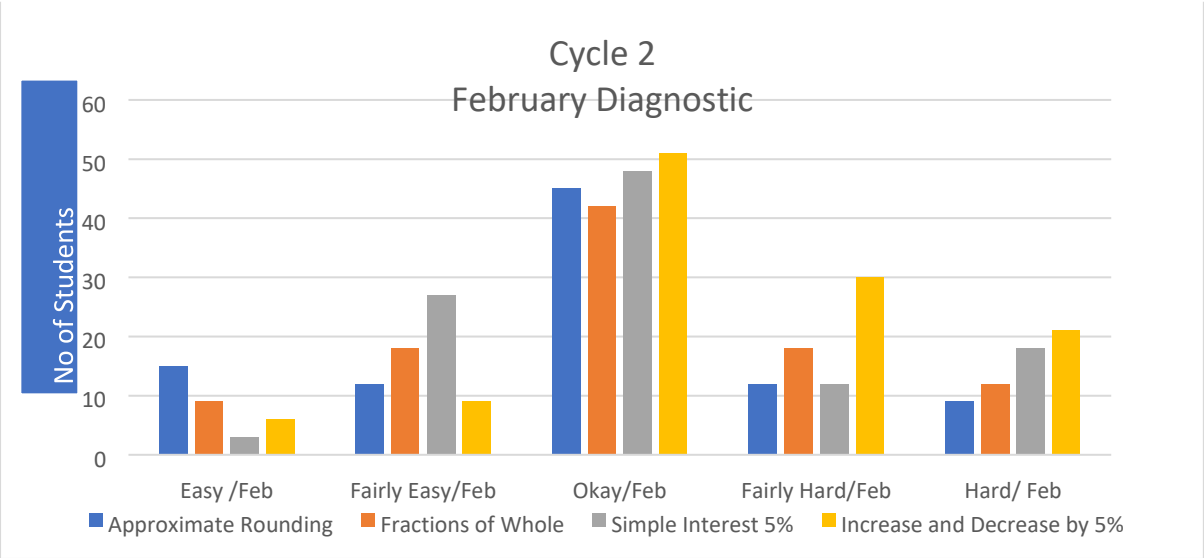
The data on the diagnostic followed the same model as in cycle 1 in harvesting and analysing data.

The are no easy formulas to students' success in Maths. The above comparable February and March diagnostic data demonstrate mixed results, for example, in students in more students in February than in March that felt okay tackling percentages continues to be a challenge. The expectation is that following the 45 minutes in-hub targeted session, student confidence in percentages should be consolidated.

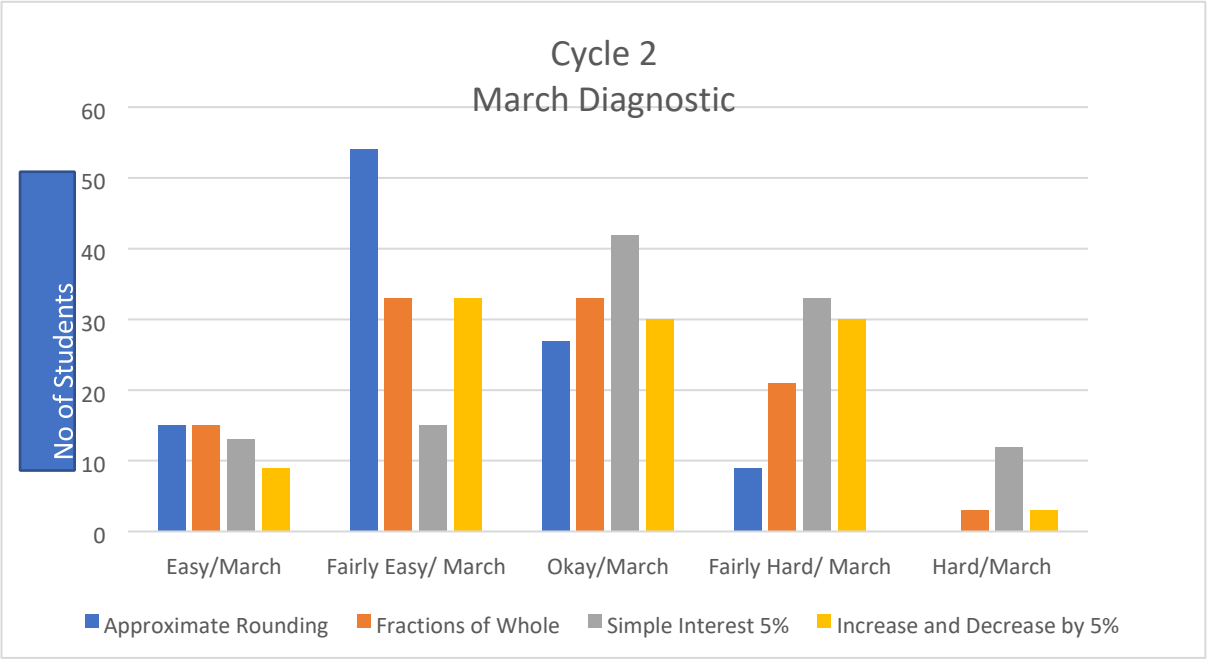
Equally, this cohort of students could demonstrate gained confidence in approximating and rounding of numbers, and evidence is further seen in their marked work in lessons - see the comparative graphs titled February Diagnostic and March Diagnostics.

