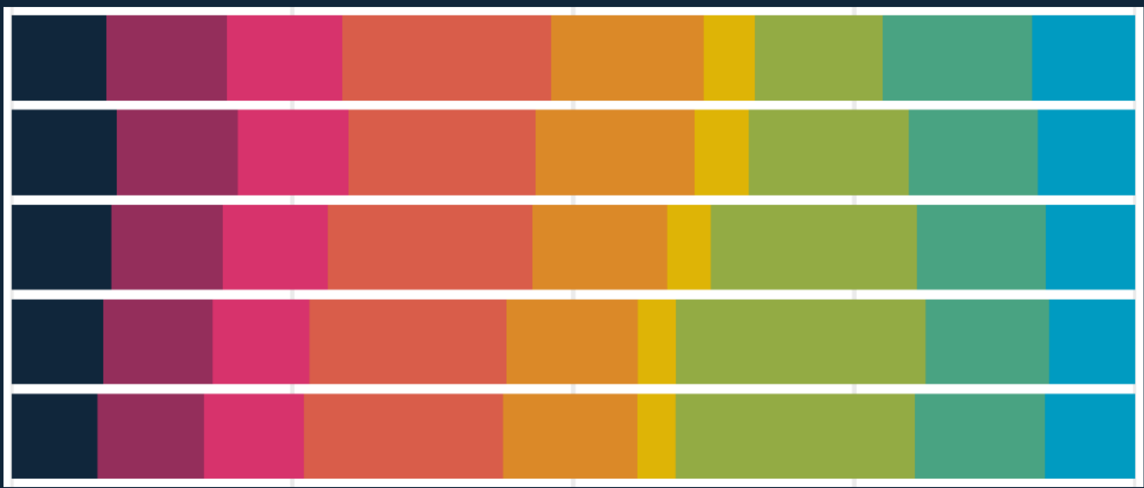
Observatory for Mathematical Education

Review of Mathematical Education 2025



November 2025

To cite this report:
Observatory for Mathematical Education (2025) Review of Mathematical Education 2025. University of Nottingham.

Issued: November 2025

To find out more about the Observatory's work, visit:
www.nottingham.ac.uk/observatory

Cover image: The regional distribution of students achieving high grades at KS1, KS2 and GCSE, and participation in A level and undergraduate mathematics for the GCSE cohort of 2017 (see Figure 3.16).

Contents

Foreword

Ensuring a good mathematical education for all learners, whatever their capabilities, interests and aspirations, has never been more important. Whilst we can all agree on this, making it happen is far from straightforward. New approaches to realizing this ambition in our complex education system are needed.

The Observatory for Mathematical Education’s longitudinal research programme is one response to this need. With an ambitious study design that bridges from policy to practice the team have a tremendous opportunity to generate groundbreaking evidence that should, in time, further our pursuit of an excellent mathematical education for all.

As the National Statistician, I advocated strongly for sustained government investment in population cohort studies. Such longitudinal approaches afford unique insights into how a myriad of social, cultural, health and economic factors shape the lives of individuals and society as a whole.

I am delighted to see similar work being funded in mathematical education. If we really want to get to grips with longstanding inequities in the system and better understand how to ensure a strong supply of quantitatively literate citizens and highly skilled mathematicians and scientists, the Observatory’s work is sorely needed.

Yet what the Observatory team is doing goes beyond a cohort study. Their commitment to generating linked data from teachers, curriculum leaders and parents in a secure way that maintains privacy makes this work both challenging and exciting. Over time, the programme will help us to better understand what shapes learner attitudes and outcomes and so improve our chances of ameliorating inequalities and making demonstrable systemic improvement.

I commend this inaugural Review of Mathematical Education to you and trust that, like me, you are looking forward to seeing how this work develops.

Dame Jil Matheson, DCB, FAcSS
Chair, Strategic Advisory Board

Director's introduction

A good mathematical education matters more than ever. It matters to around nine million children and young people in England who spend several hours every week in classrooms and lecture halls doing it, and to the quarter of a million professionals who teach them. It matters to politicians, employers, parents and citizens. It matters for civic engagement and everyday quantitative literacy. It matters for scientific progress and economic productivity. It matters for our collective future. It therefore matters that we understand how mathematical education in England is working and how it might be improved for the benefit of all, irrespective of background and context.

In 2023, the Observatory for Mathematical Education was founded with a simple yet ambitious goal; to undertake and disseminate an unprecedented, large-scale programme of longitudinal research that supports the improvement of mathematical education and delivers long-term benefits for individuals and society. Our aim is to work holistically to understand England's national system of mathematical education, a system that comprises an amalgam of different people, practices and policies in diverse educational contexts, supported by a cornucopia of organisations and networks. This is an ambitious goal, but we are determined to make significant contributions to the evidence base and improve our understanding of the organisational and educational factors that best support learners to succeed.

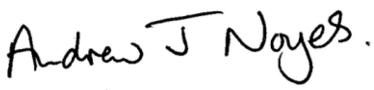
Following a rapid set-up phase in the 2023-24 academic year, the Observatory published its Introductory Report[1] in late 2024. The Report set out the concepts and plans that frame the research programme. In the most recent academic year, 2024-25, the team successfully completed its first cycle of data generation in around 360 primary and secondary schools and sixth form colleges, with around 40,000 survey responses from learners in Reception, Year 7 and Year 12 classes and across the transition to university.

This inaugural Review of Mathematical Education (RoME 2025) introduces these longitudinal studies by presenting high-level findings from each study. In addition, the Review reports on our observations on mathematical education from the time of the general election of 2024 to the summer of 2025, highlighting strategic decisions that impact directly or indirectly upon mathematical education. We also present analysis of trends in mathematical education, building on our earlier report: the Mathematics Pipeline in England[2].

In writing yet another 'report' on mathematical education one is mindful of all that came before and sanguine about the change potential of ink on paper (or pixel on screen); people make change. We are merely 'standing on the shoulders of giants'; another voice in a rich and long-running conversation about mathematical education in which ideas and evidence get circulated and sifted and from time to time, somewhat serendipitously, lead to changes in thinking and then perhaps also in practices and policies.

This Review is different from many of those earlier reports in that it makes no recommendations. Instead, and in line with the Observatory's theory of change and operational plan, our goal herein is to inform debate, to provoke with evidence, and to present answers to questions that readers might be asking.

