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Mathematics in further education: student progress over time

The Mathematics in Further Education Colleges Project:

Interim Report 4

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October 2020

Nuffield Foundation

Acknowledgments

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1. Introduction

In 2014, the government's new Condition of Funding for post-16 education required young people who had not achieved a grade C (now grade 4) or above in their GCSE English and/or mathematics at age 16 to continue their studies of these subjects. At that stage, the requirement was merely that students enrol on appropriate courses of study but a year later in 2015 it became mandatory for students completing Key Stage 4 with a grade D to retake a GCSE course in order to try and achieve a grade C/4.

In order to monitor the impact of this reform, a new maths progress measure was introduced in which points are attributed to different mathematics qualifications, thereby allowing aggregated measures of progress to be calculated at institutional level. Strictly speaking, the policy required course *enrolment* rather than examination *entry* and, as can be seen below, a substantial number of post-16 students did not enter any mathematics qualifications, though this number has fallen. The evidence of mathematics progress has been mixed and the Condition of Funding, commonly referred to as the 'GCSE resit policy', has received some public criticism[1].

As explained elsewhere[2], colleges have changed their strategies over time. Whilst there has been no choice for those arriving in FE colleges with a grade D/3, the choice of qualification and progression pathways for those arriving with lower than grade D/3 has varied by college. This has depended on college decisions about the value of different qualifications and whether the college prioritises the maximization of progress (as measured by the government's 'maths progress' scores) or GCSE pass rates. The analysis below shows a gradual drift away from Functional Skills mathematics. It is important to note that the government's 'maths progress' measure is a model and, therefore, as in all models, it encodes values and priorities. In this progress model GCSE is valued over other qualifications[3] in accordance with influential national reports (e.g. the Wolf Report, 2011[4]).

The Mathematics in Further Education Colleges Project (MiFEC, 2017-20) set out to analyse matched administrative data[5] for a series of 16-year-old GCSE cohorts in England in order to understand students' mathematical outcomes over the subsequent two years in Further Education colleges. Individualized data allow for a range of descriptive and inferential analyses of population subgroups (e.g. gender or ethnicity) as well as of college-level effects. Unfortunately, major changes resulting from data security concerns and legislation (e.g. GDPR) and technical changes (e.g. ONS Secure Research Service) have made getting access to this data challenging. These issues, together with legal obstacles in merging datasets for non-governmental use, have resulted in considerable delays to this work. In lieu of these delays, we here synthesize and re-present the DfE's annual published outcomes for post-16 students under the Condition of Funding to explore some of the high-level patterns of engagement and progression from last few years. This is the focus of this short report.

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[1] For example, Ofsted noted the negative impact of the policy in 2017 (https://www.bbc.co.uk/news/education-39306268) and in 2018 Labour committed to scrapping the policy if in government (https://feweek.co.uk/2018/11/20/rayner-labour-would-scrap-gcse-english-and-maths-forced-resits-policy/)
[2] https://www.nottingham.ac.uk/education/documents/research/mifec-interim-report.pdf
[3] See Dalby and Noyes (2020) for an analysis of the long-run growth and decline of functional skills mathematics.
[4] https://www.gov.uk/government/publications/review-of-vocational-education-the-wolf-report
[5] Matching of the National Pupil Database (NPD) cohorts of 16-year-olds with subsequent records from the Individualised Learner Record (ILR)

The key findings from this analysis are as follows:

1. The Condition of Funding resulted in an immediate increase in the uptake of GCSE in further education, as intended.
2. The initial improvement in mathematics 'progress' can be accounted for by the switch from Functional Skills mathematics to GCSE (for prior Grade D/3 students) as the points awarded to GCSE are higher. Whether students gain more useful mathematical skills cannot be determined.
3. After the initial change resulting from the introduction of the new policy, there has been little further progress in improving GCSE resit pass rates for those leaving school at age 16 with a grade D/3.
4. Three out of four students with a GCSE Mathematics grade E/2 at age 16 fail to make progress over the following two years.
5. Around 40% of students with a GCSE grade E at age 16 go backwards over the following two years, at least according to the maths progress measure.
6. The general trend since the introduction of the Condition of Funding is a move away from Functional Skills to GCSE. This corroborates our case study work as reported in the MiFEC project's second Interim Report[6].