However, the overall pattern as seen on both Fig is one with a demonstratable trend of improvement from 14 out of 16 who found working out percentages compared to hard to only 3 out of 83 students. The progression model is further seen in the March diagnostic data, where students' confident by March hovered around the 15 marks compared to the 10 marks in February, when expressing how easy they found the identified topics; this is farther supported by the end spectrum of the comparable diagnostic data, where 'hard' hovers on average around an average of 15 students out of 83 who found all topics 'hard' compared to the month of March data that saw that data drop to an average of less than 10 students out of 83 who still felt the topics were 'hard'.

Fig 10 and Fig 11



Questionnaire



From Fig 10 and 10, the 2 graphs and the table below present data collated from a questionnaire that student responded to as a way of reflecting on their learning throughout cycle 1 and 2 of this AR. 79 students responded to the questionnaire and below is the analysis.

On Fig 11 below, Question 5 in the questionnaire was reflective and demonstrated how students felt in taking part in the AR. The students peaked at 46% felling quite happy having taken part in the research and 76% of students felt the research was quite to very beneficial to their learning a good indicator of progressing initiatives and ideas used with in this AR.

Students have continued to value the specialist support of the MSSMs as demonstrated in Fig 12, with a 'most positive' marker of 14 – one of the three highest post markers on the graph. The incorporation of MSSMs in planning and delivery has enhanced how students are supported in Maths. Good work had been done in the Study Centre as discussed in the literature review and in cycle 1 had continued to progress and standardisations in how support in learning is taking.