Whatever your interest in mathematical education might be, I hope that you will learn something new and consider doing something differently as a result of reading our Review of Mathematical Education 2025.



Professor Andrew Noyes
Director, Observatory for Mathematical Education
University of Nottingham

Executive summary

All children and young people need a high-quality mathematical education to prepare them for their future work and lives. Precisely what form this should take - and how best to achieve it - is a matter of ongoing debate. Countries take different approaches, influenced in part by historical developments in schooling structures, curriculum and assessment, but also framed by a range of cultural expectations and attitudes, for example on the value of teaching as a profession, or on attitudes to mathematics itself.

The focus herein is on mathematical education in England which is a huge undertaking including around millions of learners and hundreds of thousands of teachers in tens of thousands of learning institutions; understanding it, in order to improve it, is a non-trivial task. Many learners have tremendous experiences with excellent teachers in supportive learning environments. Yet the evidence is clear that this is not the case for all learners. Addressing this disparity motivates the Observatory for Mathematical Education team.

The Observatory was founded in late 2023 with a ten-year programme at the heart of which are three longitudinal cohort studies in 174 primary schools, 149 secondary schools and an additional 42 sixth form colleges. Starting in Reception, Year 7 and Year 12, we will follow these nationally representative samples of learners for up to seven years, also surveying their teachers and lecturers, curriculum leaders and parents. The study will enable us to understand the factors that shape attitudes to, and outcomes in, mathematics education.

The programme presents a unique opportunity to map and model learner trajectories and inform interventions to tackle some of the longstanding problems in our system, for example the lower engagement of females in post-16 mathematics. Taking a holistic, systems approach the Observatory is exploring *who gets what* out of mathematical education in England, *why this happens* and *how things might be improved*.

This Review focuses on the academic year 2024-25, the first data generation cycle of the cohort studies. Survey data from learners in Reception (5,457), Year 7 (25,437) and Year 12 (7,254), their teachers (257/693/461 respectively) and subject leaders (162/141/40 respectively), are reported in three phase-specific Sections. In addition, the Review includes some trend analysis (Section 3) and an account of the national strategic and tactical moves in the mathematical education policy landscape (Section 2).

This Executive Summary cuts the findings in a different way; it is the *warp* to the Review's *weft.* The cohort studies all contain insights on learners' attitudes and experiences, teachers practices and professional histories, and subject leaders' strategies and tactics. Selected findings across these themes are included here together with highlights from the analysis of trends in mathematical outcomes and observations on policy activity in the first year of a new government.

Learners' attitudes to mathematics

- Reception pupils generally have positive attitudes to mathematics with some variation by month of birth and between schools.
- Patterns in Reception pupils' mathematics attitudes are broadly similar across demographic groups such as free school meal eligibility, ethnicity and sex.

- Year 7 pupils typically recognise the importance of mathematics and generally feel they are doing well in mathematics in Year 7.
- Two in five Year 7 pupils report that they have high or somewhat high levels of anxiety about learning mathematics.
- Year 12 A level Mathematics students report high levels of confidence and enjoyment, with confidence higher for male students and those with higher GCSE Mathematics grades.
- First year undergraduate students on mathematics degrees report dramatic falls in confidence during the first semester.

Mathematical engagement and outcomes

- General trends in mathematics attainment over the past 10 years show little change; socio-economic participation, attainment and skills gaps show no sign of narrowing.
- In December the Trends in International Mathematics and Science Study findings for England reported good overall performance but concerning attainment gaps.
- Entries for level 3 qualifications post-Covid continue to rise with A level Mathematics, Further Mathematics and Core Maths increasing by 4.4%, 7.2% and 19.6%, respectively, in 2025.
- Male students are outperforming female students at A level while the reverse is true at degree level. Fewer than 30% of Black students achieve top A level grades - 10 percentage points fewer than any other ethnicity.
- Just 9% of undergraduate mathematics students come from the lowest socio-economic quintile, down from 13% five years ago.
- There are regional variations in engagement at advanced and higher levels; students in the North-East are least likely to study mathematics post-16.
- The OECD's Survey of Adult Skills showed significant improvement in numeracy skills across England, particularly for 16–24-year-olds, albeit with some concerns about increased skills gaps.

Teaching mathematics

- Reception mathematics teaching is based upon a published scheme in 93% of schools with one in ten using a textbook.
- Teaching in Year 7 classrooms tends to include practices that could be characterised as *teacher-centred* more frequently than those that are typically thought of as *student-centred*.
- In a Spring Term snapshot of mathematics lessons (i.e. 'in your last lesson') about half of Year 7 teachers reported a focus on number topics with very few lessons on ratio and proportion, problem-solving or on statistics and probability.
- The vast majority of secondary mathematics teachers are using presentational software but very few make use of mathematical manipulatives.
- Both students and teachers report that A level Mathematics lessons are dominated by teacher-centred practices.
- Those studying A level Further Mathematics report experiencing different kinds of pedagogy and are less likely to view mathematics as procedural, compared with those studying A level Mathematics only.

Teachers of mathematics

- England's generalist primary teachers enjoy and are confident teaching mathematics, and feel they do a good job teaching mathematics, but over half regularly feel stressed and many report that their workload is unacceptable.
- Teachers of mathematics in both primary and secondary schools report having enough time to teach the curriculum but not enough time for administrative tasks.
- The government's commitment to recruit more teachers is progressing slowly with ongoing concerns about teacher recruitment though falling school rolls might ameliorate the situation.
- In secondary schools with a higher percentage of pupils eligible for free school meals, there are proportionally fewer teachers of mathematics with a mathematics or STEM-related undergraduate degree.
- Over half of secondary teachers of mathematics report feeling that the job is stressful. Some of them have paid work in education outside of their school; around one in eight provide private tuition.
- Secondary teachers of mathematics report needing professional development in the use of digital technologies in mathematics.

Mathematics subject leadership and organisation

- Primary school mathematics leaders mainly teach upper primary (41% teach year 6 classes) and some feel less confident in their knowledge of mathematics teaching in early years.
- Two in five secondary schools are using a school-created scheme of work in Key Stage 3 to support planning.
- Most secondary schools (69%) are using some form of attainment-related grouping in Year 7 but this rises to almost 100% in Year 11.