2. Data and Methods

The Department for Education (DfE) publishes aggregate data relating to students' mathematics and English progression as they move from Key Stage 4 (KS4) into post-16 study. The data used herein specifically relate to students who have not achieved a Grade 4 or a C in GCSE Mathematics aged 16. It compares students' KS4 achievements with their progress in mathematics at the end of their 16-18 studies.

Although the datasets include students on all study pathways and in all types of institutions, the majority of them are in further education (FE), and more specifically in FE colleges. For example, the 2018 data release included 145,448 students who needed to undertake post-16 mathematical study; 95% were in further education and 92% of those were in FE colleges (i.e. not sixth form colleges). So although the analysis herein includes 16-18 students from all institutional types we assume that it can be applied to FE colleges. The DfE's analysis shows, however, that these mathematics students tend to progress less well in FE colleges than in other settings so the patterns in progress discussed below probably overestimate progress in FE settings.

The DfE publishes progress data annually for the previous academic year. Six years of data were collated in order to examine changes in mathematics progress since the introduction of the GCSE resit policy. This analysis includes changes in attainment for successive year cohorts of students who achieved Grades 3, 2, 1 or a fail (D, E, F, G, U) in KS4 aged 16. The reason for this approach is to compare like with like; changing entry strategies in colleges might render overall GCSE pass rates, for example, meaningless. It also includes the number of students who were required to study mathematics as part of their funding agreement, but who were not entered for an examination in any qualification.

[6] https://www.nottingham.ac.uk/research/groups/crme/documents/mifec/interim-report-2.pdf

These students are represented by the term 'No Entry'. Whether they have studied part or all of a programme of mathematical study is not known.

The data contains aggregated information about the highest mathematics grade achieved by students who had not achieved a GCSE grade C/4 at age 16. The reporting years presented in this analysis are therefore the final year of post-16 study, when the majority of students are aged 18. These students would typically have completed Key Stage 4 two years earlier. *Table 1* sets out when the funding policies were introduced for the years that students finished post-16 study and the year they would normally have finished KS4. The first two years are included as baseline data. The data does not specify when they completed that grade or how many attempts they had[7]. So, the attainment of a student resitting and obtaining a grade 4 in the November after commencing a post-16 programme is equivalent to one who has retaken the GCSE multiple times to achieve the same result. Whilst this outcome is counted as equivalent, the experience will no doubt have been very different.

Table 1: Cohort Years and Policy Changes

Year students reach age 18	KS4 year (age 16)	Policy Changes
2013/14	2011/12	
2014/15	2012/13	
2015/16	2013/14	First cohort of students required to continue to study a qualification if not holding a GCSE Mathematics grade A* to C (Grade 4 or above)
2016/17	2014/15	First cohort of students required to study GCSE Mathematics if they achieved a grade D in GCSE Mathematics at KS4.
2017/18	2015/16	
2018/19	2016/17	

2.1 The data

Table 2 summarises the data used in this analysis, setting out the mathematics achievements in FE of all students who were required to continue learning mathematics in their programme post-16. The raw data used in this analysis shows students' original achievement at the end of KS4 (Year 11/Age 16). Students at KS4 typically study towards, and are entered for GCSE qualifications. This data only contains information relating to students who did not achieve at least a Grade 4/C at GCSE in KS4.

[7] For a more in depth analysis of the 2015/16 FE leavers see Rodeiro, C. V. (2018). "Which students benefit from retaking Mathematics and English GCSEs post-16?" Research Matters (25): 20-28.

Table 2: Achievements of 16-18 students studying mathematics as a Condition of Funding

16-18 Mathematics Achievement	2015/16	2016/17	2017/18	2018/19
No entry	31785	25056	21464	18989
Fail	4468	4500	4523	3938
Entry level in Functional Skills, Free Standing Mathematics or ESOL	23208	18460	16817	14805
Grade 1 or G in GCSE Mathematics or G in AQA Use of Mathematics	2076	2675	3627	5442
F in GCSE	3357	3733	2963	1556
L1 Functional Skills; L1(A-C) Free Standing Mathematics; L1(D/M) ESOL; D/E in AQA Use of Mathematics	26655	18215	14610	13739
Grade 2 or E GCSE	10302	12054	15638	17577
Grade 3 or D in GCSE; L2 Functional Skills; L2 ESOL; A*/A/B/C in AQA Use of Mathematics	28787	28323	31387	33270
Grade 4 or C GCSE	18563	23675	26521	24800
Above Grade 4 or C	195	91	466	831
TOTAL	149859	138942	138581	135462

The DfE produces this data to show how students have progressed in mathematics and English during 16-18 studies. *Table 3* provides an example of the points allocated to each qualification and grade by the government's maths progress measure.

