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Students' Perspectives on Mathematics in Further Education Colleges

The Mathematics in Further Education Colleges Project:
Interim report 3

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Nuffield Foundation

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1. Executive summary

Improving the mathematical skills of adults in England is a national priority, as highlighted in the Industrial Strategy[1], Sainsbury Report[2] and Post-16 Skills Plan[3]. The benefits to individuals, in terms of future earnings, are well evidenced[4] and there is growing recognition of the wider value of mathematical skills for full and meaningful engagement in society[5].

The Further Education (FE) sector is critical in plans for improving national quantitative skills and, according to Smith's (2017)[6] report on post-16 mathematics education, there is a need for wider recognition of the importance of Further Education in the post-16 education landscape. Indeed, the majority of 16-18 year olds with low prior attainment in mathematics are studying in general FE colleges, mostly on vocational study programmes.

A new post-16 Condition of Funding[7] was introduced in 2014 to help tackle low prior attainment and increase the proportion of students achieving a GCSE Mathematics grade C/4. However, progress for 16-18 year olds in FE colleges remains slow with just over a third (36.5%) making positive progress[8] in 2019 and 18.2 % achieving a GCSE grade 4[9].

The Mathematics in Further Education Colleges Project (MiFEC) offers the latest and most extensive research analysis of the state of mathematics education in England's FE colleges. Comprising four interconnected work packages, the project has already reported major findings in a series of reports and articles.

The first Interim Report[10] focused on a national survey of the mathematics teacher workforce whilst the second Interim Report[11] provided a wide-ranging analysis of policy enactment and practice in a sample of 32 FE colleges in England. The project's Final Report (due autumn 2020) will synthesise the project findings and make recommendations for stakeholders including policymakers, college managers, curriculum leaders and Continuing Professional Development (CPD) providers.

This third Interim Report presents analysis of student-generated data from the case studies. It explores young people's perceptions of mathematics and experiences of

[1] BEIS (2017). Industrial Strategy: building a Britain fit for the future. London: HMSO.
[2] Report of the independent panel on technical education. 2016. Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/536046/Report_of_the_Independent_Panel_on_Technical_Education.pdf
[3] DfE (2016). Post-16 Skills Plan. Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/536043/Post-16_Skills_Plan.pdf
[4] Cerqua, A. & Urwin, P. (2016). Returns to Maths and English Learning (at level 2 and below) in Further Education. London: BEIS.
[5] Bredberg, J. (2020). The role of mathematics and thinking for democracy in the digital society. Policy Futures in Education, 18(4) 517–530
[6] Smith, A. (2017). "Report of Professor Sir Adrian Smith's review of post-16 mathematics." London: DfE.
[7] The Condition of Funding, commonly referred to as the GCSE re-sit or retake policy, made it compulsory for those who had not attained at least GCSE grade C/4 to continue their mathematics study post-16
[8] According to the government's maths progress measure. See here for the full guidance.
[9] DfE (2020). Revised A level and other 16-18 results 2018 to 2019. Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/859515/2019_revised_A-Level_and_other_16_to_18_results_in_England.pdf
[10] Available at https://www.nottingham.ac.uk/research/groups/crme/documents/mifec/interim-report-1.pdf
[11] Available at https://www.nottingham.ac.uk/research/groups/crme/documents/mifec/interim-report-2.pdf

learning the subject in FE colleges. This report complements the teachers' perspectives on students' experiences that were reported in the second MiFEC Interim Report.

The analysis of students' perspectives addresses several of the MiFEC project's research questions:

- How do FE colleges *mediate*, *moderate* and *modulate* government policy on post-16 mathematics education?
- What different strategies have been employed?
- How has/is funding shaping college policy and classroom experience?
- What are the workforce strengths and limitations?
- How is curriculum and assessment changing?
- What are the possible unintended consequences of policy upon classrooms?

The project's case studies of 32 General FE colleges (GFECs), which were either single providers or part of a college group, comprised around one sixth of 187 similar providers at the time of sampling (Sept 2017). This sample was stratified across the nine regions of England and based on the selection criteria set out in the second MiFEC Interim Report.

Student focus groups took place during visits to the colleges. They included an individual, card sorting activity that exploring teaching and learning experiences and preferences. The field work involved 44 site visits and 62 student focus groups in which a total of 388 students participated from a range of vocational areas. 93% of the sample were aged 16-19 and the large majority were studying GCSE (80%) with others following Functional Skills (15%) and Core Maths (5%) programmes. This report presents findings from a cross-case analysis of the data concerning students' perceptions of their experiences of mathematics in FE.

The main findings are as follows:

Student motivation to retake mathematics centred on the 'exchange-value' of the qualification rather than the 'use-value' of the skills. Students needing a GCSE mathematics qualification for progression to further study or their chosen career identified this as a source of motivation. The majority of students stated that a mathematics qualification, especially GCSE, was an advantage in the employment market but some questioned how essential the actual mathematics was for certain jobs.

Students were unconvinced about the relevance of the mathematics they were learning to their lives, careers and vocational studies. The most useful mathematics for life and work was described as 'basic numeracy'. Students sometimes identified specific mathematics topics that were relevant to their vocational areas but connections were weak and hidden in work routines. Much of GCSE mathematics was considered only useful for passing the examination.

Failure to pass the GCSE examination, or understand mathematics in class, reinforced negative attitudes and emotions. A lack of interest, low confidence and anxiety were common responses amongst students to mathematics. Prior experiences in school contributed but negative reactions were reinforced by evidence of continuing failure, from examination performance or classroom learning.

Students valued individualised, student-focused approaches to teaching and learning from understanding and approachable teachers. Students were generally more positive about their learning experiences in college than those in school but felt they would benefit from

more use of student-focused approaches to teaching and learning, according to the categorisation used in a previous study[12]. They valued clear explanations and alternative methods but most important was having a teacher that they could 'connect' to and feel comfortable approaching for help.

Students rarely understood college systems for the organisation of mathematics classes and were critical of inconvenient timetabling, disruption to classes and ineffective action concerning poor attendance. Most students were unaware of why they were in a particular class but sometimes found the timetabling of mathematics inconvenient or unconducive to learning. Students stated a strong preference for continuity regarding both teacher and class members. The reorganisation of classes for some students was too frequent and unhelpful. Action to deal with poor attendance or disruptive class behaviour sometimes appeared ineffective from a student perspective.

Few students were in favour of the GCSE re-sit policy and proposed a more differentiated approach to improving their mathematics skills and qualifications. Views of current policy from students reflected their perceptions of having differing needs. They questioned the relevance of qualifications and some of the mathematics included in them. Students proposed that the focus should be on developing mathematics for specific vocational areas and GCSE becoming an option rather than mandatory.

In summary, these findings are in broad agreement with those of teachers and managers in the MiFEC case studies, although there are some important points of difference that signal areas for improvement:

- Students' reliance on the 'exchange-value' of the GCSE qualification as their primary source of motivation and their low rating of the usefulness of mathematics suggest that greater emphasis on the relevance of mathematics would lead to increased motivation.
- Managers and teachers gave the impression that the linking of mathematics to vocational or real life applications, especially through the practice of embedding into vocational learning, was common practice. Students themselves saw few connections, which suggests these practices need further exploration.
- The importance of addressing students' attitudes and emotional responses to mathematics was well evidenced by students and staff. There was general agreement about the approaches to teaching and learning that were most helpful, including the importance of the teacher-student relationship but students' preferences for greater use of student-centred approaches should be noted.
- Students found it difficult to understand some of the organisational systems that affected their learning experiences. Better understanding of these, such as the reasons why they are placed in certain groups, the purpose of initial assessment and the attendance monitoring processes would be empowering.

[12] Swan, M. (2006). Collaborative learning in mathematics: a challenge to our beliefs. Leicester: NIACE

2. Introduction

The Mathematics in Further Education Colleges (MiFEC) project is a national, mixed-methods research project funded by the Nuffield Foundation that is providing evidence-based advice for policymakers, college managers, curriculum leaders and practitioners on how to improve mathematics education in England's further education colleges.

The project centres on general further education colleges (GFECs[13]) since these are the main providers of further education in England with 174 GFECs out of a total of 257 FE colleges[14] (February 2019). For simplicity, we will sometimes omit 'general' for brevity.