Mathematics education strategy

- The Curriculum and Assessment Review has been prominent in educational conversations during the 2024-25 year.
- The focus on 'mastery' in school and college mathematics learning remains unchanged whilst discussions concerning the impact of AI are growing.
- There is continued funding for GCSE resits, the NCETM's Maths Hubs, the Advanced Mathematics Support Programme (AMSP), the Advanced Maths Premium and teacher recruitment.
- Concerns about GCSE resits are ongoing, and the adult numeracy Multiply programme reached its planned end without a plan for next steps.

These are but some of the many findings reported and discussed in the Review of Mathematical Education 2025. Together they raise many more questions, and the Observatory team will be digging deeper into the data in the coming months. By the summer of 2026, the next cycle of data generation will have been completed. This will mark the start of the task of mapping changes in attitudes and experiences and attempts to explain the extent and drivers of these changes.

Section 1
Introduction to RoME 2025

Evidence
Excellence
Equity

1. Introduction to RoME 2025

1.1 The challenge

The case for the importance of mathematical education has been made countless times, with different emphases and arguments depending on the particular points and angles of view of the protagonists. We will not repeat those arguments here.

A more important question that this Review aims to explore is 'who gets what?' out of the current version of mathematical education in England, with the corollary questions 'why does this happen?' and – perhaps most importantly – 'how could these patterns be changed?' These questions are about systems of (mathematical) education but are also about society more widely; they are about building holistic understandings in order to better design and implement change strategies at different scales.

Some readers of this Review will be concerned about the so called 'excellence pipeline', e.g. how can the system educate more mathematicians and quantitatively skilled physical, engineering, life and social scientists? Others might be concerned for the general quantitative and data literacy of all young people (and future adults) and their capacity to function effectively in the increasingly mathematically formatted and data-saturated mid-21st century. Either of these interest groups might be more or less concerned with questions of equity, diversity and inclusion, and how entrenched patterns of engagement and attainment might be better understood and tackled. These are our collective concerns; those of the Observatory, of mathematics education and policy communities, but also of the general public and society as a whole.

The ambition of the Observatory for Mathematical Education is to help build an evidence base that will ultimately support the improvement of policies and practices in mathematical education. Of course, we can only play our part alongside the very many teachers, leaders, policy makers and researchers who share these goals and ambitions.

Our contention is that we currently lack a coherent, holistic, system-driven approach to understanding mathematical education and that without this, progress will at best be slow, and then probably not well understood. The Observatory aims to address this shortcoming, and this inaugural Review of Mathematical Education is the curtain raiser to our long-term project.

1.2 The Observatory for Mathematical Education

The Observatory for Mathematical Education was founded in late 2023 and builds on a half century of outstanding research and development in mathematical education at the University of Nottingham. It was launched with a founding grant from XTX Markets, the Observatory concept being seeded in an earlier report on the mathematics education pipeline in England[3].

The Observatory's mission is to generate and communicate evidence-driven, and policy-relevant research to improve mathematical education, learner outcomes and longer-term benefits for individuals and society. However, with education research being typically small-scale, piecemeal and underfunded, the Observatory is also developing a model for programmatic, longitudinal research[4] on educational systems. Importantly, the

Observatory is working across activity scales and networks as well as over time and place.

Mathematical education is a big project. In England around 9 million children and young people are learning mathematics. They are taught by around a quarter of a million teachers and lecturers in well over twenty thousand institutions. This system has many successful features as evidenced in national trends and international comparisons, though challenges remain - for example in socially patterned attitudes, attainment and access to advanced and higher courses of study. These successes and shortcomings are understood and experienced in different ways, and it is important to bridge the concerns of politicians and policymakers, education leaders and classroom practitioners and an array of other interested stakeholders[5]. The Observatory's programmatic research design aims to do just that.

The 2024 Introductory Report[6] set out the Observatory's foundational concepts and plans and set out three aims for the programme:

- To **integrate** analyses of varied aspects of the mathematical education system.
- To **inform** initiatives, interventions, and practices at multiple scales.
- To **improve** engagement, progress, attainment, and participation in mathematics.

The research programme comprises three strands: 1) trend analysis, 2) longitudinal system studies[a], and 3) targeted research and development projects. These are supported by a growing programme of collaboration, communication, commentary and consultancy. This report focuses on the first two aims (i.e. the core programme) and further information about other ongoing trials and evaluation projects can be found online[7].

The academic year 2024-25 was the Observatory's first full operational year, in which the expanding team designed and completed a major programme of data generation. The pre-processing of some of that data has only recently been completed, and its analysis is ongoing, so the full potential of the data linkages will not be realised for some time. However, some initial reports[8] have been published, amongst which are a report on Key Stage 3 Teachers of Mathematics, another on motivations for choosing A level Mathematics, and two reports on the transition to university and mathematics degree landscape.

1.3 About this report

Given the longitudinal nature of the Observatory's programme, a key objective is the production of timely evidence, including updates on the mathematical education system as a whole, and the progressive changes in the attainment and attitudes of the large numbers of learners involved. This Review of Mathematical Education (RoME) 2025, is the first in what we intend to be a series of annual reports. These Reviews are not research reports in the traditional sense; they are always 'interim' staging posts on a longer journey. Although many research findings are presented throughout, the sheer scale of the datasets and the number of questions of interest would make it impossible to include everything, at least in such a way that anyone would want to read it.

[a] We began conceptualising these as cohort studies but now describe them as system studies conducted over time and space, a key element of which is the tracking of a large cohort of learners.

This Review is also not a position paper or advocacy document and so the reader will not find recommendations herein. That said, the inclusion criteria for the Review are not neutral and the curation of the findings draws readers' attention to matters that they might find interesting or ought to know. The fact remains that much of the Observatory's analysis is not included herein but will get reported in technical and themed reports and, later, in the peer-reviewed research literature. In time, each Review will act as an index to the wider outputs of the Observatory programme as well as other recent and relevant research.

Whilst the annual Reviews of Mathematical Education seek to avoid advocating positions, the programme's vision is that compelling evidence leads to reflection and action for educationalists and other stakeholders. This has already begun to happen following the publication of Observatory reports earlier in 2025, for example through a collaboration with the Academy for the Mathematical Sciences, and no doubt parts of this Review will resonate strongly with different audiences.

This Review is organised into a further five sections.