Fig 11

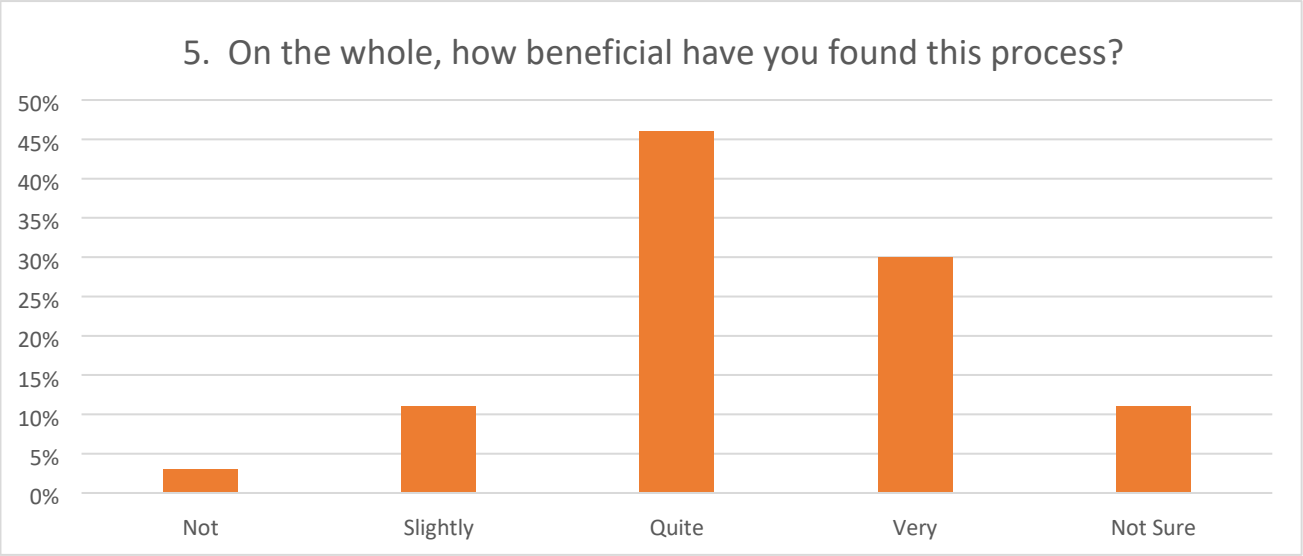


Fig 12

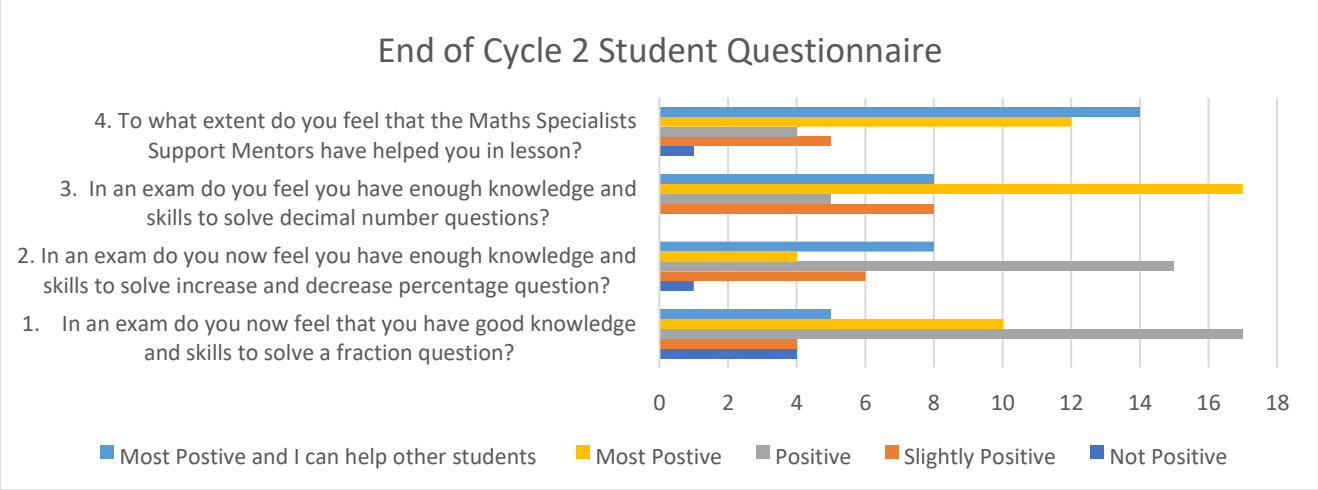


Fig 13

The questions below informed the stake holders and how the recommended approaches to teaching and learning have developed the students' mastering of: Fractions, Percentages and Decimal Numbers in a period of 12 weeks, between November to March 2022.

The one most appropriate to you. 1 holds the Not Positive impact and 5 implies the most positive impact where a student feels he/she can help another to understand a question involving Fractions, Percentages and Decimals.

Specialist Maths Software

Below, Fig 14, is data collated to demonstrate students use of the Specialist Maths Software in completing their Maths tasks. Data was taken from 11 classrooms. The data analysis was consistent in all 11 classes, which informed of a continuous decline in completion work set

1. In an exam do you now feel that you have good knowledge and skills to solve a fraction question?	**4**	**4**	**17**	**10**	**5**	
2. In an exam do you now feel you have enough knowledge and skills to solve increase and decrease percentage question?	**1**	**6**	**15**	**4**	**8**	
3. In an exam do you feel you have enough knowledge and skills to solve decimal number questions?	**0**	**8**	**5**	**17**	**8**	
4. To what extent do you feel that the Maths Specialists Support Mentors have helped you in lesson?	**1**	**5**	**4**	**12**	**14**	
Total	**6**	**23**	**41**	**43**	**35**	
Average Mark	**1.5**	**5.75**	**10.25**	**10.75**	**8.75**	
	Not	**Slightly**	**Quite**	**Very**	**Not Sure**	
5. On the, whole how beneficial have you found this process?	**1**	**4**	**17**	**11**	**4**	
	3.00%	**11.00%**	**46%**	**30%**	**11%**	

throughout the AR period; comparison was drawn on student usage in cycle 1 and cycle 2. Please see the table presented on Fig 15 below.