These general FE colleges are large, complex organisations in which the context as well as the organisation and management of mathematics provision has an impact on students. A typical college focuses on vocational education and training but may also offer academic programmes and courses for adults. Apprenticeships, specialist provision, supported learning and HE provision are also provided by many colleges.

Since *incorporation* in 1992, responsibility for further education has transferred between government departments several times. Changing priorities in policy and qualifications have influenced the mathematics offer to students and this curriculum history frames the present position and ongoing developments.

The most relevant, recent changes in government policy are as follows:

- The extension of compulsory education to age 18 in a stepped approach from September 2013;
- The Condition of Funding in autumn 2014, which made it compulsory for students without GCSE Grade C/4 to either retake GCSE mathematics or undertake a different mathematics qualification with the aim of then progressing to GCSE;
- An adjustment to the Condition of Funding in 2015 that made it compulsory for students with GCSE Grade D/3 to retake GCSE rather than any alternative mathematics qualification;
- An adjustment to the Condition of Funding from September 2019 making it no longer obligatory for students who achieve Level 2 Functional Skills mathematics to progress to GCSE.

Other significant curriculum changes, such as revisions to GCSE and Functional Skills mathematics qualifications, have also taken place and Local Area Reviews have led to a number of college mergers.

Performance measures have supported the Condition of Funding developments, the most pertinent being the high-grade achievement rate[15] and the mathematics progress measure[16]. These indicate that the progress made by 16-18 year olds in FE colleges is

[13] GFECs form the major part of the Further Education (FE) sector. Other FE colleges (e.g. Sixth Form Colleges, specialist colleges) may identify with some of the issues raised but the size of provision and organisational complexity of large GFECs means this has been the main focus of this study. Where we use FE Colleges it refers to GFECs

[14] Association of Colleges. 2019. *College Key Facts 2018-19*. Retrieved from: https://www.aoc.co.uk/sites/default/files/College%20Key%20Facts%202018-19.pdf

[15] High-grade achievement is the percentage of students gaining GCSE grades 1-4 out of the total enrolled at the start of the course.

[16] See here for the full guidance.

disappointing with, for example, over a third (36.5%) making positive progress[17] in 2019 and 18.2 % achieving a GCSE grade 4[18].

The MiFEC project set out to understand mathematics education in this complex, changing FE system through several interlinking work packages, findings from which have been reported in a series of reports and articles. The first Interim Report "A survey of teachers of mathematics in England's FE colleges"[19] was published in December 2018. The second interim report in February 2020 presented findings from FE college case studies[20] conducted from December 2017 to April 2019 and will be followed by a final report in the autumn of 2020[21].

The MiFEC case studies of FE colleges explored the following questions:

- How do FE colleges *mediate*, *moderate* and *modulate* government policy on post-16 mathematics education?
- What different strategies have been employed?
- How has/is funding shaping college policy and classroom experience?
- What are the workforce strengths and limitations?
- How is curriculum and assessment changing?
- What are the possible unintended consequences of policy upon classrooms?

We adopt the term *GCSE retake* rather than GCSE re-sit since this indicates that the course has been retaken rather than a student simply having a second (re-sit) attempt at the examination. We also use the term *high grade achievement*[22] since this is commonly used in the sector as a measure of student outcomes rather than examination pass rates. Our reference to *students* in the report is to those in the focus groups. The majority were retaking GCSE mathematics but there was also representation from groups taking Functional Skills and Core Maths qualifications.

The main part of this report is divided into six sections that focus on the key issues generated in the focus group discussions. Analysis of an individual exercise that explored students' perceptions of their lessons and preferences in teaching approaches is included within the section about teaching approaches.

[17] According to the government's maths progress measure. See here for the full guidance.
[18] DfE (2020). Revised A level and other 16-18 results 2018 to 2019. Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/859515/2019_revised_A-Level_and_other_16_to_18_results_in_England.pdf
[19] Available at https://www.nottingham.ac.uk/research/groups/crme/documents/mifec/interim-report-1.pdf
[20] Available at https://www.nottingham.ac.uk/research/groups/crme/documents/mifec/interim-report-2.pdf
[21] The final report will synthesise findings from the four strands of the MiFEC project. In in addition to the two mentioned here (strands 3 and 4) this includes 1) a policy trajectory analysis from 2000 to the present day, and 2) quantitative analysis of administrative data to understand participation patterns and the relationship between policy and college practices
[22] *High grade achievement* is the number of students achieving GCSE grades 9-4 as a percentage of the number enrolled on a GCSE course. The measure takes into account those who started the course and did not enter the examination and replaces what was previously referred to as the *success rate*.

3. Research methods

The MiFEC project research design comprised an initial six in-depth cases of FE college providers[23] from December 2017 with the addition of 23 more providers from May 2018. These 29 providers yielded a total of 32 college case studies since some providers were groups of colleges functioning largely independently and more than one college from the group was studied. The sampling approach and selection criteria for the case studies has been described in detail in the second MiFEC interim report.

This present report focuses on analysis of data from the student focus groups that took place during the case study visits. It complements the teachers' perspectives on students' learning experiences of mathematics that were presented in the second Interim Report.

3.1 Data generation

The main focus of the MiFEC project was on 16-18-year-old students and particularly those yet to achieve a Level 2 qualification in mathematics. Focus groups generally comprised students aged 16-19 at various points in their mathematics studies and with different levels of achievement, although some groups also contained adults (aged 19+). The majority of students were retaking GCSE mathematics but students on Functional Skills mathematics or Core Maths (Level 3) courses were also included in some focus groups. The age distribution of participants and the mathematics qualifications they were studying at the time are summarised in *Tables 1 and 2*.

Age	16	17	18	19	19+
No of students	82	139	97	38	28

Table 1: Age distribution of students participating in focus groups

Qualification	GCSE	FS Level 2	FS Level 1	FS Entry	Core Maths
No of students	296	11	41	4	16

Table 2: Mathematics qualification courses of focus group participants

The majority of the students were in their first (207) or second (136) year in college. Students with a range of prior grades took part, with the majority who declared a prior grade having attained GCSE grade 3 or D (192) or a grade 2 or E (66).

Where possible, students were involved from two designated areas - Construction and Health and Social Care - as these two areas are contrasting in terms of gender and of views of the vocational relevance of mathematics. Where a third focus group was scheduled, colleges were asked to select a gender-balanced vocational area in the college. This strategy aimed to achieve a gender balance and a range of views. There were some practical limitations on the availability of students from the preferred vocational areas on the visit days. In some cases, colleges arranged focus groups for students from alternative vocational areas. The data obtained indicates a reasonable balance of male (159) to female (182) students. The areas of Health and Social Care (92), Construction (54) and Business (45) were most strongly represented in the focus groups, with smaller numbers from a

[23] The original selection was of 'providers' since the background data were categorised in this way.

wide range of areas including Public Services (21), Hair and Beauty (20), Engineering (19), Information Technology and Computing (18) and Sport (15).

The research design involved two-day visits to the main cases in the first year and one-day follow up visits a year later. Additional cases received a one-day visit in the second year. Three student focus groups per college were planned into the main cases and a maximum of two focus groups for the shorter cases. The focus group sessions comprised two parts: 1) an individual card-sorting activity and 2) a whole-group discussion.

The desk-based activity involved the placement of statement cards about what happens in mathematics lessons in college on a Likert scale. The statements were based on those used in a previous study[24] and were categorised as either teacher-centred or student-centred (see *Section 4.4*). In addition, two further statements were added that were of particular interest, concerning the use of technology (computers) and connections to students' vocational study programmes. Students were asked to complete two separate tasks, placing the statements to indicate their views of:

1. What their current, or most recent, mathematics lessons were like;
2. What they thought mathematics lessons *should* be like to help them learn best.

A schedule of areas for group discussion was developed to address the main research questions. A copy of the protocol can be found in Appendix 1. The main areas discussed with students were:

- Their experiences of learning mathematics in college;
- Their opinions on the approaches to teaching and learning used;
- Their progress with mathematics;
- The organisation of mathematics classes in college;
- Their opinions of government policy.

Colleges were responsible for asking students to take part but participation was voluntary. There was no doubt some bias in this selection process as teachers were keen to identify those that would engage in the focus group process. Students were assured of confidentiality in order to encourage honesty and openness in their responses.

Research ethics approval was secured at the University of Nottingham and principals/CEOs of all participating colleges were provided with comprehensive project information and asked to provide consent on behalf of the college. Individual staff and students engaged with the research on a voluntary basis. They were also provided with project information and privacy notices before giving signed consent. Colleges were asked to identify any students invited to join focus groups who were considered to be vulnerable adults so parental consent could be obtained prior to the visit.