An overview of mathematical education in England 2024-25

During 2024-25 the Observatory team tracked key policy moves pertinent to mathematical education and monitored reports and analysis, including those specific to England and wider international comparisons. This section, together with those in future Reviews, aims to build a form of national institutional memory for mathematical education. It combines some high-level national statistics about the (mathematical) education in England and our synthesis of pertinent decisions and events from the general election of 2024 to the summer of 2025.

Trends in mathematical education

The Observatory team is analysing high-quality administrative datasets such as the National Pupil Database, Higher Education Statistics Agency datasets and Longitudinal Educational Outcomes data. Building on the earlier published research[9] this section uses individual learner records to trace learner trajectories and identify patterns in that data associated with social backgrounds, institutions or region. With many years of data available, this is where the systemic impact of policy changes or exogenous factors (e.g. Covid-19) are explored.

Primary mathematical education

Unlike the trend analysis, the primary (and secondary) longitudinal studies of mathematical education include attitudinal data from large numbers of learners in representative samples of schools across England as well as information on the careers and pedagogies of their teachers. These different data streams can be linked in powerful ways and ingested into the National Pupil Database to include social background and other educational data. This year, this Section focuses on the views of around 5,500 pupils in Reception year, their teachers' pedagogic approaches and some aspects of mathematics teaching across primary schools.

Secondary mathematical education

Similarly to the primary section, the secondary section showcases preliminary findings from the different data streams. A focus of Section 5 in RoME 2025 is on the power of the data structure which allows one to 'zoom' in or out between around 25,000 Year 7 students in 1000 classes in 148 schools. Together with insights from teachers and department heads, Section 5 highlights the multiscale complexity of the data, the limitations of homogenisation, and the challenge of developing a rigorous understanding of educational systems.

Advanced and higher mathematical education

For RoME 2025 (and 2026), this third phase section includes a focus on those studying A level Mathematics together with some consideration of issues of transition to undergraduate mathematics study and the state of the undergraduate degree landscape at this time. Thereafter, this will become more focused on the higher education study that will build from the A level cohort of summer 2026.

How to read the report

When writing reports, people often ask 'what is the intended audience?' This is an easy question to ask but not always so easy to answer, particularly as one might have several different audiences in mind. The Observatory's premise is that analysis and action at every scale is necessary for holistic understanding and change planning so the Review must speak clearly to multiple audiences.

This first Review has been compiled with consideration given to how different stakeholder groups might engage with it, and not simply by dividing 'executive summary only' from the 'full report' readers. For example, someone with a strong interest in a particular educational phase might proceed to that section as well as relevant parts of the trend analysis (Section 3) and annual overview (Section 2). Someone with a more generalist view might focus on the opening Sections only.

1.4 Longitudinal studies cycle 1

The longitudinal studies observe mathematical education over time in a representative sample of schools and colleges across England and follow a cohort of students in those institutions to understand their experiences and trajectories. This systems analysis is based on the conceptual framework in Figure 1.1. This framework seeks to understand the relationships between 1) learner attainment and participation, 2) attitudes towards mathematics, 3) classroom and pedagogic factors, 4) institutional factors, 5) system factors, and 6) socio-cultural and familial factors.

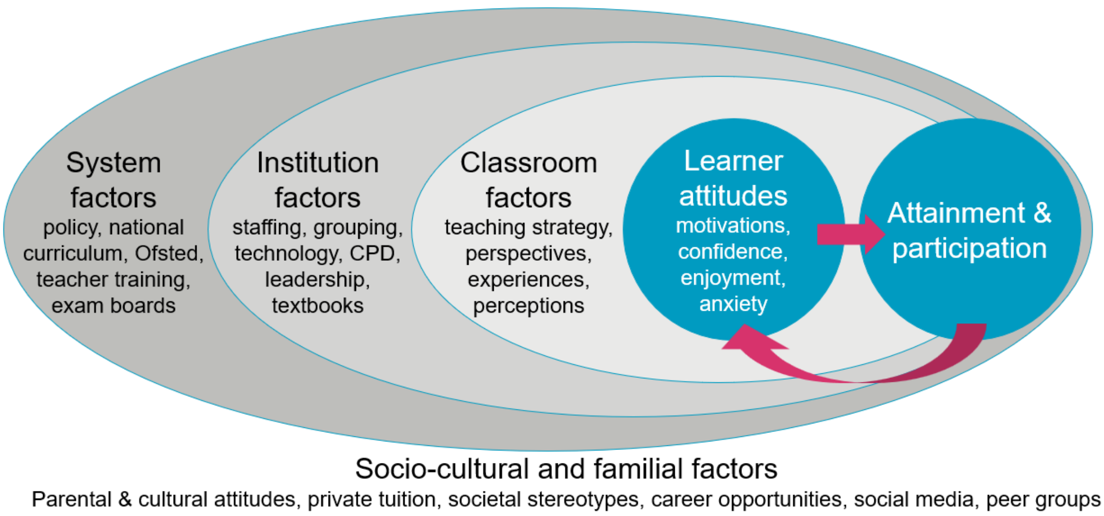


Figure 1.1 Conceptual model informing the Observatory's cohort study research design.

Figure 1.2 highlights the intended progression of the longitudinal studies.