The issues raised by students in AR cycle 1 persisted and more so in AR cycle 2, as topics in the classroom demanded varied and differentiated ways of teaching and learning, which took, extra time, resulting in extended tasks on Maths specialist software time being squeezed out of a lesson. Please see Fig 15, which compares students' time spent on the Math specialist software in cycle 1 (which is more) to that of less time spent of the software in cycle 2. This is consistent in all the 4 days that FS Skills Maths is delivered in the college. Fig 14 (FS Maths Thursday students) is an example of how data was collated.

Fig 14

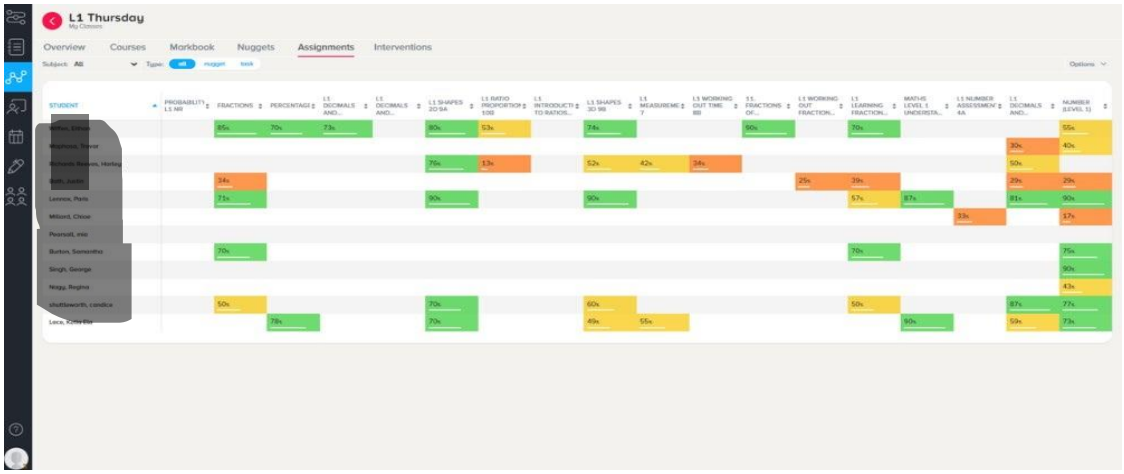


Fig 15

The data below demonstrates and compares how often students completed tasks on Specialist Maths Software		
	Cycle 1	Cycle 2
Monday	73%	45%
Tuesday	36%	17%
Wednesday	73%	30%
Thursday	21%	17%

Conclusions and Recommendations

Conclusions

In this AR, we researched, implemented and reflected on the triangulation approach taken at New College Stamford to supporting students back into the classroom and strategies to support students tackle concisely failed topics at L1 and L2 FS Maths. The AR project introduced an in-class timely intervention learning hub and a Maths mastery approach alongside a technology theme. The project team aimed to blend timely intervention of identified knowledge gaps through concepts of Maths mastery, the use of technology software and use of MSSMs.

The introduction of MSSMs meant that student support within the classroom is bridging the quality of learning and promotion of students' Maths mastery.

Equally, not only do all students benefit from skilled directions but receive comprehensive feedback of tasks that they complete in lessons.

The Maths Mastery approach to learning promoted inclusivity of students with varied levels of learning needs and helps students to move away from memorisation of formulae to deeper ways of gaining mathematical thinking and fluency and increase communication and collaborations.

Students have continued to value the specialist support of the MSSMs as demonstrated in Fig 12, with a 'most positive' marker of 14 – one of the three highest post markers on the graph-. The incorporation of MSSMs in planning and delivery has enhanced how students are supported in Maths. Good work had been done in the Study Centre, reflecting discussed in the literature review and in cycle 1.

Students have continued to value the specialist support of the MSSMs. The incorporation of MSSMs in planning and delivery has enhanced how students are supported in Maths. Good work has continued to progress in the Study Centre, for example standardisations in how students are supported. Colleagues in the Study Centre are gaining new skills in how to support students learn, for example use of modelling for maths masterly.