The maths progress points system allows for measurement of improvement in terms of mathematics examination outcomes, even when different types of qualifications are studied. *Table 3* summarises the points system from 2018/19, which has fundamentally been the same from 2015/16, apart from the addition of the new GCSE Grades 1 to 9. Since the points system was comparable prior to 2018/19, this allows trends across cohorts to be studied.

Table 3: Example of a progress point values and qualifications in 2018/19

	Grade Achieved					
Points awarded	**Reformed GCSEs (9-1)**	**Legacy GCSEs (A*-G)**	**Functional skills**	**Free standing maths**	**ESOL**	**AQA use of maths**
8	Grade 9	A*				
7.7	Grade 8					
7	Grade 7	A				
6.3	Grade 6					
6		B				
5.7	Grade 5					
5	Grade 4	C				
4	Grade 3	D	L2	L2 (all grades)	L2 (all grades)	A*/A/B/C
3	Grade 2	E				
2.5			L1	L1 (A-C)	L1 (d/M)	D/E
2		F				
1.7				L1 (D)		
1.5					L1 (pass)	
1	Grade 1	G				
0.8				L1 (E)		
0.4			Entry Level	Entry Level	Entry Level	
0	Fail	Fail	Fail	Fail	Fail	Fail

It should be noted from the green shading in *Table 3* that level 2 Functional Skills is not numerically equated with a level 2 pass in GCSE (grade C/4). Functional skills was

introduced following the Tomlinson Report[8] as an equivalent to GCSE, partly in response to employer demand for better assessment of workplace skills, and for a time was intended to be an essential requisite for the award of a grade C. The maths progress measure's points system awards a lower value to the qualification than a level 2 GCSE pass. So, prior to the Condition of Funding, students arriving into FE colleges with a GCSE grade 3 might be enrolled onto level 2 Functional Skills and make progress with their mathematics (i.e. moving from a level 1 to a level 2 qualification). In this new progress model, a student with a GCSE grade D/3 (level 1) who subsequently achieves a level 2 pass in Functional Skills will be deemed to have not progressed.

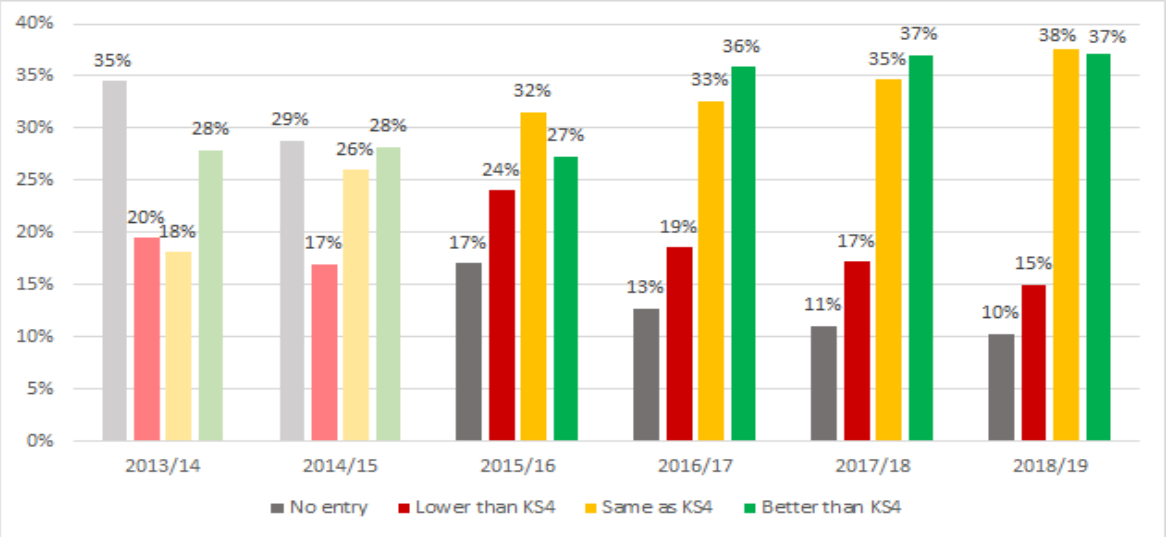
3. Analysis

As explained above, each group of 16-18 students is subdivided into groups with different prior attainment at GCSE: grades D/3, E/2 and so on. Each group is considered in turn as the Condition of Funding has been more or less directive for each group.