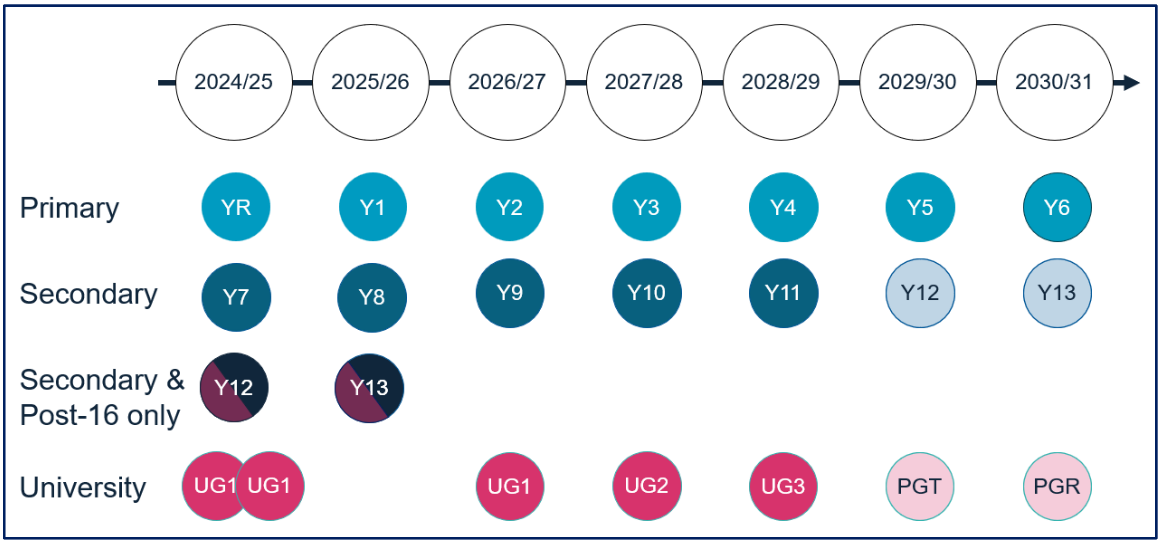


Figure 1.2 Schematic diagram of the cohorts tracked through the longitudinal studies.

In 2024-25, data generation comprised the following:

- **Pupil surveys**: multiple-choice questions on mathematics attitudes and experiences delivered in different ways dependent on participants.
- **Teacher surveys**: a range of questions on qualifications, years in teaching, working patterns and professional development (for all teachers of mathematics).
- **Pedagogy surveys**: a range of questions on mathematics teaching choices including a focus on a specific lesson (for those teaching learners in Reception, Year 7 and Year 12 A level Mathematics).
- **Subject Leader surveys**: a range of questions on school/college policies, curriculum choices, teacher autonomy, networks, approach to professional development, etc.
- **Parent/guardian surveys**: multiple-choice questions on understanding of, and support for, their child's mathematics learning (for learners in Reception, Year 7 and Year 12 A level Mathematics).

The power of the data is three-fold. Firstly, there is its sheer scale; Table 1.1 sets out the achieved samples from each of the data generation tools[b]. Secondly, the data were collected from a large and representative sample of schools and colleges. Further information about the school sample is available in a technical report[10]. Thirdly, each pupil in Reception, Year 7 and Year 12 within these schools and colleges is grouped in classes, linked to their teacher and school subject leader and parent/guardian surveys.

The operational challenges of collecting the data were considerable but, when combined, these three factors afford the Observatory unique and valuable insights into how the mathematical education system in England is functioning. Initial insights from the data can be found in Section 4 (primary), Section 5 (secondary) and Section 6 (advanced and higher).

[b] The total possible sample sizes (assuming 100% response rate) are not always easy to discern, particularly so for teachers. Furthermore, the research design for surveying Year 12 students means that the 'distributed' numbers are estimates based on past cohort sizes in each institution.

Type of survey		Distributed	Completed	Response rate
Subject leaders	Sixth form college Heads of Maths	42	**40**	95%
	Secondary school Heads of Maths	148	**141**	95%
	Primary school Maths Leads	174	**162**	93%
Teacher workforce	Secondary school teachers	1,589	**1,043**	66%
	Primary school teachers	2,316	**1,405**	61%
Teacher pedagogy	Sixth form college Year 12 teachers	246	**186**	76%
	Secondary school Year 12 teachers	473	**275**	58%
	Secondary school Year 7 teachers	1,044	**693**	66%
	Primary school Reception teachers	424	**257**	61%
Learners	Sixth form college Year 12 pupils	5,995	**4,730**	79%
	Secondary school Year 12 pupils	3,175	**2,524**	80%
	Secondary school Year 7 pupils	30,446	**25,437**	84%
	Primary school Reception pupils	6,534	**5,457**	84%

Table 1.1 Sample sizes and response rates generated from Cycle 1.

1.5 Looking ahead to 2025-26

Any analysis included in this Review arises, by and large, from within one of several large datasets. The next step for the Observatory team is to work across these linked datasets (and matched administrative data such as the National Pupil Database) to explore the relationships between social, sectoral, institutional, classroom and attitudinal factors. We aim to publish a fuller account of analysis from Cycle 1 as a baseline for comparison as time progresses.

The primary cohort is now in Year 1 and in early 2026 pupils and their teachers will complete surveys. In Year 8, pupils and teachers are being surveyed in the autumn term of 2025 with similar attitudinal scales to those used in Year 7 in order to monitor changes over time. In the spring of 2026, and after the closure of the university applications process, the Year 13 A level Mathematics students will be surveyed. This survey will have a particular focus on next steps and university choices and some of these students will become part of the higher cohort study in the following year.

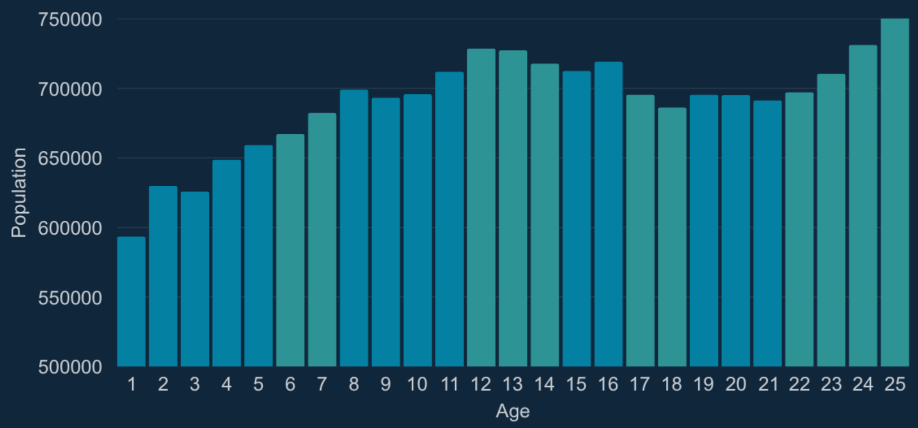
During the year, the team will complete the design and set up of the higher cohort study that will intertwine existing Year 13 A level Mathematics participants with a new wave of recruitment from the undergraduate mathematical sciences students starting in autumn 2026. Alongside this the Observatory is conducting a number of bespoke projects, such as the evaluation of the Advanced Mathematics Support Programme and a study of the experiences of those progressing to A level Mathematics with a grade 6 in GCSE Mathematics.