The issues raised by student in AR cycle 1 persisted and more so in AR cycle 2, as topics in the classroom demanded varied and differentiated ways of teaching and learning within the classroom demanded extra time working, resulting on extended tasks on Maths specialist software time being squeezed out of a lesson, please see Fig 15, which compares students time spent on the Math specialist software in cycle 1 (which is more) to that of less time spent of the software in cycle 2. This is consistent in all the 4 days in a week that FS Skills Maths is delivered in the college. Fig 14 (FS Maths Thursday students) is an example of how data was collated.

Students have continued to value the specialism support of the MSSMs as demonstrated in Fig 12, with a 'most positive' marker of 14 – one of the three highest post markers on the graph-. The incorporation of MSSMs in planning and delivery has enhanced how students are supported in Maths. Good work had been done in the Study Centre as discussed in the literature review and in cycle 1 had continued to progress and standardisations in how support in learning is taking.

Reflections and Recommendations

Reflections

Lecturer and SMMS Focus Group's reflections

A focus group between 1 Lecturer and 2 MSSMs was conducted to reflect on both AR first cycle and second cycle.

How are students responding and interacting to the Maths Mastery teaching strategies?

Overall, students have appreciated the varied ways they can solve Fractions, Decimals and percentage questions.

Students have responded well to the support they are getting from their Maths Specialists Support Mentors.

How students responding and interacting with learning software?

Student have responded less well to the use of Maths Specialist Software, as learning tool. Discussions and opportunities of 'deep dive' that involves face to face sessions with the software providers and developers would benefit student learning experience. Interfaces and tasks to be bespoke for institutions who have invested in their software.

Reflecting on the support you gave the students	what comments would you make?

Students understanding of the functions of numerator and denominators have been understood in both Fractions and percentages. Students are answering exam type questions, regarding these topics, with a higher frequency compared to cycle 1.

Students seems to be less confident rounding, multiplying and dividing decimal numbers.

What problems have you encountered (if any)?

Time has been the main problem. Not enough time to teach concept, as there many exam standards and topics covered in the course overall. Students' engagement with Maths specialist software has continued to be a challenge for reasons identified in cycle 1, please see page 15 and fig 7 on Maths specialist software.

What changes/developments have you made/introduced?

1. 45 minutes at the beginning of the lesson as a way of enhancing key knowledge and skills in solving Fractions, Percentage and Decimal questions.
2. Time to be allocated for continuous Charing of good practice and ideas with the Study Centre.
3. Varied ways of teaching the same topic and different ways of solving the same problem. This has allowed students to connect concepts and consolidate knowledge and skills in learning how Fractions, Percentage and Decimals are related.

Recommendations

1. 45 minutes at the beginning of the lesson as a way of enhancing key knowledge and skills in solving Fractions, Percentage and Decimal questions.
2. Time to be allocated for continuous Charing of good practice and ideas with the Study Centre.
3. Varied ways of teaching the same topic and different ways of solving the same problem. This has allowed students to connect concepts and consolidate knowledge and skills in learning how Fractions, Percentage and Decimals are related.
4. The introduction of MSSMs within lessons enhances students' learning experience; students are reached more quickly and efficiently in the support that they need and those that need extended tasks are identified more quickly and set the right level of challenge.
5. Maths Mastery approach to learning promotes inclusivity of students with varied levels of learning needs and helps students to move away from memorisation of formulae to deeper ways of gaining mathematical thinking and fluency and collaborations.
6. MSSMs also noted that students with SENs (Special Educational Needs) were more engaged and emotionally seemed happier in lessons.
7. Introductions of Maths Mastery, please see page 8, also page 17 including analysis of Fig 9, has promoted an enthusiasm of wanting to engage with Maths in lessons.
8. Working with tiles has promoted group work and communication in the classroom.
9. Student Using interactive software to develop maths skills can polarise student opinion both positively and negatively. It can be used to supplement additional learning; however, time taken to login often disrupts the flow of the lesson and learning.