3.2 Approach to analysis

The desk-based activity was analysed by converting the Likert scale to numerical values and then undertaking a range of descriptive analyses of each of the two activities, including differences between what was experienced and considered desirable (see *Section 4.4*).

Transcriptions of the group discussions were coded in an iterative process using NVivo. Full transcripts of half of the discussions were used to develop a coding framework. Coded

[24] Swan (2006) Collaborative learning in mathematics: a challenge to our beliefs. Leicester: NIACE

data were then analysed further to examine the emergent themes and summarise the key points. Partial transcripts of the remaining files were coded and analysed until a 'saturation point' was reached where no new themes or key points were generated.

This analytic approach, when combined with the scope and scale of the dataset, means that though we are unable to make statistically generalisable claims, we can claim some analytic generalisability, albeit with the caveat that there is some selection bias in the sample.

4. Main findings

The six sections below explore students' 1) motivation to study mathematics, 2) perceptions of the relevance of mathematics, 3) attitudes and emotions, 4) experiences of learning mathematics in college, 5) perceptions of the organisation of mathematics provision in their college and 6) views on the government's Condition of Funding policy. The perspectives are almost all from students retaking GCSE mathematics or Functional Skills mathematics, although a small number of Core Maths students also contributed.

4.1. Motivation to study mathematics

The most common reason given by students in the focus groups to study mathematics (except those taking Core Maths) was because they had not achieved a GCSE grade 4 at school. More detailed discussion highlighted more complex motivations in which extrinsic sources, such as the value of a GCSE qualification were prominent. The four main sources of motivation reported by students were, in order of frequency:

1. To get to university;
2. To get a job or secure a better job;
3. To improve their overall qualifications profile and make them more competitive;
4. To get on to another college course after completing their current one.

Few students made reference to the usefulness of the skills they might develop, or to any intrinsic reasons linked to the subject itself and saw the exchange-value of the qualification as the most important motivating factor.

Students aiming to progress to university were generally well motivated to achieve a GCSE qualification, but this was less evident when the transition was distant or uncertain.

Students on Level 3 courses with intentions of progressing to university were clear about the need for the qualification, as one explains:

> *…most of us want to go on to university and obviously in order to get into university you need to have a maths qualification of Grade 4. So we're all motivated to achieve that goal so we can obviously pursue on to doing our careers. (MC4, S1)*[25]

Where university aspirations were less clear or further off, such as for students on Level 2 courses, the need for GCSE mathematics was less pressing; there was time to improve their grade and they might change their mind about university.

Some students referred to friends who had been offered university places without mathematics, which raised questions about the need for the qualification. Inconsistency between official messages about entry requirements and their personal anecdotal evidence created uncertainty and sometimes reduced motivation.

Students frequently referred to a mathematics qualification being necessary to gain employment but there was disagreement about how widely this applied.

In the following extract, students discussed the need for a mathematics qualification when applying for jobs (MC1):

[25] Quotes are attributed to numbers Main Cases (MC) and Additional Cases (AC) and student groups (e.g. S1)

Student 1:	*Cause no-one will take you on as a jobbie, unless you've got your maths and English.*
Student 2:	*That's what they want us to believe, yeah.*
Students:	*[laughing] Yeah*
Interviewer:	*Do you believe it then?*
Students:	*No, no*
Student 2:	*I don't believe it at all*
Student 3:	*No*
Student 2:	*I know people that haven't got maths and English and are still working.*
Student 3:	*Forty years ago, you didn't even need it, so why do you need it now?*
...	
Student 1:	*No, but it depends what sort of job you want to go into*
…	
Student 1:	*It's a dog eat dog world*
Student 2:	*If I want to be a dentist or whatnot, then yeah, you need to have really good grades. But if you want to be a bin man, then it don't really matter.*

Students frequently claimed that employers would want mathematics qualifications and that GCSE mathematics was the best one to have. A minority contested this claim, making reference to either their own experience of working part-time already without GCSE mathematics, or knowing people who had 'good' jobs without a mathematics qualification.

> *I know people that don't have their maths. I know people that don't have a single GCSE, they still get work. They still have a good job and they're still earning over £1000 a month. (AC15, S1)*

Students in particular vocational areas, most notably the construction trades, were the least convinced that they needed a mathematics qualification.

> *It depends what job you're going for. As brick layers or plasterers, you don't really need GCSEs. (AC23, S2)*

Similar distinctions between jobs were made by other students, with mathematics not being needed for jobs they considered low level (e.g. working in a shop) but useful to get a higher level or 'better' job (e.g. running own hair salon, rather than being employed by someone else).

Some students were motivated by the belief that a mathematics qualification would improve their profile and give them an advantage in the employment market.

Students frequently stated that having GCSE Mathematics would help them gain employment, or a better job where there was competition. As one student explains "It just opens up a lot more things for you if you've got it than if you haven't got it" (MC1, S1).

Some students took a longer term view, thinking that a mathematics qualification would improve their long term prospects, especially if they needed to change jobs later in life.

The majority, however, did not seem to be looking beyond their current situation and immediate plans for progression or employment.

Discussions often characterised the job market as divided between adults with GCSE mathematics and those without. In a small number of focus groups, students argued that this 'labelling' was an imposed restriction and that their skills were equally, or even more, important, for example:

Student 1: *They'll look more highly of you because you have. But it doesn't define you. That's what I think. We need to have it because it is a government requirement. But then it is just a number or letter on a piece of paper. So in the end it doesn't really matter because it's you.*

Student 2: *You can still be good at a job if you don't have it. But people just look. It grades you as well, kind of. (AC19, FG2)*

Students debated whether GCSE mathematics was an appropriate gatekeeper to particular careers. There were some strong views about this, especially from mature students who could not progress further without a GCSE mathematics qualification and a small number of students who felt job-related skills were more useful than mathematics.

A small number of students stated that GCSE mathematics was important to their progression in college.

For some students, GCSE mathematics was considered a requirement for progression to a different college course, usually at Level 3, but others were unsure about progression requirements:

Student 1: *You can't get onto Level 3 if you've not got maths.*

Student 2: *You needed it to get straight on there but you can go from here.*

Student 3: *If you don't pass it this year, you can still get onto Level 3. (AC26, S1)*

Uncertainty, again, undermined a potential source of extrinsic motivation, although it was a clear requirement for some individual students who had missed school, or been educated in another country.

Some students were motivated to pass the qualification in order to avoid having to retake the examination again or attend any more mathematics lessons.

Students often described mathematics as an unwelcome addition to their main study programme. The prospect of no longer having to attend, or take another mathematics examination was motivating:

You want to get it out of the road, so you can go onto your job, or uni, or stuff like that. Like it, it makes it so people want to get the grade instead of, like, going to next year and be like "Oh, I've got to take maths again". (MC1, S1)

In several cases, students appeared more motivated by the prospect of being released from studying mathematics than they were about the possible value the qualification might have in the future.

4.2. Perceptions of relevance

Students' views about the usefulness of mathematics generally, and of GCSE mathematics in particular, are reported in this section. These focus on the mathematics skills students are developing and perceptions of relevance to their lives, careers and vocational learning.

Students made distinctions between mathematics that was useful for everyday life, vocational employment, or passing an examination.

Students referred to several distinct categories of mathematics in terms of their relevance and gave examples, as shown in *Table 3*.

Not useful		**Useful**		
Maths for the examination	**Maths for other vocational employment**	**Maths for employment**	**Maths for everyday life**	**Maths for own vocational area or employment**
Algebra Venn diagrams Geometry (general) Trigonometry Pythagoras' theorem		Basic numeracy	Basic numeracy Percentages (Both in the context of handling money)	Basic numeracy Measurement (e.g. Construction) Handling money (e.g. Hairdressing)

Table 3: Students' perceptions of the usefulness of mathematics

There was wide agreement amongst students that much of the mathematics they were learning in GCSE would never be useful in everyday life. The response below is typical.

> *Cos you don't necessarily need maths for everything. There's things in life that don't involve maths. Daily things like shopping doesn't need, like, trigonometry or any of the hard things. I just think it's quite irrelevant. (AC16, S1)*

Students reported a range of examples of mathematics that they considered irrelevant to everyday life or employment. These were considered only useful for passing the examination and sometimes broadly described as the more difficult GCSE topics.