The Review now proceeds to review important moves in mathematical education during 2024-25.

Section 2
An overview of mathematics education in England 2024-25

Evidence
Excellence
Equity

Population in England (ONS mid-2024 estimates[A])



Bar colours depict education 'stages': EYFS, KS1, KS2, KS3, KS4, KS5, Undergraduate, Postgraduate

£110.3 billion

Education spend in UK in 2023-24

4.1% of GDP[B]

ENGLAND

21,971 maintained schools with **8,445,551** children[C]

468,693 FTE teachers with **74.1%** female[D]

PRIMARY

16,743 schools
4,554,974 children

217,460 FTE teachers
84.8% female

SECONDARY

3,456 schools
3,671,427 children

217,563 FTE teachers
63.2% female

1,151 Multi-Academy Trusts managing **10,626** schools[E]

Trust size	1	2	3-5	6-10	11-20	21-30	31-40	41+
Trusts	986	150	322	356	230	48	32	13
Schools	986	300	1,265	2,768	3,298	1,167	1,142	686

Table: trust size, number of trusts and number of schools in trust

Figure 2.1 Selected national education statistics, based on most recent data (see Appendix for sources).

PRIMARY

Achieve expected level in EYFS maths early learning goals 2023-24[F] **77%**

Multiplication tables check average attainment score for Year 4 pupils 2023-24[G] **20.6** (out of 25)

Achieve standard level in KS2 maths 2024-25[H] **74%**

Achieve higher level in KS2 maths 2024-25[H] **26%**

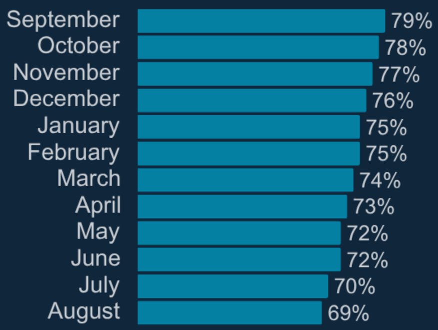


Figure: % achieve standard level in KS2 maths by month of birth 2024-25[J]

SECONDARY

35,377
Secondary Maths Teachers[L]

GCSE Maths grades 9-4 in England 2024-25[M]

58% (of 831,555 entries)
All ages

72% (of 622,535 entries)
16-year-olds

17% (of 206,732 entries)
Aged 17+

	A*	A	B	C	D	E	U	TOTAL
9	33%	36%	17%	8%	4%	1%		24,785
8	5%	24%	26%	21%	14%	7%	2%	22,548
7	1%	8%	17%	23%	24%	19%	8%	13,963
6		3%	9%	16%	25%	28%	18%	3,346
5					22%	36%	42%	179

Table: matched pupil grades - 2021 GCSE Mathematics to A level Mathematics[K]

POST-16 EDUCATION

Level 3 maths entries[N]

15,316 (51% female)
Core Maths

112,138 (37% female)
A level Mathematics

19,390 (27% female)
A level Further Mathematics

HIGHER EDUCATION

Mathematical sciences[P]

10,585 (34% female)
undergraduate first degree entrants

940 (33% female)
postgraduate research entrants

5,780 (26% female)
academic mathematics staff

Figure 2.2 Selected national mathematics education statistics, based on most recent data (see Appendix for sources).

2. An overview of mathematical education in England 2024-25

2.1 Four big themes

Section 2 of the Review summarises the challenges and change processes from the 2024-25 academic year[c] and identifies deeper currents of change.

In the first full academic year under a new government - what the Secretary of State considers a year of laying foundations[11] - there were important developments in mathematical education regarding *curriculum* and the rethinking of *budgetary* priorities, attempts to tackle longstanding *problems,* and all of this framed by *international evidence* on educational performance:

- **Curriculum:** the former Prime Minister's mathematics-to-18 agenda and plans for an Advanced British Standard (ABS) were quickly shelved by the new government. Instead, they made good on their curriculum review pledge and committed to establishing 'strong foundations'[12]. With the political attention on curriculum, numerous organisations published reports to inform the debate with discussions concerning the impact of AI becoming commonplace. 'Mastery' remains central to curriculum conversations.
- **Budget:** Amidst budgetary constraints the desire for a strong mathematical education remains[13]. Though some areas of mathematical education funding initially appeared less secure, commitments to GCSE resits[14], the NCETM's Maths Hubs[15], the Advanced Mathematics Support Programme (AMSP)[16], the Advanced Maths Premium[17] and teacher recruitment and retention[18] remained, funded in part by the repurposing of the Advanced British Standard budget. In contrast, the expansion of the university maths schools programme stalled.
- **Challenges:** A post-election commitment to recruit more teachers progressed slowly[19] with ongoing concerns about teacher recruitment. However, some forecasts for the teacher workforce noted green shoots of recovery[20] at a time of falling school rolls. The previously planned teacher degree apprenticeships[21] started recruiting but remain a small part of the system. Concerns about GCSE resits were ongoing, and the adult numeracy Multiply programme reached its planned end[22].
- **International evidence:** The TIMSS[23] findings for England were mixed; there was good overall performance but concerning attainment gaps. The long-awaited update of the Survey of Adult Skills[24] showed significant improvement in numeracy skills across England, particularly for 16-24 year olds, albeit with some concerns about increased skills gaps.

This Section now proceeds to consider strategic activities in curriculum and assessment, two areas of post-compulsory mathematical education (advanced/higher and skills/adult), teacher workforce and the organisational landscape.

[c] Some earlier events are included in RoME 25 as this is the first Review and the latest datasets in some instances are from 2023-24 or earlier.

2.2 Mathematics curriculum and assessment

Developments in curriculum and assessment 2024-25

- The government announced the Curriculum and Assessment Review; the Interim report provided four areas of focus.
- The Royal Society's mathematical futures programme imagined what mathematical and data education should look like in 20 years' time.
- The Maths Horizons Project outlined how England should reform mathematics education for the age of AI.
- OCR's Striking the Balance focused on next steps for the 11-16 curriculum and assessment.
- The number of Early Years Stronger Practice Hubs was increased to provide advice, share good practice and offer evidence-based professional development for early years practitioners.
- EEF funded a systematic review of effective approaches to teaching mathematics in Key Stage 3 and 4.
- Oak National Academy released its full set of mathematics materials.