Key Stage 4 leavers with GCSE Mathematics grade D/3

Figure 1 shows progress in mathematics during 16-18 studies by students who achieved a Grade 3 or a D in Mathematics GCSE at KS4. This shows the year the student completed KS5 (usually 2 years of post-16 study). For example, the data for 2018/19 refers to students who finished Key Stage 4 in the 2016/17 academic year.

Figure 1: Progress of students aged 18 who achieved a Grade 3 or D at KS4



Students finishing their 16-18 studies in 2015/16 included the first students to be required to study a mathematics qualification as a condition of their funding, if they had not already achieved a grade C/4 in GCSE Mathematics. The 2016/17 cohort were the first students to complete two years of further education with the requirement to re-enrol on a GCSE Mathematics course.

In 2016/17 there was an increase of 9%, compared to the previous year, in the proportion of students who improved their mathematics grade (according to the points score) during

[8] http://www.educationengland.org.uk/documents/pdfs/2004-tomlinson-report.pdf

their 16-18 studies. This appears to indicate good progress with student outcomes but is likely to have been merely due to the change from requiring students take an unspecified post-16 mathematics course to requiring them to resit GCSE. As explained above, the valuing of GCSE grade C/4 as worth more than level 2 Functional Skills means a transfer of students between these courses has an immediate effect, even though they might have no more mathematical skills.

Between 2016/17 and 2018/19 the GCSE grade D/3 students who passed with a C/4 or above made up a little over a third of the cohort (36-37%). A similar proportion could only achieve the same mathematics outcome as they had done in KS4 after two further years of study. The proportion of students who achieved a lower level qualification fell by 9% over the four years between 2015/16 and 2018/19, and students who were not entered for a mathematics qualification fell by 7% to a low of 10% of students completing further education in 2018/19. The decline in the proportion of students achieving lower grades or not being entered is matched by a slight year on year increase in the amount of students who achieved the same Grade 3 or D as they had done at KS4.

This makes it appear that the initial policy change to require students to study mathematics in further education if they had not achieved a grade C/4, led to an immediate increase in the proportion of these students improving their mathematics outcomes during KS5. However, after the initial increase, the proportion of students making progress towards a GCSE grade 4 has stabilised. There has been a small and steady increase in the proportion of students who manage to maintain the same grade (D/3) following up to 2 additional years of GCSE Mathematics (32-28%), sometimes resitting multiple times, whilst the proportion going backwards or not being entered has fallen from 31% to 25%.

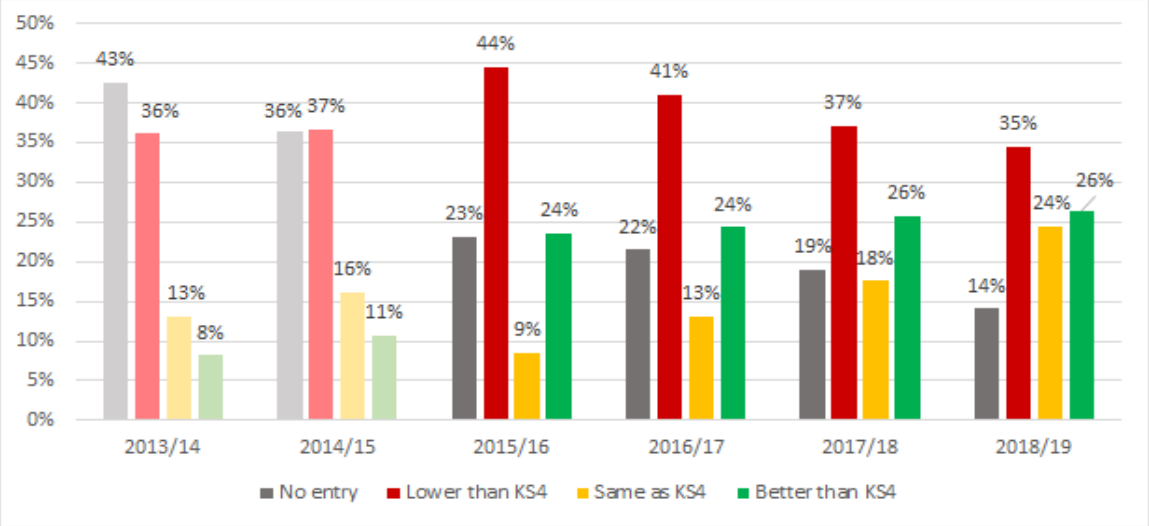
On the left-hand side of *Figure 1*, the years 2013/14 and 2014/15 are displayed in lighter shades as they were prior to the Condition of Funding policy change that required students to study mathematics alongside their main programme of study. The biggest difference for students who achieved a Grade 3 or a D in GCSE Mathematics at KS4 is the large drop in the numbers of students who were not entered for a mathematics qualification. The decline over 6 years from 35% of the cohort being non-entrants in 2013/14 to 10% in 2018/19 is a success for continued mathematics learning up to the age of 18. Although some of these would have allowable reasons for exemption, a tenth of this sub-cohort still do not take a mathematics qualification during their 16-18 studies.