Most students identified a few topics that they could use in their vocational course. They identified mathematics that could be useful in other vocational areas, sometimes being more important (e.g. Accountancy) and sometime less important (e.g. Beauty Therapy) than in their own vocational area.

Students' assessments of the usefulness of mathematics reflected their personal views, i.e. whether they themselves would ever use the mathematics. This was sometimes limited by their current life experience and their inability to project forward to possible scenarios in the more distant future.

The main area considered relevant to everyday lives was personal finance, which students often described as very 'basic' mathematics or numeracy.

Students considered very little of their formal mathematical study to be useful to them in everyday life except what they referred to as 'basic' skills, i.e. arithmetic. The contexts

were almost exclusively about handling money, for example when shopping, and given that they reported having learnt these skills much earlier in school they did not feel GCSE mathematics was helping them. Some students were interested in learning more about finance, including areas such as mortgages and taxes, as these would be useful in the future but pointed out that these were not part of their GCSE.

The mathematics embedded into students' vocational learning was often seen by students as unconnected to GCSE mathematics and sometimes not recognised as mathematics.

Students identified some mathematics that they used in their vocational areas but rarely saw links between this and GCSE mathematics. In most cases, it appeared to students that what was taught by mathematics teachers and vocational staff was unconnected.

Students sometimes found it difficult to identify the mathematics they were using in their vocational practices because it was embedded into a work routine. For example, in animal care, students referred to feeding the animals but took time to identify that they were working with different measurements and ratios.

Student 1: *We don't really think of it as maths, it's more just cos it's part of, like, what we do when we do our practical lessons. So we don't really think of it as; oh we need to remember maths for this.*

Student 2: *It's just one of those things where after a few weeks, it's just embedded in your head that you need to remember what to do.*

Student 3: *It becomes part of your routine.*

Student 1: *You don't really think of it as extra maths. You just think of it as something you need to do to help an animal. (AC18, S1)*

Other students talked about how automation, for example in computer programming and retail, had removed the need to use mathematics. For many, mathematics was what happened in a mathematics lesson and was unrelated to life outside the classroom.

Students identified the relevance of mathematics to their vocational area when this was emphasised by their mathematics teacher.

An exception to this disconnected view occurred in one focus group where a group of plumbing students talked extensively about how their mathematics teacher made connections to the mathematics they were using in Plumbing.

> *Steve connects everything we do. Like the same measurements we do. So it's very helpful. And when we go into the plumbing, we know how to do it cos Steve has helped us out. (AC18, S1)*

In this case, the mathematics teacher explained applications of mathematics in their plumbing course and supported them with the mathematics skills they needed. The students were one of only a few groups who could identify that their mathematics course, in this case Functional Skills mathematics, helped them with their vocational learning.

4.3 Attitudes and emotions

Students were not asked specifically about their attitudes and emotional responses to mathematics in the focus groups but these did emerge strongly in their discussions, suggesting that they are particularly important aspects of their experiences of mathematics. For the majority of students, mathematics was associated with negative attitudes and emotional responses, especially with respect to:

- taking mathematics examinations;
- the government's GCSE Mathematics re-sit policy;
- past experiences of learning mathematics in school;
- incidents in their current experiences of learning mathematics.

Common emotional responses included feeling stressed, frustrated, annoyed, angry or anxious. Students explained how these led to them wanting to give up or 'switch off' from trying to learn mathematics. Students' reasons for such negative responses are explored below.

Students frequently referred to the stress and anxiety they felt concerning the GCSE mathematics examination and its consequences.

Personal experiences of failing the GCSE examination for a second time (or more) were prominent in many of the focus group discussions. Students explained how failure in the examination triggered a range of negative emotions such as disappointment and frustration, often leading to a loss of confidence and a reluctance to make the effort to try again:

> *Everyone, everyone in our class…they just don't care anymore. They just want to, you know, like, we've, we've all tried it the first time (MC1, S2)*

The main aspects of the GCSE examination that triggered emotional responses were:

- the examination environment;
- the consequences of failing the examination;
- results that indicated little or no improvement.

Students often expressed a lack of confidence in their ability to perform in an examination environment, even when they felt confident in class, for example: "When you're in an exam environment, your head goes all weird. You don't really think properly" (MC5, S1). There was a general lack of confidence amongst students that they could improve their examination performance. Students often described their prospects of achieving a grade 4 in their next sitting of the GCSE no more positively than a "hope".

Continuing failure in the examination for some students results in a cycle of decreasing motivation or increased anxiety.

Some students were particularly anxious about the consequences of another failure since this might deny access to further study (e.g. university) and so determine their future. Others expressed annoyance at having to continue studying mathematics and retake the qualification:

> *Student 1:* *Then you have to come back and think; oh, I was so close but I didn't do it, I need to keep doing it. And then, by this point, there's an irritation to it or you get a bit bored and fed up.*
>
> *Student 2:* *You just don't wanna do it anymore. (MC5, S2)*

Those who had already retaken and failed for a second time, or more, were generally less optimistic than those retaking for the first time. Some of these students explained how they were now giving up hope that they would ever pass and becoming reluctant to try: "the more times we do it, the more we'll give up and start not paying attention." (AC24, S1). Some had gone backwards in their GCSE outcomes and found this demotivating. Their

descriptions of multiple attempts suggested cycles of declining confidence, resilience and engagement.

Students' emotional responses to the requirement to retake GCSE mathematics were often negative.

Students often reported being unhappy about the need to keep retaking GCSE mathematics. Some appeared angry or annoyed about having to continue studying mathematics, particularly because it meant attending extra lessons compared to other students on the same vocational course. Others were keen to succeed but found that the requirement to retake mathematics was causing them stress, anxiety and frustration.

Students identified specific incidents in their experiences of learning mathematics that triggered negative emotional responses.

The most common classroom experiences identified by students that they felt triggered negative emotions were:

1. Being unable to understand the mathematics;
2. Being unable to see evidence of improvement;
3. Finding others were understanding the mathematics more quickly.

When students did not understand the mathematics, especially when they were keen to learn, they referred to feeling stressed and frustrated: "…when you don't understand it. It's just the frustration that puts you off it. Yeah, like trying to get your head round it" (MC2, S1). They also talked about being discouraged by not seeing any evidence of improvement, especially when compared to their peers, and being embarrassed when they did not understand or disengaging when they felt left behind.

Students' motivation to engage with mathematics learning was sometimes low, even when they were convinced of the need for a GCSE qualification.

Even when a GCSE mathematics qualification was valuable for progression, students still reported lacking the self-motivation to engage fully with their studies. More immediate reasons to pass, including "escaping" from mathematics lessons and enjoying more free time, seemed to take precedence over long-term goals. The pressure of work for their main study programme also affected students' attitudes and engagement with mathematics. Even though they acknowledged the value of GCSE mathematics, succeeding with their main programme was a higher priority, especially when under pressure to complete assignments.

Students were generally more positive about their experiences of learning mathematics in college than school but few described these as enjoyable or liked the subject.

Mathematics was typically considered as not a popular or interesting subject:

> *Well obviously you don't like it cos you don't wanna go through another year of sitting it when you've just done 5 years of it at school. (AC25, S1)*

Many reported more positive learning experiences in college than they had had in schools, but stopped short of saying they actually enjoyed mathematics lessons. Students were more positive when they thought they were making better progress in college than at school or that the approaches to teaching and learning in college were more effective.

Students gained confidence from evidence that they were making progress, either in attainment or understanding of mathematics.

Evidence of progress in terms of interim college assessments and examination results boosted confidence, as one student explains:

> *I've improved a lot more. First time I was nine marks off and last year I was six marks off. So I have improved. I know it's only little, but I have improved. And in myself I have improved. (AC19, S2)*

Small improvements in marks were sufficient to increase confidence for some students, although many remained cautious about actually achieving a GCSE grade 4 in their next retake of the examination. Other students reported how verbal affirmation of progress and encouragement from their teacher built confidence.

Some identified areas of mathematics they now understood better than they did in school or at the beginning of the year.

> *Just when you're going through the lessons you actually start to understand things that you never used to understand. And even though your grade might not be improving you know your knowledge is. Like I definitely feel more comfortable for my next exam. (AC15, S1)*

In this case, the student's own recognition of better understanding was more important than their grades, although the effect was increased confidence about the next examination.