The new government announced its **Curriculum and Assessment Review**[25] two weeks after being elected in July 2024 and it has been a prominent feature of the educational conversation this year. With a strong commitment to being evidence informed, two pertinent aims are to ensure an 'excellent foundation in core subjects of reading, writing and maths' and 'a curriculum that ensures children and young people leave compulsory education ready for life and ready for work'. The Review is ongoing at the time of writing, but an interim report published in March 2025[26] identified four areas of focus for the next phase, the first of which is concerned with addressing socio-economic attainment gaps.

The **Royal Society's Mathematical Futures Programme**[27] (2021-24) reported early in the academic year and took a different approach to curriculum planning by imagining what mathematical and data education should look like 20 years hence. Thinking on such a timescale is needed due to the length of educational careers. The report called for greater emphasis on statistical and data education, a step change in the use of digital technologies, and greater focus on quantitative literacy and applications across subjects and qualification pathways.

The later **Maths Horizons**[28] report echoed many of the Mathematical Futures concerns, framing the curriculum debate as 'in the age of AI'. That report set out three ten-year objectives:

- Ensure that students secure the fundamental maths knowledge needed to navigate education, work and daily life with confidence.
- Ensure that students leave education equipped to use their maths to solve abstract and real-world problems with flexibility.
- Build the pipeline of students who continue with maths beyond age 16 for advanced mathematical study.

One could hardly argue with 1 and 2 and it is fair to say that this is already the aspiration of the curriculum, albeit as yet unrealised; the future of 3 very much depends on wider system factors. Whilst the Futures and Horizons reports had a more visionary spirit, with their recommendations reflecting this, **OCR's Striking the Balance**[29] focused on next steps for the 11-16 curriculum and assessment, calling for reduced content and assessment in GCSE Mathematics, a new type of Key Stage 3 assessment and for the building of stronger mathematical foundations that would reduce the number of GCSE resit students in colleges.

Against the mandate of the Curriculum and Assessment Review, the likely impact of these other reports is moot. That they have stimulated wider conversations about mathematical education is arguably a good thing. That said, curriculum decisions are not value free and, as a recent **OECD report**[30] has shown, serious consideration is being given to evolving mathematics curricula in many countries, though not always in the same direction.

Policy refocusing on early years intends to provide children with 'the best start in life'[31] and 'strong foundations'[32] in the first years of schooling and is reminiscent of what happened in the late 1990s with Sure Start and the National Numeracy Strategy. The emphasis on foundations is also seen in the reorganisation of curriculum oversight for mathematics at the DfE, now part of 'right foundations' with English, and not positioned as part of STEM as previously. Interest in pursuing a 'phonics for maths' has been accompanied by more resources being directed towards the youngest learners with the expansion of government-funded childcare in September 2025 and commitment to double the number of **Early Years Stronger Practice Hubs**[33].

Amidst the periodic swinging of emphasis on early foundations and advanced mathematics, Key Stage 3 can be the relatively overlooked 'middle child' of the system. However, important work in this area commenced in 2024-25 and is ongoing, for example:

- The Education Endowment Foundation's evidence review[34] and new trials.
- The Maths Excellence Fund[35] programme (£7m across 4 projects).

A different project that came to fruition this year was the full launch of the **Oak National Academy**. Initiated by the then Secretary of State, Gavin Williamson, as a response to the challenge of remote learning during the pandemic it became an arm's length body to the DfE in 2022, though not without considerable controversy[36]. Oak aims to *improve pupil outcomes and close the disadvantage gap by supporting teachers to teach, and enabling pupils to access, a high-quality curriculum whilst also reducing teacher workload*. During 2024-25 an independent review was conducted[37]. It noted close alignment between the Oak mathematics curricula and the work of Maths Hubs and the potential for greater cross-referencing between the two.

2.3 Advanced and higher mathematics

Developments in advanced and higher mathematics 2024-25

- The Advanced British Standard halted when the new Government was formed, but there is on-going debate around maths-for-all-to-18.
- The OECD's Maths for Life and Work concluded that England should consider expanding the range of post-16 mathematics options.
- The national Advanced Mathematics Support Programme had a change in budget and was refocussed in some areas.
- The Advanced Maths Premium and new Core Maths Premium provided £42m of funding to schools, up from £20m in 2023-24.
- A level Mathematics/Further Mathematics and Level 3 Core Maths had record entries in summer 2025.
- More mathematics degree programmes closed as Higher Education funding pressures made smaller programmes less viable.
- The Maths Degrees for the Future programme is funding innovation in course design at five universities.

Whilst the Curriculum and Assessment Review will likely not impact upon advanced mathematics qualifications directly, the Mathematical Futures and Maths Horizons reports have addressed this agenda explicitly. These reports are the latest contributions to long-running debates on maths-for-all-to-18. Despite the remarkable growth in the number of students completing A level Mathematics, and the ongoing embedding of Core Maths, England continues to be something of an outlier[38] in post-16 maths participation.

The proposed **Advanced British Standard**, which now will not go ahead, was intended in part to be a vehicle for pursuing the maths-for-all-to-18 agenda. The ABS received negative reactions from many at the time, and left a key question unanswered: what mathematics should young people do from 14 onwards? The Mathematics Futures programme envisaged a different model for 14-18 mathematics and data qualification pathways, one for which many of the essential ingredients are (or have) been used in recent years. The Royal Society recommended the development of

> *"a single Mathematical and Data Education qualifications framework which enables all students to continue to study MDE to 18. Design the framework around parallel and complementary foundational and advanced mathematics and general quantitative literacy strands, with recognition of domain-specific competences acquired in vocational and technical routes. Base the general quantitative literacy strand on redevelopment of the existing Core Maths qualifications."*

The report provided a skeleton framework for achieving this, but it seems a long way from happening. The **OECD report** – Maths for Life and Work – also concluded that England should "consider expanding the range of post-16 mathematics options…to cater for the diversity of student strengths, interests and future ambitions."[39]

All of that said, the 2024-25 year saw renewed, yet evolved, commitment to supporting advanced mathematics in England, though at one stage it seemed that some aspects of support for advanced mathematics might be deprioritised:

- DfE announced the **Advanced Maths Premium** would rise from £600 to £900 for 2024-25, with a separate Core Maths Premium (also of £900) to be introduced. Together AMP and CMP payments total £42m, up from £20m in 2023-24.
- The High Value Course Premium and Large Programme uplift continued [£139.2m and £10.1m compared to £137.4m and £10.9m in 2023-24].
- Announcement of a reduction in the **Advanced Mathematics Support Programme**[40] funding from April was made in January 2025. In March XTX Markets indicated they would provide the AMSP with 18 months of additional 'emergency funding' (£520k). By May, the DfE indicated that AMSP funding would revert to previous levels (£8.2m per year[41]) with an increased focus on improving girls' participation and opening pathways to AI careers.