Key Stage 4 leavers with GCSE Mathematics grade E/2

For students who achieved an E grade or a Grade 2 in GCSE Mathematics at KS4, the picture of their mathematics achievement in further education[9] is quite different, as shown in Figure 2.

[9] For these lower grades, an increasing proportion of the students will be studying in further education colleges.

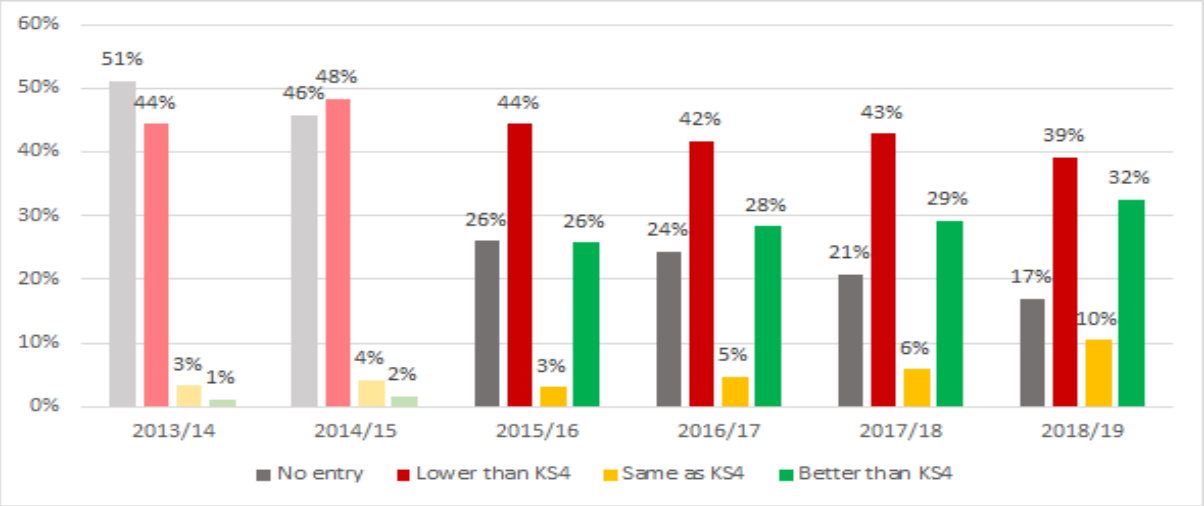
Figure 2: Progress of students aged 18 who achieved a Grade 2 or E at KS4



In every year since the change to the Condition of Funding, around a quarter of these students have improved their grade, almost always from an E/2 to a D/3. This is a notable improvement compared with academic years 2013/14 and 2014/15, although what the benefits are of this improved test performance is unclear since they still do not achieve the intended 'pass' grade. The number of students achieving the same level of mathematics qualification has also increased between 2015/16 and 2018/19, rising from 9% to 24%. The number of students achieving a lower level qualification than they did at KS4 has decreased from 44% in 2015/16 to 35% in 2018/19 but this still represents the most common outcome for students who achieved a Grade 2 or an E at KS4. Overall, 3 in 4 of these grade E/2 students achieve no better that they did at age 16. Whether this is an acceptable level of progress as a policy outcome is unclear.

Figure 3 shows the progress of students who achieved a Grade 1 or a G in GCSE Mathematics at KS4.

