

Analysis of the uptake in AS and A level Mathematics and Further Mathematics since their reform in 2017 – changes in the availability of these qualifications in schools and colleges in England.

Stephen Lee, Kevin Lord

Mathematics in Education and Industry

AS and A level Mathematics and Further Mathematics qualifications were reformed in England for first teaching in 2017 as part of reforms to all A level qualifications. Changes to the assessment, content and educational philosophy to emphasise problem solving and the use of technology were made. Qualifications overall became linear, rather than modular, and achievement at AS no longer counted towards the awarding of an A level grade. Education charity Mathematics in Education and Industry (MEI) have conducted analysis into both the uptake and availability of AS and A level Mathematics and Further Mathematics in schools/colleges in England. There has been a large decrease in entries for AS Mathematics, like for all other subjects, although AS Further Mathematics has done relatively well. An analysis of provision at institutional level, prior to 2017 and after, shows a complete shift from offering both AS and A levels to predominately just A levels.

Keywords: AS level; A level; further mathematics; post 16

Background to the reform of post-16 mathematics qualifications for first teaching in 2017

A period of significant change happened in the education system in England for major secondary and post-16 qualifications, including mathematics, between 2015 and 2018. This section will provide some background and insight into these changes.

At the end of compulsory secondary education, typically at age 15-16, learners in state funded institutions would usually take General Certificate of Secondary Education (GCSE) examinations, including in English and maths. This totals around 550,000 learners per year. Wholesale reforms were made to GCSEs, with English and maths reformed initially, for first teaching in September 2015. Most other subjects then followed in 2016 or 2017, with a very small number in 2018. These reforms included new content and changes to the structure, assessment and grading compared to the previous GCSEs, see Ofqual (2017). Content was increased for GCSE Mathematics, and more difficult topics were introduced, along with a greater emphasis on problem solving and proof, see Department for Education (2013).

For post-16 education, learners have considerable choice over what qualifications they may study. The most popular academic qualifications are Advanced Levels (A levels), usually taken over two years, and Advanced Subsidiary (AS) Levels, equivalent to one year's worth of A level study. AS/A level qualifications were reformed, with 13 subjects (including English and sciences) changed initially, for first teaching in September 2015. Most other subjects then followed in 2016 or 2017, with a very small number in 2018, Ofqual (2018a). The main features of the AS/A level reforms, as stated by the regulator, Ofqual (2018b), are:

1. Assessment will be mainly by exam, with other types of assessment used only where they are needed to test essential skills.
2. AS and A levels will be assessed at the end of the course. AS assessments will typically take place after 1 year’s study and A levels after 2. The courses will no longer be divided into modules and there will be no exams in January.
3. AS and A levels will be decoupled – this means that AS results will no longer count towards an A level, in the way they do now.
4. AS levels can be designed by exam boards to be taught alongside the first year of A levels.
5. The content for the new A levels has been reviewed and updated. Universities played a greater role in this for the new qualifications.

AS/A level Mathematics and Further Mathematics were changed for first teaching in September 2017 and content can be seen in Department for Education (2016). Discussion of the ‘big eight’ changes, namely – “linearity, decoupled, synoptic, 100% prescribed content including mechanics and statistics (Mathematics), use of data in statistics, overarching themes, use of technology and Further Mathematics”, are given in Glaister (2017, pp.17-21). The timing of the AS/A level Mathematics and Further Mathematics changes meant for mathematics, unlike other subjects, learners who studied the new GCSE Mathematics in 2015 would be the first to study the new mathematics AS/A levels in 2017.

In late 2017, soon after new mathematics AS/A levels had been introduced, Lee et al. (2018) undertook to survey teachers to try and gain an early understanding of how the changes were affecting provision in schools/colleges. Responses were received from teachers in almost 450 schools/colleges and the key findings were (Lee et al. 2018, pp.6-9): Three quarters indicated that “AS levels are not offered in general”, or that they “may be taken by a few students”, that “3 A levels only” was the most common standard offer available, that entry requirements have increased for AS/A level Mathematics and Further Mathematics, and half of respondents indicated uptake for AS/A level Mathematics had reduced in 2017/18 when compared to 2016/17 (the last full year of the old maths qualifications). These were worrying initial findings, but the actual uptake which has subsequently occurred is discussed in the next section.