Students responded negatively to systems and policies that they perceived to be unfair. Some students expressed frustration or anger that the requirement for GCSE mathematics for their progression in college, career or university entrance was a barrier preventing them from progressing to their chosen career. This was a view taken by several mature adult students as well as some 16-18 year olds.

> *It's keeping me behind from doing what I wanna do. I can't get to uni this year, I have to take a gap year and that's just wasting my time, because of maths. I will need it but not some of things in there. (AC24, S1)*

Several stated that they believed themselves to be capable of functioning effectively in the workplace without GCSE mathematics and felt this was an unfair barrier. Emotions in a few cases were strong, particularly from mature students who had ambitions to improve their life situation and were trying hard but not succeeding in the examination. In these cases, perceptions of being in an unfair system were sometimes accompanied by anxiety about mathematics, despite having higher qualifications in other subjects.

Students also commented on unfairness in relation to the emphasis on examination performance rather than their work during the year. Some felt anxiety prevented them from demonstrating their ability in an examination and others referred to examination questions being designed to "trick you" rather than enabling them to demonstrate what they knew.

4.4 Students' views of mathematics teaching and learning

This section presents analysis of the individual desk-based activity, alongside students' views of teaching and learning from focus group discussions. The desk-based activity

explored students' views on the teaching and learning approaches they experienced in mathematics classrooms and whether they thought different approaches would better support their learning. Students' discussions about their learning experiences focused mainly on the teacher and the classroom environment but aspects such as support outside the classroom were also included.

Students considered mathematics teaching techniques to be more teacher-centred than student-centred.

When asked to identify on a 5-point Likert type scale (1=never to 5=very often) how often their lessons consisted of various activities, there was a division between those pedagogies considered to be more teacher- and student-centred, with the former being more common as shown in *Figure 1*.

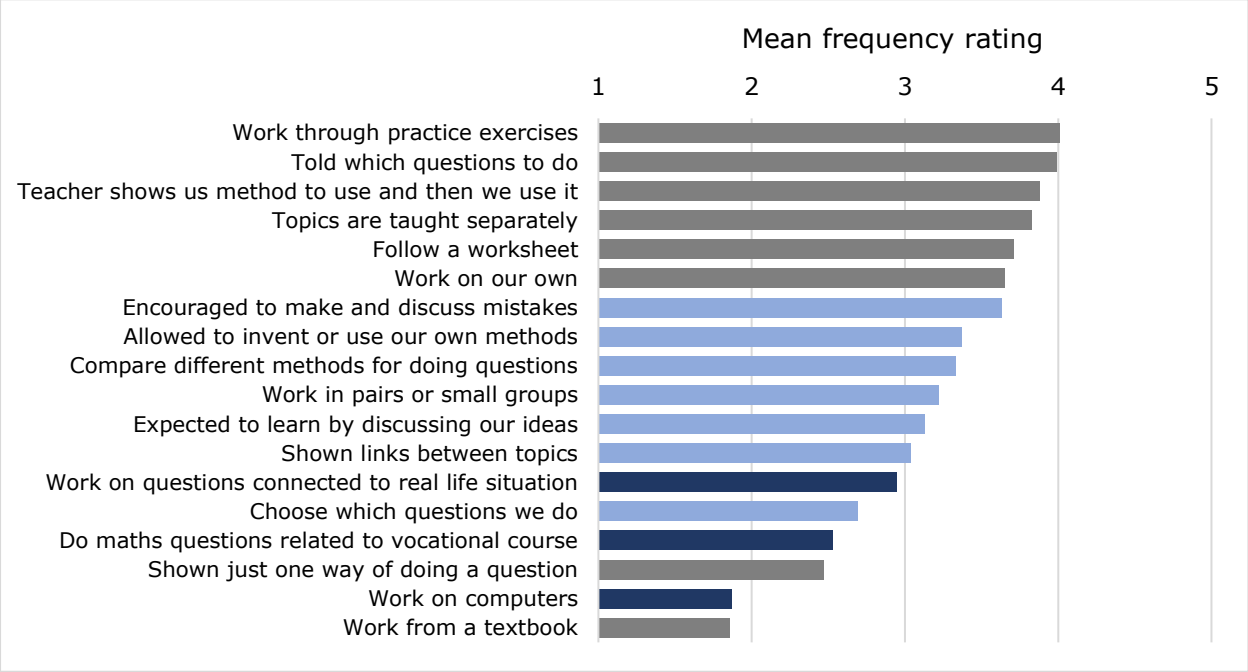

Figure 1: In what ways is mathematics taught in your class? N=388 (N.B 'teacher-centred' items are grey; 'student-centred' items are pale blue; 'others' are dark blue)

Students would prefer greater use of student-centred approaches.

When asked to consider what they thought would be the most conducive teaching and learning approaches to support their learning there was more mixing of the teacher- and student-centred activities as seen in *Figure 2*.

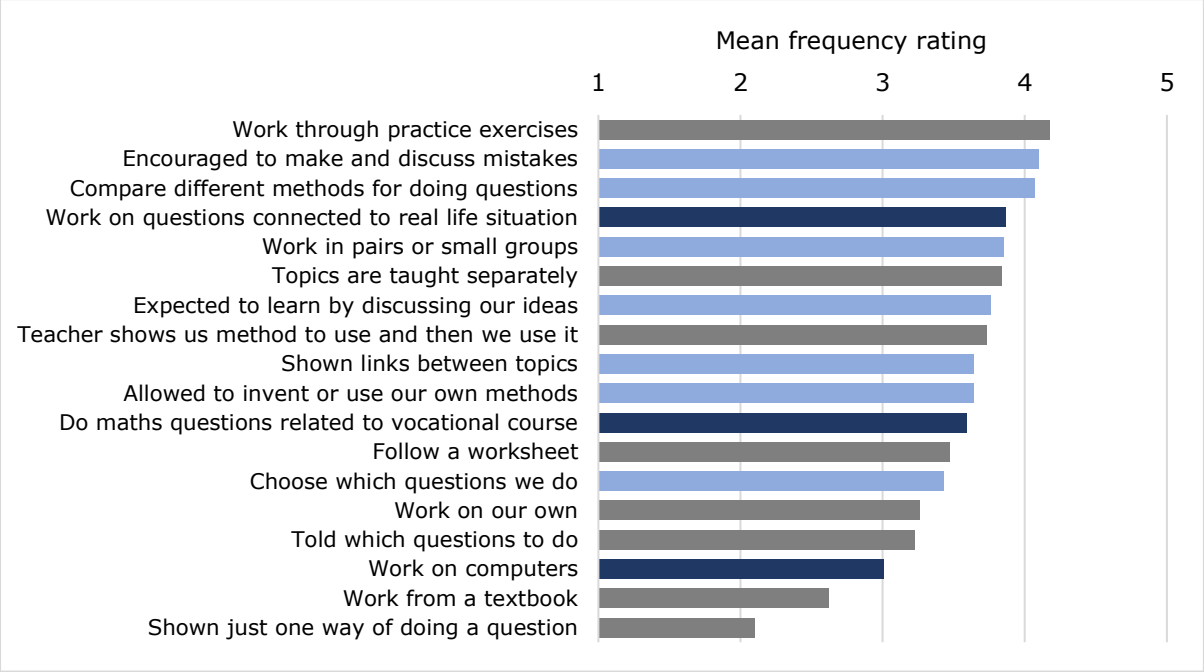

Figure 2: In what ways would mathematics lessons work best for you? N=388

The clearest and most consistent shift between these two views (experienced and preferred) is that students think that more student-centred pedagogy would support their learning.

They would particularly like to see more links between topics, more connections to real life situations and greater agency in activity choices. These preferences are consistent with points made by students in their discussions about the relevance of mathematics to life and the usefulness of individualised approaches. For example, students explained that they generally prefer to be shown more than one method so that they can find one that they understand.

Although overall they would prefer more use of computers in the classroom than they currently experience, the distribution of their 'ideal' responses is 'normal', i.e. without strong views either way. This is a sizeable shift from the very limited use of computers in classrooms at present, as shown in *Table 4*.

		Ideal						
		Never	Not often	Sometimes	Often	Very often	Total	%
Current	Never	39	33	57	34	22	185	(49.7)
	Not often	9	20	32	15	18	94	(25.3)
	Sometimes	3	11	28	8	6	56	(15.1)
	Often	2	2	11	4	8	27	(7.3)
	Very often	0	2	3	3	2	10	(2.7)
	Total	53	68	131	64	56	**372**	
	%	(14.2)	(18.3)	(35.2)	(17.2)	(15.1)		

Table 4: Current and ideal use of computers in classroom to learn mathematics.