Figure 3: Progress of students aged 18 who achieved a Grade 1 or a G at KS4



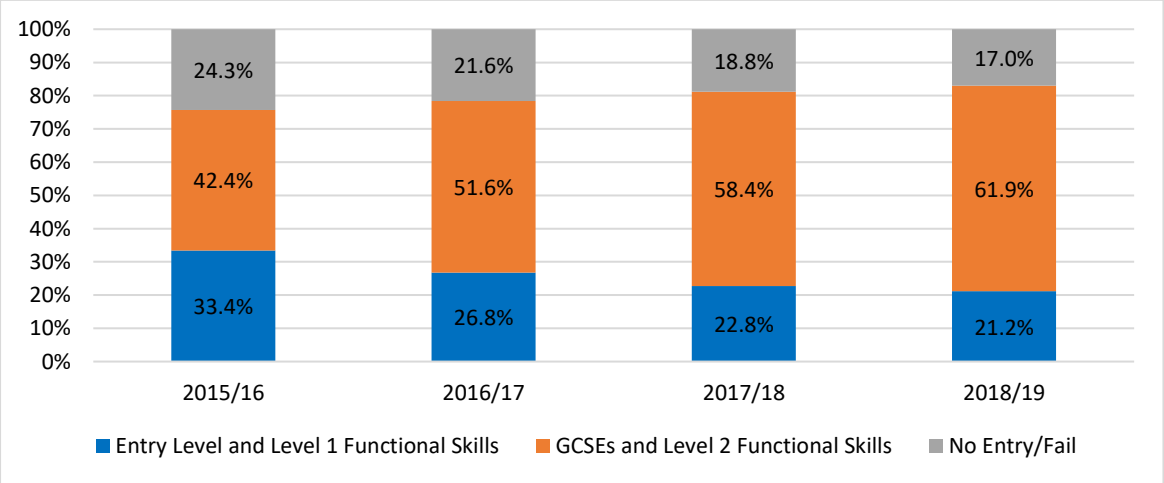
The proportion of these students who achieved a higher mathematics qualification during FE substantially increased after the policy change. The proportion jumped from just 2% in 2014/15 to 26% in 2015/16 and has slowly increased to 32% by the end of the 2018/19

academic year. This clearly shows better progress for these students as a result of the Condition of Funding but not the intended achievement. The increase is mostly matched by a decline in the number of students not entered for a qualification. The proportion of students achieving a lower grade has fallen slightly but remains alarmingly high, representing 39% of the cohort in 2018/19 who, following further mathematical study, achieve a qualification rated lower than their achievement in school.

All Key Stage 4 leavers under the Condition of Funding

Figure 4 shows achievements for all students and illustrates the move away from Functional Skills qualifications and the increased uptake of GCSE by 16-18 students under the Condition of Funding.

Figure 4: Change in 16-18 mathematics achievements between 2015/16 and 2018/19



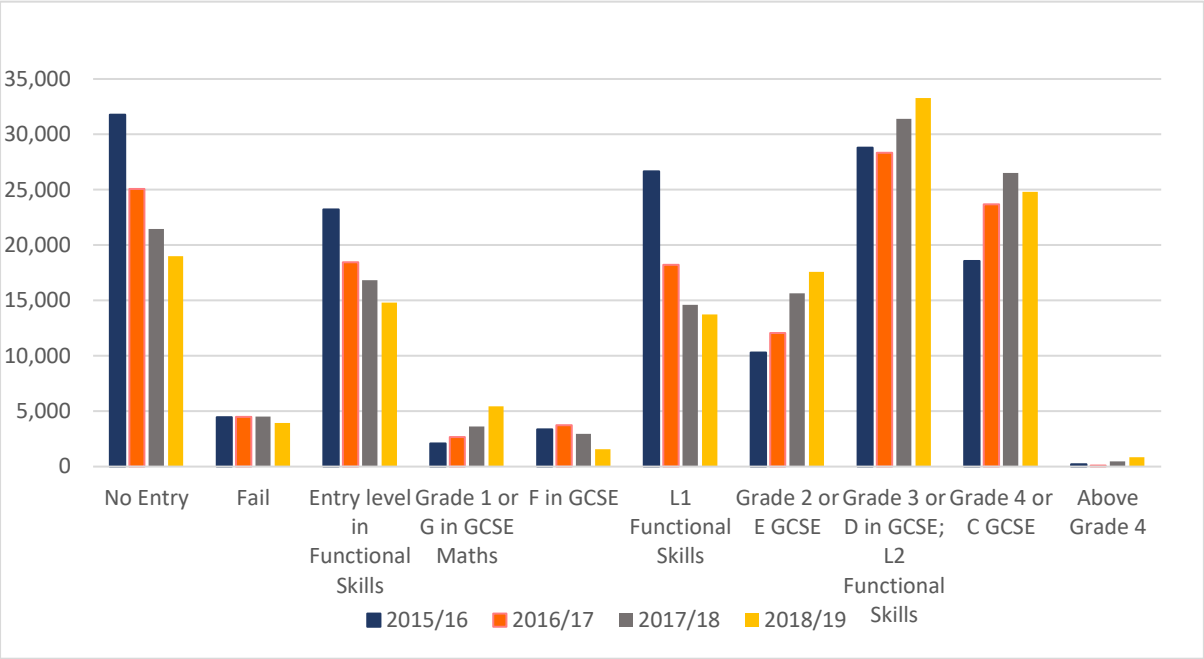
Due to the nature of the available data, it is not possible to separate level 2 Functional Skills from GCSE Mathematics. Both qualifications are rated as the equivalent of four progress points and therefore fall into the same category. However, other sources[10] suggest that the number of students who take level 2 Functional Skills is small compared to those taking GCSE Mathematics and has fallen over this time period.