Uptake of AS/A level Mathematics and Further Mathematics

Data are released by the Joint Council for Qualifications (JCQ) on A level results day in August each year to show national uptake of GCSEs and AS/A levels, see JCQ (2021). Figure I shows a chart of data collated from JCQ’s annual summer releases for 2003-2021 for AS/A level Mathematics and Further Mathematics in England.

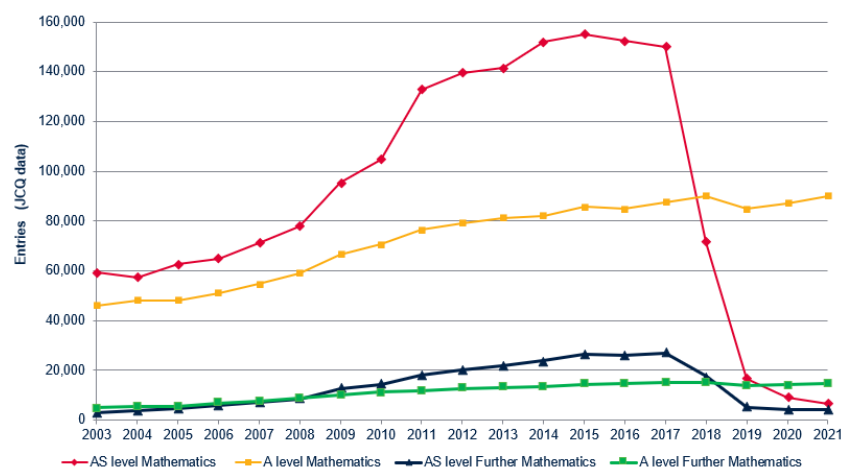


Figure I – AS/A level Mathematics and Further Mathematics entries 2003-2021 (JCQ, 2021)

Whilst Figure I shows increases of slightly different magnitude for each of AS/A level Mathematics and Further Mathematics from 2003, it is the values around 2017 that are of particular interest here when considering the impact of introducing the new qualifications. Entries for AS Mathematics and AS Further Mathematics fell dramatically in summer 2018 and summer 2019, which were the first two years of the new mathematics examinations. Small decreases then followed in summer 2020 and summer 2021. As the new mathematics A level courses were linear and expected to be studied over two years, both A level Mathematics and Further Mathematics entries in summer 2018 were likely to be for the ‘old’ qualifications, and entries went up slightly in summer 2017 and summer 2018. However, as anticipated from the survey findings of Lee et al. (2018), mentioned in the previous section, in summer 2019, A level Mathematics and Further Mathematics entries fell. More positively though, summer 2020 and summer 2021 entries for both A level Mathematics and Further Mathematics increased year-on-year, with 2021 values nearly identical to the peak entries in 2018.

The data presented in Figure I is for mathematics, but what is the wider context for all subjects, following the changes to AS/A level qualifications? Figure II shows the overall AS/A level entries in England from 2013 to 2021 (Ofqual, 2021). The starting year of 2013 was selected so that a few years data could be observed prior to the initial AS/A level changes being introduced for first examination in summer 2016.

	AS entries	A level entries
2013	1,305,080	812,940
2014	1,350,540	790,420
2015	1,330,660	801,510
2016	1,135,605	783,295
2017	659,880	785,450
2018	269,090	769,670
2019	117,595	745,585
2020	86,970	731,855
2021	58,300	756,230

Figure II – Overall AS/A level entries in England from 2013 to 2021 (Ofqual, 2021)

Values shown in Figure II are for overall AS and A level entries, not the number of unique student entries, i.e. students study multiple AS/A levels – Vidal Rodeiro and Williamson (2022, p.53) indicate that of the cohort who started post-16 study in 2020, 48.3% studied three A levels, and 10.4% studied four or more A levels.

A level entries in Figure II show some fluctuation between 2013 and 2016 prior to the first set of students being examined for the reformed A levels. After the reforms the entries reduced from 785,450 in 2017 down to 731,855 in 2020, but then increased to 756,230 in 2021. Whilst there is likely to be some impact of the reforms on the number of A level entries, the changing uptake heavily aligns to the change in the population of 18-year-olds in the country, as given in table 1 of ONS (2018) – this indicates that there would be a low of 710,000 18-year-olds in 2020 and a gradual increase year-on-year to 886,000 in 2030.