Another area discussed in the focus groups was the value of contextualising mathematics in vocational learning or realistic contexts. The sorting task showed a clear desire for more contextualisation in the mathematics classroom. *Figure 3* compares the current and desired frequency with which students work on mathematics problems connected to real life situations.

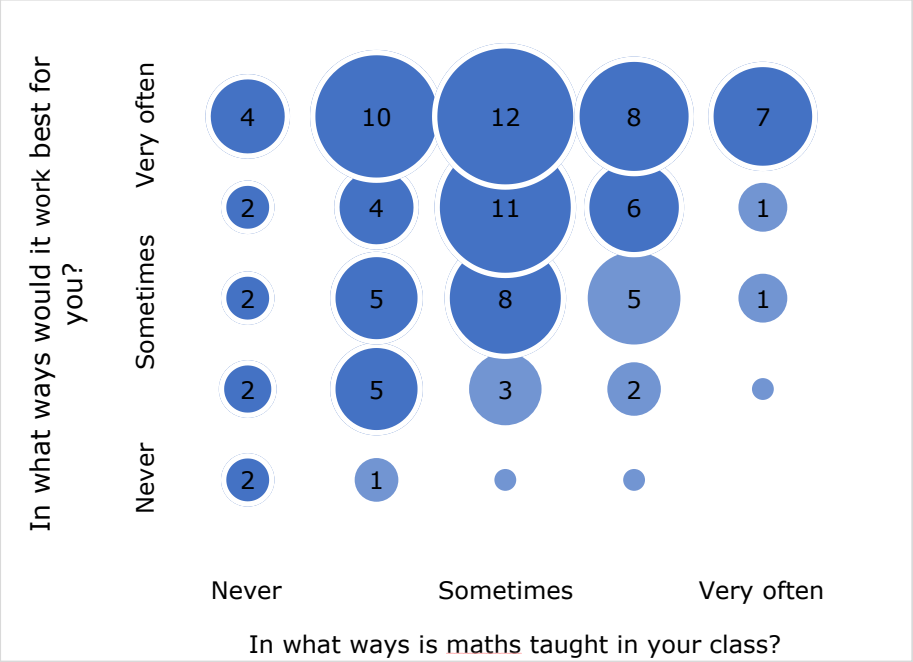

Figure 3: Percentages of students' responses to the statement "We work on questions connected to a real life situation" for both current experience and ideal classrooms.

Students highlighted the importance of a good relationship with their teacher.

Students described how good teachers, in their opinion, were ones that were able to "connect" with the group and with individuals. They expected their teacher to know their personal areas for development and how they learned best, but, most importantly, they wanted their teacher to be approachable.

> *I just feel like a maths teacher shouldn't be, like, considered… any teacher shouldn't be considered absolutely perfect at what they do because it makes the people learning feel small when they don't get it right. So it's easier to have a teacher that you can relate to rather than a teacher that knows absolutely everything. Personally, I just prefer to have someone that seems human. (AC03, S2)*

The teacher-student relationship was a key factor that students felt affected their learning and students highlighted specific personal qualities in a teacher that they felt were helpful in building that relationship, such as patience and humour.

Most students considered their experiences of learning mathematics in college to be better than in school.

Students were not asked specifically about their prior learning experiences but often made comparisons between school and college. The majority reported feeling more positive about their learning experiences in college than in school, with their reasons focusing on:

- better relationships with their teachers in college;

- more individual support and interest in them as individuals;
- evidence of making progress and understanding mathematics better;
- a more relaxed classroom environment where they felt more comfortable about trying to learn mathematics.

Good relationships within the classroom, especially with their teacher, seemed important to students. These may, to some extent, be facilitated by smaller class sizes in college but students who felt they had better experiences in college also referred, however, to the teacher having a different approach to teaching and being more approachable as a person. This made it easier to ask questions and be more included in the classroom.

Students often reported greater confidence that their teacher in college was supportive and interested in them making progress.

> *Like, they're serious about us getting us grades. But, like, as… like, my teacher, like, she's… she like, tries to push me because she wants me to get my grade. Like, she actually cares about me getting a grade. She's not just coming to us and teaching [unclear] and going. She's constantly offering one-to-ones and interventions and stuff like that to try and make sure that you get your grade. (MC1, S1)*

The level of individual support provided was often identified as being better in college. Smaller class sizes may, again, have helped teachers provide this but students also reported being treated with greater respect and receiving more encouragement from their college teachers. For example:

> *Yeah I used to just get yelled at. A teacher has actually called me stupid before in school because I couldn't understand something. I don't understand why I was getting treated like that and it just shuts you down. But in college, you get encouraged. (AC15, S1)*
>
> *I got made to feel dumb at one point in school. But in college they treat with respect. (AC19, S2)*

Students benefitted from clear explanations, alternative methods and practice.

The need for sound understanding of both the mathematical content and alternative pedagogical approaches from teachers was highlighted by students. There were multiple references by students to the need for clear explanations that they could understand, for example:

> *He's, like, really good at explaining stuff. Like, when he's explaining it. It just makes it like… seems really simple. And like, I've had, like, loads of others, and a lot of them, they just take ages, like, going through loads of ways of explaining it and you still don't get it. But with Eddie, you just… I don't know what he does, but he just seems really good at explaining stuff so you get it. (MC1, S2)*

The students in this focus group had difficulty identifying exactly why they understood mathematics better when it was explained by this particular teacher but other students felt they learned best when the teacher spent time breaking down the mathematics into smaller steps. There was wide agreement from students that they benefitted from being shown alternative approaches, even though it might take time to find a method that they really understood.

> *I think a good maths teacher shouldn't make us understand the topics in just one way because not everyone can access that way. And they should try different ways to learn and different ways to resolve problems. (MC2, S4)*

Students often referred to having more opportunities to explore alternative methods in college and being given different explanations if they did not understand the first time:

> *He tries to explain it in different ways. If you don't get it one way, they'll explain it again in a different way. In high school it was like; if you don't it this way, you won't get it at all. This is the only way to do it. (AC19, S2)*

Students were also aware that they did not always retain what they had been taught and that they needed repetition and practice. Some attributed this to having a bad memory or it being difficult to make mathematics "stick in my head" (AC26, S1) although recall under examination conditions was also a problem.

> *I don't remember half the stuff just cos I've got a bad memory to be fair. It all just goes away when you're in an exam. For me anyway. I will just forget everything. (MC5, S2)*

Opportunities to revisit topics and revise were valued by students as a solution to this problem. Students also valued feedback on tests, so they would know what areas to work on. There was, however, criticism in some cases that they did not always have the opportunity to follow this through and work on their weaknesses, for example:

> *Student 1:* *We get our test papers back, so we can have a look at it, then we don't do anything.*
>
> *Student 2:* *We just put it away again.*
>
> *Student 1:* *We get to know what we need to work on, but we don't actually get to work on it. (AC26, S1)*

There was also criticism of teachers who went through topics quickly and did not give students the time to gain a secure understanding before moving on, or tried to cover a wide range of topics rather than focusing on the students' areas of weakness.

Students wanted to be taught by empathetic teachers who understood their difficulties with learning mathematics and were committed to helping them improve.

Students appreciated teachers who understood them and listened to their questions rather than delivering what they described as a teacher "teaching themselves" or delivering a "lecture" rather than interacting with the class.

> *I think the biggest issue that I find is that some teachers have forgotten what it's been like to be a pupil. I wish they would just understand that we do struggle sometimes. (AC25, S1)*

> *If we're struggling as well he'll say 'that's cos I'm teaching it a way you don't understand so we need to work on a way you can engage with us'. So it's just making it so much better to know that someone's gonna try and find the way that suits us, rather than the way that suits them to teach. (AC15, S1)*

Students valued a teacher that they felt would not "give up on them" but would work with them and try to find ways of helping them understand. They also looked to their mathematics teachers for encouragement:

> *I feel like what you said, encouragement, is really important because you just need someone, even if you already know yourself, you just need someone who keeps*

> *telling you, "You can do this. You can do it. Like maybe you didn't get it last year or the year before, but this year you can do it." I feel like that's what I need to hear. (MC4, S1)*

Students identified sources of support for their mathematics learning as primarily their teacher, their peers (in class) and materials accessed electronically (out of class).