Students achieving Entry level or level 1 Functional Skills mathematics declined by just under 12% between 2015/16 and 2018/19 and the proportion of students who were not entered also declined. The proportion of students achieving a GCSE at any grade (or a level 2 in Functional Skills) increased to account for nearly 62% of students by 2019.

Figure 5 shows the achievements of all students required to continue learning mathematics during their 16-18 studies. It shows the change over time in the numbers of students achieving different qualifications and levels of award.

[10] NCFE estimates that there were around 6,500 students who passed Functional Skills level 2 in Mathematics in 2017/18. DfE figures for 2017/18 used here show a combined total of 31,844 students passing GCSE Grade 3 or D; L2 Functional Skills; L2 ESOL; A*/A/B/C in AQA Use of Mathematics
https://www.ncfe.org.uk/blog/resits-reformed-functional-skills-and-t-levels-the-future-of-post-16-english-and-mathematics-in-a-changing-landscape

Figure 5: Students' mathematics achievements at the end of 16-18 study



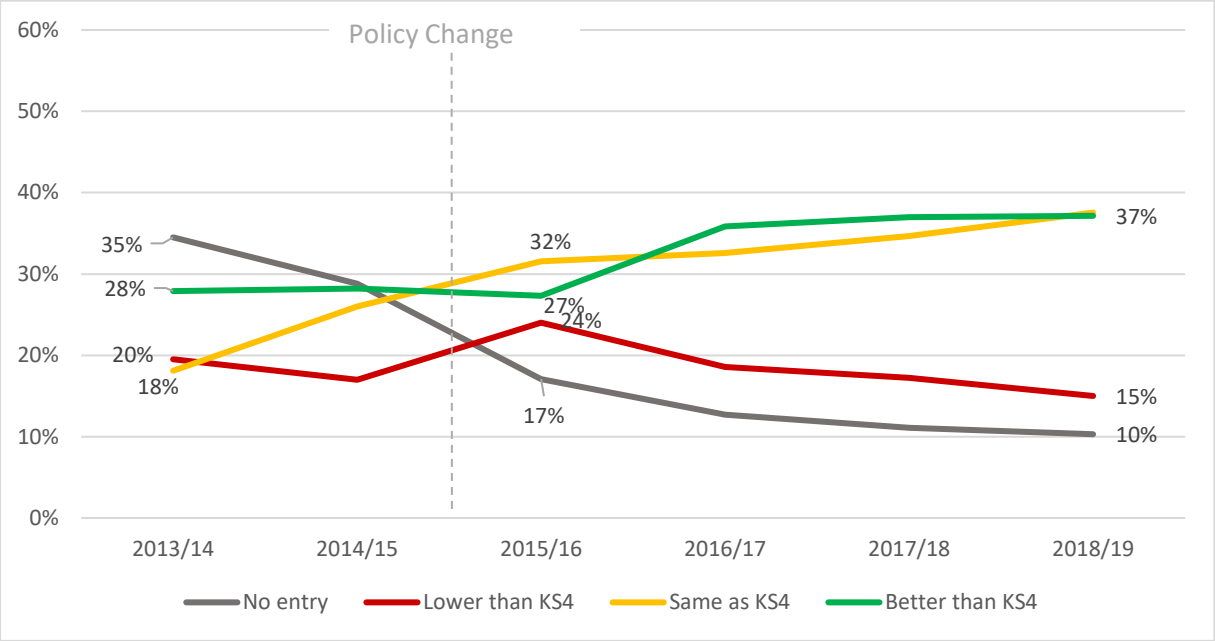
There is a clear decline in the number of students achieving Entry level and level 1 Functional Skills. The number of students who are not entered for a qualification is also declining and, whilst the number who are entered but fail the examination remains steady, these are a small proportion of the overall cohort. Students achieving a Grade F at GCSE are declining as this grade is no longer available in the new GCSE grading system (it sits between a Grade 1 and 2). There is growth in the number of students achieving GCSEs at all grades, including a rise in the very tiny number of students who achieve higher than a Grade 4.