Data in Figure II is much more dramatic for AS entries. There were consistently around 1.3 million AS entries in 2013, 2014 and 2015, which reduced greatly following the start of reforms to AS/A levels. By the time the reforms for almost all AS and A level qualifications had been implemented, in summer 2018, the number of entries had fallen by over one million from 1,330,660 in 2015 to 269,090 in 2018. AS entries continued to fall to just 58,300 in 2021. The overall collapse in AS entries is likely down to a combination of the structural reforms to AS and A level qualifications, i.e.

decoupling them and the prospective costs for examinations, but also the wider funding changes that occurred around the same time, e.g., Lee et al. (2018, p.33).

It is worthwhile to look across all subject areas for their AS uptake relative to A level uptake to determine if there is anything of interest to note. If the AS entries for a subject are taken as a percentage of that subject’s A level entries, then overall for summer 2021 this would be 7.7% (58,300 AS entries and 756,230 A level entries), Ofqual (2021). Mathematics, which has the biggest A level entry by far, is perfectly aligned to this average (6955/90,290=7.7%). However, Further Mathematics is very much an outlier with many more AS entries by comparison with the number of A level entries at 28.1% (4175/14,850). ‘Other sciences’ (which is distinct from the individual subjects of Biology, Chemistry, Physics, etc) has the second highest proportion, 16.9% (245/1450) and Law has the third highest proportion, 11.9% (1520/12,825). The fact that Further Mathematics has the highest proportion of AS entries compared to A level entries will be considered in a wider context later in this paper.

Availability of AS/A level Mathematics and Further Mathematics

The UK government produce a public dataset that lists individual schools/colleges and their entry numbers for given post-16 subjects, see Department for Education (2021). The latest data release is for 2020-21, but 2019-20 data were not released due to the COVID-19 pandemic. It should be noted that the 2020-21 release differed in its methodology and the dataset no longer separates out AS entries from A level entries for each school/college. Conversely, datasets for 2018-19 and previous years had separation of AS and A level entries for each school/college, but values for 1 to 5 entries were suppressed. The overall number of schools/colleges who have some entries to A level Mathematics has remained relatively stable over recent years at just over 2,000, and similarly for A level Further Mathematics at around 1,400. Analysis has been undertaken on the raw information from Department for Education (2021) for 2018-19, which is the most recent year where there is separation of AS and A level entries.

Figure III shows that of the 2,133 state-funded institutions that had at least one entry for an A level, A level Mathematics was the most widely taught, with 2,063 institutions having at least one entry. Within the listed ‘top 20’ then follows Biology, Chemistry, History, Psychology and Physics with entries in 2,001, 1,973, 1,943, 1,914 and 1,907 institutions respectively. A level Further Mathematics was the tenth most widely taught subject, with entries in 1,382 institutions, ahead of subjects like Economics (1,151) and Computing (1,122).

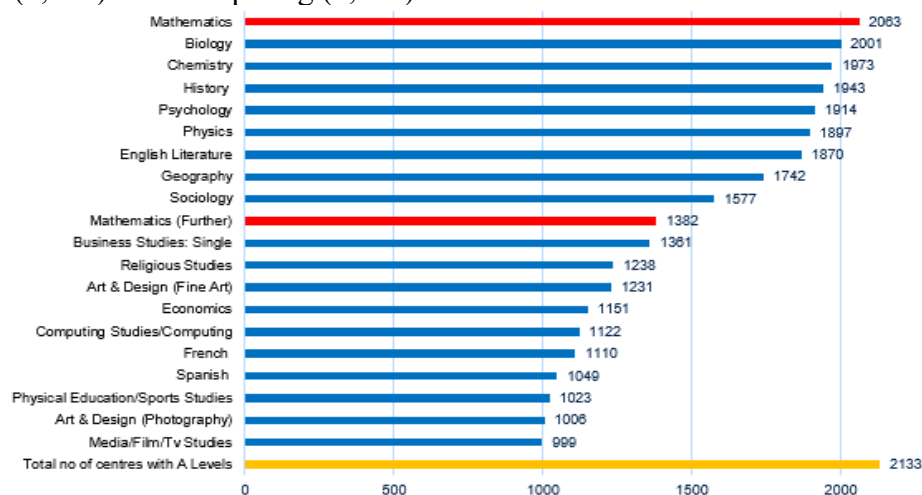


Figure III – Number of state-funded institutions with A level entries by subject in 2018/19 (DfE, 2021)

Although A level Further Mathematics was the tenth most widely taught, a review of the number of entries for each institution (raw data - DfE, 2021) shows it is quite fragile – 60% of the 1,382 institutions had only between 1 and 5 entries for A level Further Mathematics, and a further 25% had between 6 and 10 entries. With over 85% of institutions having small cohort sizes of between 1 and 10 for A level Further Mathematics, this brings about many challenges for schools/colleges, including funding and staffing. By contrast, for A level Mathematics, of the 2,063 institutions, 15% had between 1 and 5 entries, 17% between 6 and 10, 13% between 11 and 15 and 11% between 16 and 20. Thus, A level Mathematics cohort sizes are more evenly distributed.