Support for learning mathematics came from several different sources according to students, as summarised in *Table 5* below.

Source	When	Type	Access
Mathematics teacher	In class and outside class	Explanation, additional work.	Verbal request or email
Peers	In class	Explanation	Verbal request
Workshops	Outside timetabled classes	Explanation, additional work, Virtual Learning Environment (VLE), websites.	Referral, request, or by attending a session.
Extra classes	Outside timetabled classes	Formal teaching	Referral, request or by attending timetabled session
Support staff	In class	Explanation	Usually only accessed by designated students with formally identified needs.
Web-based sources or VLE	Outside class	Video explanations, tests, additional work, worked examples	Freely available on computer or other device

Table 5: Sources of support identified by students

Teachers were, understandably, the main source of support for student learning, including informal one-to-one support outside lessons and, in some cases, providing extra work or feedback by email. However, students explained the importance of the aforementioned good rapport and empathetic teacher style so they felt able to approach their teachers for help.

Students reported asking their peers for help in class and sometimes found explanations from other students easier to understand than those provided by their teachers, as one student explains:

> *It's better to like learn off somebody you relate to as well. I find it difficult to learn from the class sometimes because he's like so, so good at maths [all laughing]. He's like a genius, but I'm not and it's best sometimes to just talk to a classmate because they like relate, they understand. (MC4, S1)*

No students referred to asking their peers for help outside class but most were aware of a range of different additional support processes provided by their colleges, including regular workshops, extra classes and revision courses during holiday periods. In some colleges, there were formal referral systems but, generally, students could access extra sessions or workshops by request, or by simply attending a timetabled session. In a few cases, students seemed unclear about the support available or how to access it, even though teachers had described the support available in interviews at the college.

Although aware of these opportunities, few students had actually accessed them. Some explained this as a general reluctance to attend additional sessions or do more

mathematics, even though they acknowledged they might benefit from the help available. A lack of motivation or the prioritisation of work for their vocational course were common reasons why support was not accessed. Other students felt that they did not require additional help from other sources because they could access all they needed from their teacher. The availability of web-based materials and/or a college VLE was widely acknowledged by students. Some referred to using these materials regularly and liking the privacy of supporting their classroom learning this way. For example:

> *He has like a website where he covers GCSE maths and I feel that like if I don't understand something from my teacher, if I go home and watch his videos, I'll be able to understand it for the next day. (MC4, S1)*

Others stated a strong preference for a face-to-face personal explanation when they did not understand the mathematics and pointed out that electronic feedback might inform them about whether they were right or wrong but did not explain why. For the same reasons, some preferred using videos in which the mathematics was explained, rather than the specialist packages used by their college.

In some colleges, students were expected to complement their classwork with computer-based learning but referred to a lack of monitoring that meant they did not always complete the work.

4.5 The organisation of mathematics in college

Students discussed how the mathematics provision was organised in their college and about specific aspects such as the number and length of sessions, the mix of students in a group and how such decisions were made. The different structures, strategies and systems in their colleges were explored in the case studies[26] and these were taken into account when analysing students' responses.

Some students found their mathematics lessons too long or inconveniently timetabled.

Most students with experience of a three-hour mathematics session, once a week, thought this was too long, even with a short break, and that it placed considerable demands on their concentration and engagement: "To be realistic, I feel like it's physically impossible to do maths for three hours" (MC4, S1). The general preference was for two 90 minute sessions a week, although a few students preferred the single three-hour session because they were able to "get it over and done with" for the week.

Students disliked having to attend mathematics lessons on days when they did not have vocational sessions, especially if they had to make long journeys into college. They found it particularly challenging to concentrate on mathematics at the end of the day and there was some resentment amongst those who had to retake mathematics (or English) because of the longer days they had to spend in college.

Reorganisation of mathematics groups was common but unsettling for many students.

Many students had experienced some reorganisation of their mathematics class, either at the outset or mid-year, which made it appear disorganised. Such changes sometimes resulted from staff illness and were temporary but the combining and separating of groups was still disruptive, as one group explains:

[26] See https://www.nottingham.ac.uk/education/documents/research/mifec-interim-report.pdf

Student 1: *We were a small class at one point and then we were big. Then the teacher was off. Then their group joined us.*

Student 2: *Recently we've had quite a lot of people in our class cos teachers have been ill. The most we've had is about twenty. At the moment we've got about ten-ish.*

Student 1: *When we were in the other room, I thought we had more like thirty. (AC18, S2)*

Most changes were about groups being split or merged, although one group gave an example of being informed that they were taking a different qualification to the one they had initially been told. Understandably, students preferred consistency and felt this was more helpful to their learning:

> *Well, for me personally, same teacher's more beneficial for me because they understand my way of learning. Whereas if I just kept swapping teachers, like, I don't think I'd be able to manage the work because I'd feel under pressure because that teacher didn't quite get how I did my maths. And I'd feel just… under pressure, really. (MC1, S1)*

Similar comments from other students reinforced the importance mentioned earlier of establishing good student-teacher relationships.

There were mixed opinions about being taught mathematics with students on the same course or from different vocational groups.

Students presented arguments for and against vocationally mixed groups:

> *If you work with your friends and you're able to help each other because you know each other, but if you work separately, I think it would probably help me more because I'd be more concentrated because I don't know anyone. So I'd be able to like work more harder because you're working by yourself so you can concentrate and get on with the work. (MC4, S1)*

Some felt, like this student, that they would be less distracted in a mixed group where they did not know the other students. They anticipated talking less and concentrating more. Others felt uncomfortable in mixed groups and less able to ask for help from either their peers or the teacher. For example, a female student in the same focus group recalled a negative effect on her behaviour when in a mixed group with students she did not know:

> *With the revision groups especially, I remember going to one and it was like full of lads from engineering and I was like the only girl in there and I didn't know the teacher and like I was trying to do my work and I didn't get something. So I just sat there and like I didn't ask for help because I didn't know the teacher (MC4, S1)*

Other students expressed similar views and felt more comfortable with people they knew. Most of the reasons given were about personal responses to a situation, or predictions of how they would react.

Few students understood why they had been placed in a particular group and had not been offered any choices about the qualification or group.

In the main, students were allocated to qualifications and classes without understanding the systems and processes: "I don't actually have a clue, I just know none of us are in the same class. I don't know how it's set" (AC16, S1).

Students frequently referred to assessments at the beginning of the year but few understood the purpose of these. Some thought this was to determine groups. Others

thought it was diagnostic to inform the teacher about students' strengths and weaknesses, although some considered this "pointless" since they were taught everything anyway.

Students were concerned that poor attendance and disruptive classroom behaviour was not addressed strongly enough.

Students' perceptions were that sanctions to address poor attendance at mathematics lessons were often not applied rigorously enough and were ineffective. Whilst they were sometimes aware that attendance was monitored, they questioned whether this resulted in timely and effective action. Some referred to the threat of being "being kicked off the course" (AC19, S2) but were unsure whether this action had ever actually been taken.

Some participants concluded that individual students were free to choose whether they would attend mathematics or not. One group highlighted how a lack of effective action about attendance was inconsistent with the message that mathematics was important.

> *If they're saying that maths and English is important, as soon as we miss a lesson, then why aren't they on our back straight away? (MC1, S2)*

Although other evidence from the case studies[27] indicates that colleges do indeed monitor attendance and implement disciplinary processes, the lack of visibility of such processes to students seems to undermine confidence in college systems.

In a few cases, students described instances of disruptive behaviour from other students in their lessons and questioned the effectiveness of actions taken to deal with these. They appreciated the calmness of teachers in dealing with such incidents, which avoided unnecessary escalation, but advocated stronger action than they had witnessed. In general, they were of the view that noncompliance with expectations about attendance and behaviour should result in stronger consequences.

4.6 Students' views of policy

Students expressed mixed opinions about the Condition of Funding and whether all students without GCSE grade 4 should retake the subject.

There were mixed opinions about the government's GCSE retake policy and whether retaking mathematics was appropriate for all students without a grade 4. Some believed that the policy was good because they believed everyone needed mathematics, even though they may not actually want to do it. The majority were less convinced and proposed alternatives around four main ideas:

- students should only retake GCSE if they need to;
- students should only study the mathematics needed for their vocational course;
- students who are close to passing should be allowed to stop;
- there should be a limit on how many times you retake the examination.