4. Appendices

Appendix 1

Figure 1b shows an alternate representation of Figure 1 in the main text. It shows change over time in the mathematics achievements of students in FE who achieved a grade 3 or a D in GCSE Mathematics (or equivalent) at KS4.

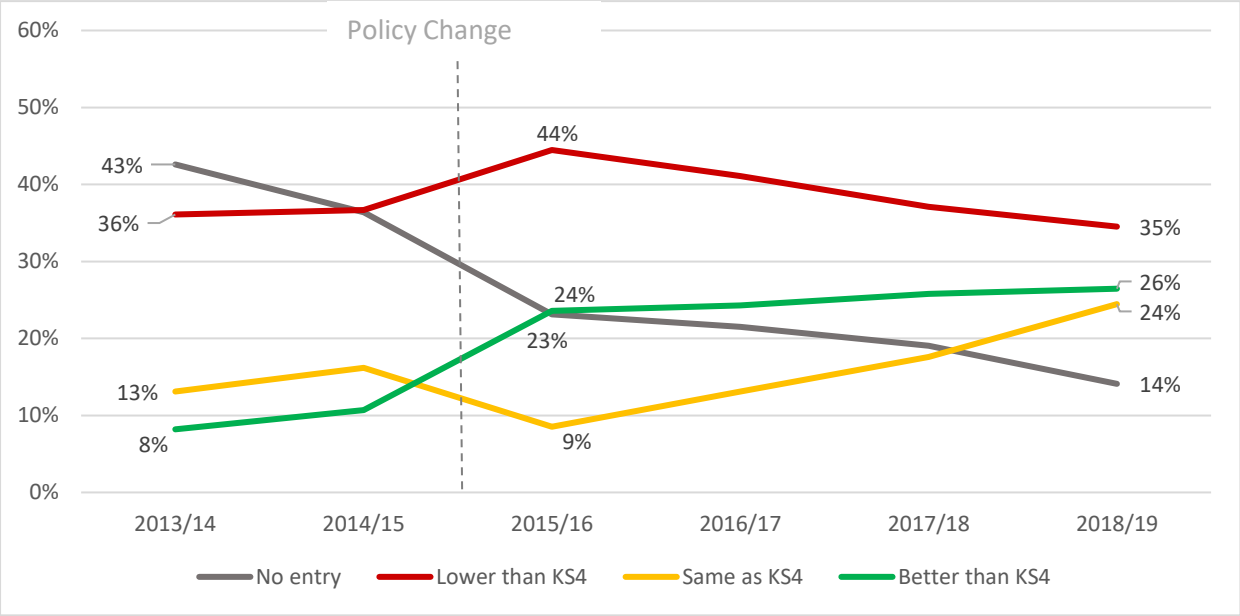
Figure 1b: Progress of students aged 18 who achieved a Grade 3 or D at KS4



Appendix 2

Figure 2b shows an alternate representation of Figure 2 in the main text. It shows change over time in the mathematics achievements of students in FE who achieved a grade 2 or an E in GCSE Mathematics (or equivalent) at KS4.

Figure 2b: Progress of students aged 18 who achieved a Grade 2 or E at KS4



Appendix 3

Figure 3b shows an alternate representation of Figure 3 in the main text. It shows change over time in the mathematics achievements of students in FE who achieved a grade 1 or a G in GCSE Mathematics (or equivalent) at KS4.

Figure 3b: Progress of students aged 18 who achieved a Grade 1 or G at KS4