An analysis of AS/A level entries at an institution level was also undertaken to consider if there were changes following the reform of AS/A levels. Figure IV shows two-way tables (with rounded values) for AS/A level Mathematics and Further Mathematics in 2016/17 and 2020/21, i.e. the last year before new mathematics qualifications were introduced, and the most recent year data are available, Department for Education (2021).

STATE INSTITUTIONS WITH ENTRIES IN SUMMER 2017		A level Maths NO	A level Maths YES	Total
AS Maths NO			20	20
AS Maths YES	80	2100		2180
Total		80	2120	

STATE INSTITUTIONS WITH ENTRIES IN SUMMER 2021		A level Maths NO	A level Maths YES	Total
AS Maths NO			1430	1430
AS Maths YES	10	570		580
Total		10	2000	

STATE INSTITUTIONS WITH ENTRIES IN SUMMER 2017		A level Further Maths NO	A level Further Maths YES	Total
AS Further Maths NO			60	60
AS Further Maths YES	200	1420		1620
Total		200	1480	

STATE INSTITUTIONS WITH ENTRIES IN SUMMER 2021		A level Further Maths NO	A level Further Maths YES	Total
AS Further Maths NO			860	860
AS Further Maths YES	80	520		600
Total		80	1380	

Figure IV –AS/A level Mathematics/Further Mathematics in institutions 2016/17, 2020/21 (DfE, 2021)

For Mathematics in 2016/17 there were ~2,100 institutions that had both AS and A level Mathematics entries. Post-reform, and with the previously stated collapse in AS student entries, there were ~570 institutions that had both AS and A level Mathematics entries in 2020/21. The most common situation, seen in ~1,430 institutions in 2020/21, was no AS Mathematics entries, but some A level Mathematics entries. Further Mathematics follows a similar trend, moving from ~1,420 institutions that had both AS and A level entries in 2016/17 to ~520 in 2020/21. However, it is worthwhile observing that the total number of institutions with some AS entries in 2020/21 was higher for Further Mathematics (600) than it was for Mathematics (580). Furthermore, institutions with A level Further Mathematics entries as a proportion of those that had AS Further Mathematics entries is 600/1380, compared to Mathematics with 580/2000. So, availability/access to study AS Further Mathematics is relatively high, and as noted earlier the proportion of AS to A level entries for Further Mathematics is the highest by a considerable margin. It is therefore being appreciated and Baldwin et al. (2020, p.201) noted that “AS Further Mathematics entries are relatively much higher than other subjects, suggesting schools and colleges are offering AS Further Mathematics as a valuable qualification in its own right.”

Concluding observations

This paper has given insight into major curriculum reforms to GCSE and AS/A levels in England between 2015 and 2018, and the analysis presented allows for many observations to be made. Firstly, Mathematics is the most taken and most widely taught

A level subject, even after all the reforms had been introduced. Secondly, A level Further Mathematics is not a niche subject choice, it is the tenth most widely available subject with entries in more than two thirds of institutions that teach A levels. However, in 85% of these institutions the number of students studying Further Mathematics is below 10, and therefore provision is vulnerable. Overall, the number of entries to A levels is seemingly highly aligned to the annual population of 18-year-olds – this is set to rise consistently between 2020 and 2030 and so A level entries are also likely to rise.

Finally, the clearest observation from analysis of these post-16 reforms is the incredible decline in AS entries, from 1.33 million in 2015 to 58,300 in 2021. The uptake and availability of mathematics AS levels have declined hugely. However, the analysis shows that AS Further Mathematics has fared considerably better than other subjects - entries as a proportion of the A level is almost 4 times higher than the overall average, 28% compared to 8%. Currently there are more institutions that have entries for AS Further Mathematics than do AS Mathematics, which is a reversal to the situation in the period before AS and A level qualifications were reformed.

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