Some further explanation of these views and the reasons for alternative policies is given below. These highlight the importance to students of relevance, choice and agency.

[27] See https://www.nottingham.ac.uk/education/documents/research/mifec-interim-report.pdf

The relevance of mathematics to the individual was an important factor in several proposals of alternative policies from students.

Students' views about relevance, as discussed earlier (*Section 4.2*) generally focussed on *either* the value of a mathematics qualification for progression to further study or employment, *or* the usefulness of mathematics in relation to their personal lives or future employment.

Retaking GCSE mathematics was widely believed to be appropriate for students who needed the qualification for progression or employment. Few thought that this should include all students and therefore there needed to be some choice offered, to either the college or the individual, about whether they should retake GCSE or not.

Some students thought it was more important for those on vocational courses with substantial mathematical content to continue studying the subject and that a differentiated approach based on direct relevance to their vocational course was appropriate.

> *I think if you're doing a course with maths in it then yeah. But there's just so many things in maths that I think, that's never going to be relevant to our course. Like triangle stuff and things like that. If you need to learn it, just learn what's needed. (AC 23, S1)*

There were varied opinions about how, or whether, this mathematics should be assessed.

> *I think we should have separate exams maybe. So it's not as intense or complicated or complex as the full exam. Someone that does Engineering, they might need the full thing. (AC 24, S1)*

Limits on the number of GCSE retakes and flexibility were features of several alternative views of post-16 mathematics policy.

Students' lack of confidence about their chances of passing GCSE (see *Section 4.3*) was evident in their views about policy. In particular, some students felt there should be a limit to the number of compulsory retakes, as one student explains:

> *I think there should be a limit. You do it three times, let's say. Then if you don't get it, you should have the option to stay on if you want but we're not gonna force you to stay. Because after the third time, people aren't exactly going to be engaged with in it. And it's just like; I don't wanna be here. (AC18, S2)*

The effects of repeated failure feature in the reasoning for this idea of capping the number of GCSE retakes. Similarly, some students proposed that those who were very close to passing, after several retakes and working hard, should be allowed a 'pass'. Flexibility to suit the individual was a common theme but often, it seems, linked to decreasing confidence and motivation amongst students who repeatedly encounter failures.

Students felt they should have more agency in terms of options and choices about what mathematics they do and whether they retake GCSE.

The general resistance from most students to the current policy was due to it being a blanket requirement and not always appropriate to their personal needs. The idea of 'maths for all to 18' was rejected by all the groups that were asked, on the grounds that some students did not need mathematics at all and certainly not mathematics beyond GCSE.

Students' own ideas about alternative policies often incorporated choices for different vocational groups or individuals. Given the option of retaking GCSE mathematics or not,

some stated clearly that they would still do so because they had a reason for the qualification and this provided motivation. Others would opt in, although reluctantly, because they believed the qualification may be useful to them in the future but there were also strong opinions, especially after more than one retake of the examination, that retaking again was not appropriate for their needs.

5. Conclusions

The analysis of student-generated data in this report shows some similarity between students' views and the teachers' perceptions of students reported earlier[28]. There are, however, some important differences which signal areas for improvement in students' experiences, as explained below.

Motivation to study mathematics amongst GCSE retake students is heavily reliant on the 'exchange-value' of the GCSE qualification in relation to students' intended progression routes and careers. Students and teachers agree that inconsistencies in university entry requirements undermine student motivation to achieve the qualification. Anecdotal evidence of gaining employment without GCSE mathematics also reduces motivation. There is a need for consistent but realistic messages about the 'exchange-value' of GCSE mathematics.

Increasing students' perceptions of the 'use-value' of mathematics would provide a second source of motivation for some students. Students are unconvinced that most of the mathematics they are currently learning will ever be useful, except for the purpose of passing an examination. Opportunities to increase the relevance, such as links to vocational or real life applications, appear to be under utilised. This is inconsistent with the impression given by college teachers and managers that embedded practices are widely used and suggests tensions between highlighting the mathematics in vocational learning and embedding the skills so deeply that they become unrecognisable as mathematics. For the purposes of motivation, the implementation and impact of embedded approaches in vocational learning needs further exploration, alongside the construction of meaningful connections to life and work in mathematics classrooms.

Students' attitudes and emotions are an important part of their post-16 learning experiences. These need attention in mathematics teaching since they influence student engagement, progress and attainment. Failure, in terms of the GCSE examination or of understanding in class, is a strong influence that contributes to cycles of declining interest, confidence and engagement, sometimes accompanied by heightened anxiety.

Students have clear ideas about how they learn best and what teaching approaches are most helpful. They value learning experiences where their individual needs can be addressed, but with a balance of student-centred and teacher-centred approaches. The majority are more positive about their learning in college than in school but still lack confidence. They particularly appreciate being shown alternative methods and having clear explanations but highlight the importance of a teacher who is approachable, encouraging and committed to helping them improve.

[28] MiFEC second Interim Report.

Students rarely understand the organisational systems that determine their mathematics group but dislike reorganisation and discontinuity. Changes in groups and timetables, especially early in the college year, appear to be common practice in many colleges and minimising this would be helpful to student learning. It would also be easier for students to become involved in their own learning if they had a better understanding of the systems and processes that influence their experiences, such as the reasons why they are placed in certain groups, the purpose of initial assessment and processes to address poor attendance.

Most students disagreed with the government's current GCSE re-sit policy and so proposed alternatives. These sometimes reflected their perceptions about the relevance of the qualification and skills, such as GCSE being optional but focussing on vocationally-related skills. Students' emotional responses and lack of confidence also influenced other proposed alternatives, in which there was flexibility for those experiencing repeated failure.

The students' views presented in this report are based on data from 62 student focus groups, with a total of 388 participants from a wide range of courses spanning 14 broad vocational areas. Although the participants were volunteers, some bias due to the reliance on self-selection, and possible college staff influence to volunteer, is to be expected. The sample included representation from 29 of the 32 case studies that were selected as to form a balanced sample of GFECs for the MiFEC project. Although, when compared to the scale of the student population, this means we cannot make statistically generalisable claims, the spread and balance of the sample suggests the findings are fairly reliable indicators of the range and type of views held by students in GFECs.

Appendices

Appendix 1: Student focus groups - discussion guide

Project information

This focus group is part of the research project Mathematics in Further Education Colleges being conducted by the University of Nottingham. First, I will ask you to fill in a short form and carry out an individual card-sorting activity. Then I have some questions about your experiences of learning mathematics that I would like the group to discuss. This will be an informal discussion but will be recorded so I can recall everything later. As explained in the project information sheet, your names will be kept confidential. Please feel free to ask at any time if anything is unclear.

Individual desk-based activity

Completion of form. This will provide: year in college; main study programme; current maths course; previous attainment in college and in school.

Card-sorting activities. These will explore student perceptions of: The ways maths is taught in college and the approaches students think work best for them.

Discussion questions

1. You have already given me some details about your mathematics qualifications. I would now like us to talk about the qualifications you are taking and the progress you have made.
    - How much progress do you feel you have made with maths in college? What do you think are the reasons why? How do you know how well you are doing?
    - Do you think the qualification you are taking is the right one for you? Why?

2. You have already carried out an activity about the teaching approaches used in mathematics lessons but I would like to ask you a few more questions about your personal experiences.
    - How well do the approaches used in mathematics lessons in college work for you? Why?
    - What has been most challenging about mathematics in college for you?
    - What makes a good mathematics teacher, in your opinion?
    - If you could change anything about your mathematics lessons in college, what would that be?

3. Could we now talk about other aspects of your experience of mathematics in college?
    - How is it decided what mathematics qualification you take in college? (e.g. prior attainment, personal choice)

- Can you describe how maths *classes* are organised? (e.g. time allocation, timetabling, mixed ability groups, vocational groups?). How well does this work well for you?
- What happens if you don't attend your mathematics lesson?
- If you are struggling, is there any extra support available, in class or in separate workshops? Have you used this support? Has it helped you make progress?
- What mathematics is there within your vocational course? How is that connected to your mathematics course?

4. Finally I would like to ask you about your views of government policy.
   - What do you think of the policy that requires all 16-18 year olds without a 'pass' at GCSE mathematics to retake the examination, or aim towards this?
   - Why do you think that?
   - What alternative would you suggest?

Are there any other comments that you would like to make or things you think are important?