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Appendix/Appendices

[i] See Appendix 1

[ii] Students are organised in mixed Level classes to include, E3, L1 & L2 FS Maths. Students working at Level E3 (Entry level 3- the level below L1 FS Maths-) Multiplication and Division in 10, 100 & 1000 [iii] See Appendix 1

Appendix i

Level 2 20/21 Academic Year

Number of students who achieve zero mark out of 16 students. So (13/16) x 100= 81% of students at Level 2 could **NOT**

- **Calculate percentage change (any size increase and decrease), and original value after percentage change and**
- **Use formulae to find volumes and surface areas of 3-D shapes including cylinders**

SCS05 Work out percentages of amounts and express one amount as a percentage of another
SCS06 Calculate percentage change (any size increase and decrease), and original value after percentage change
SCS07 Order, add, subtract and compare amounts or quantities using proper and improper fractions and mixed numbers
SCS08 Express one number as a fraction of another
SCS10 Add, subtract, multiply and divide decimals up to three decimal places 0.00
SCS11 Understand and calculate using ratios, direct proportion and inverse proportion 0.00
SCS16 Calculate perimeters and areas of 2-D shapes including triangles and circles and composite shapes including non-rectangular shapes (formulae given except for triangles and circles)
SCS17 Use formulae to find volumes and surface areas of 3-D shapes including cylinders

SCS18 Calculate actual dimensions from scale drawings and create a scale diagram given actual measurements

SCS19 Use coordinates in 2-D, positive and negative, to specify the positions of points 100.00

SCS21 Draw 3-D shapes to include plans and elevations

SCS24 Estimate the mean of a grouped frequency distribution from discrete data

SCS25 Use the mean, median, mode and range to compare two sets of data 0.00

L1

Sample of L1 students 20/21 exam results topic by topic FS Maths. For exam only 5% could **Calculate simple interest in multiples of 5% on amounts of money and this question came 50% of the times in the exam. This means the 2 most asked questions in 20/21 exam series had to do with,** Add, subtract, multiply and divide decimals up to two decimal places and 53% of students achieved whilst the topic **Convert between units of length, weight, capacity, money and time, in the same system only 37% of students achieved.**

		Students Achieving in the Exam series %20/21	How often a topic is likely to appear In the exam% In Both Paper 1 and 2
SCS18	**Calculate simple interest in multiples of 5% on amounts of money**		
SCS14	**Calculate percentages of quantities, including simple percentage increases and decreases by 5% and multiples thereof**		

SCS3	Multiply and divide whole numbers and decimals by 10, 100, 1000		
SCS21	Recognise and make use of simple scales on maps and drawings		

SCS15	Estimate answers to calculations using fractions and decimals		
SCS9	Find fractions of whole number quantities or measurements		
SCS10	Read, write, order and compare decimals up to three decimal places		
SCS19	Calculate discounts in multiples of 5% on amounts of money		
SCS24	Draw 2-D shapes and demonstrate an understanding of line symmetry and knowledge of the relative size of angles		
SCS26	Use angles when describing position and direction, and measure angles in degrees		
SCS29	Find the mean and range of a set of quantities		
SC20	Convert between units of length, weight, capacity, money and time, in the same system		
SCS28	Group discrete data and represent grouped data graphically		
SCS12	Approximate by rounding to a whole number or to one or two decimal places		

SCS16	**Recognise and calculate equivalences between common fractions, percentages and decimals**		
SCS23	**Calculate the volumes of cubes and cuboids**		
SCS31	**Use equally likely outcomes to find the probabilities of simple events and express them as fractions**		
SC8	**Read, write, order and compare common fractions and mixed numbers**		
SCS4	**Use multiplication facts and make connections with division facts**		
SCS22	**Calculate the area and perimeter of simple shapes including those that are made up of a combination of rectangles**		
SCS27	**Represent discrete data in tables, diagrams and charts including pie charts, bar charts and line graphs**		
SCS17	**Work with simple ratio and direct proportions**		
SCS1	**Read, write, order and compare large numbers (up to one million)**		
SCS11	Add, subtract, multiply and divide decimals up to two decimal places		
SCS5	Use simple formulae expressed in words for one- or two-step operations		
SCS6	Calculate the squares of one-digit and two-digit numbers		

SCS2	Recognise and use positive and negative numbers		
SCS30	Understand probability on a scale from 0 (impossible) to 1 (certain) and use probabilities to compare the likelihood of events		
SCS7	Follow the order of precedence of operators		
SCS13	Read, write, order and compare percentages in whole numbers		
SCS25	Interpret plans, elevations and nets of simple 3-D shapes		