Just prior to the 2024-25 academic year, a report for the **London Mathematical Society**[42] crystallised longstanding concerns about the health of undergraduate mathematics programmes, noting that against general growth in entries to higher education courses of 25% between 2012-13 and 2021-22, enrolments in mathematics had remained static at best. The growth in A level Mathematics and Further Mathematics has not been reflected in transitions to undergraduate mathematics. Furthermore, there has been a drift towards enrolments in higher-tariff Russell Group institutions. In recent years Birkbeck, Brighton and Oxford Brookes universities have closed their mathematics programmes. In 2025 mathematics degrees at Middlesex and Wolverhampton universities were added to that list. With wider funding pressures across the Higher Education sector, a further 24 universities in England and Wales have announced budget cuts or redundancies and, at the time of writing, it is unclear what effect this will have on future mathematics provision.

This concern about the health of undergraduate mathematics stimulated a programme overseen by the **Campaign for Mathematical Sciences**: Maths Degrees for the Future[43]. Grants of up to £500k were awarded to support programme innovation over the coming three years in five institutions: Cardiff University, Imperial College London, King's College London, University of Nottingham and the Open University. Furthermore, the University of Greenwich and Heriot-Watt University will each receive £150k to encourage more school pupils to pursue mathematics degrees.

Meanwhile the rise of generative artificial intelligence has continued to prompt debate in Higher Education regarding its use in pedagogic practice and assessment. Concerns about its impact on academic integrity prompted **a joint statement from the learned societies** (IMA, LMS, RSS) calling for invigilated on-campus examinations and closed-book assessments to be retained within assessment portfolios of mathematics degrees[44].

2.4 Mathematical skills education

Developments in mathematical skills education 2024-25

- Changes to the GCSE resit policy were announced too late to be fully implemented in 2024-25.
- The Curriculum and Assessment Review and other reports continue to seek solutions to post-16 numeracy policy.
- The government dropped the mathematics exit requirement for post-19 apprenticeships.
- The OECD's Survey on Adult Skills brought positive news, particularly for the 16-25 age group.
- The Multiply programme came to an end with concerns about the lack of succession planning.

Since 2014 the condition of funding policy has resulted in the vast majority of learners who have not achieved at least a grade 4 in GCSE Mathematics (and English) by the age of 16 retaking the qualification during their 16-18 education. The GCSE resits policy continues to divide opinion[45].

In 2024-25 the **condition of funding rules changed** with a new requirement of a minimum of four contact hours per week for mathematics on such programmes[46]. The timing of this announcement meant that colleges would not be monitored on their compliance in the first year. In addition, progress measures were reintroduced for the 2024-25 cohort as the post-Covid baseline data were once again available.

In the autumn of 2024, there were renewed concerns about the burden of providing GCSE resit programmes for a growing number of students not achieving at least a Grade 4[47]. November of that year saw a 21% increase on GCSE resit entries compared to the previous year. The **Curriculum and Assessment Review** was also concerned with GCSE resits, though a separate group is exploring this and not the one focused on mathematics elsewhere in the education system.

A report by Pearson for the Education Policy Institute (EPI)[48] made several recommendations for policymakers, practitioners and researchers, the last of 12 of which was that “More research is needed on the efficacy of the resit policy, including the impacts of taking resits on student progression, attainment and labour market outcomes”[d]. The report highlighted key patterns in the data, most of which are generally well known and unsurprising, and highlighted that indiscriminate November entry strategies can do more harm than good for some students.

The challenges of achieving progress in mathematics for those learners who left school after 11 years with poor understanding and attitudes to mathematics is considerable. Linked to this, in February 2025 the government announced that it would **drop the exit requirements for post-19 apprenticeships** to include mathematics and English functional skills[49].

[d] Observatory analysts are currently examining the income levels of students who achieve grade 4 at the first attempt, those who pass via a resit and those who do not pass the resit by 19.

In more positive news, December 2024 saw the publication of the latest results from the **OECD's Survey on Adult Skills** (part of the Programme for the International Assessment of Adult Competencies). The previous results had been widely referenced as evidence for reforms and greater investment in improving adult numeracy, but these results were positive in several respects:

- There was a significant increase in adult numeracy scores in England with only Germany and Japan in the G7 positioned higher.
- Young people (16–24-year-olds) had significantly improved numeracy scores compared to the 2012 survey[e].
- The age distribution of skills was now in line with international averages.

In contrast, the report noted that the gap between highest and lowest scores had widened and that men scored significantly higher than women.

Three months later in March 2025 the **Multiply programme** (2022-25) ended. Multiply was only ever funded for 3 years, but there have been prominent calls for continued support for improving adult numeracy, amongst them a strongly worded response from the House of Lords Science and Technology Committee[50].

[e] The data for PIACC 2024 was collected in 2022-23, so 16-24 year olds in the study were in schools (Reception to Year 11) roughly between 2009-10 – 2021-22 for the youngest respondents and 2002-03 – 2013-14 for the oldest.

2.5 The mathematics teacher workforce

Developments in the mathematics teacher workforce 2024-25

- The incoming government pledged an additional 6,500 teachers by the end of the parliament, but details remain unclear.
- Secondary mathematics teacher recruitment continued to fall short of its target – 73% of target achieved in 2024-25 (63% in 2023-24).
- Bursaries for mathematics teacher training remained in place (£28,000) and new target retention incentives were introduced.
- New teacher degree apprenticeships in secondary mathematics were developed as a pilot from September 2025, initially involving only a small number of trainees.
- There was a focus on provision and evaluation of early years and lower primary professional development.
- An above inflation teacher pay award of 5.5% was announced in July 2024 and 4% agreed for this current year.

In the summer of 2024, the incoming Labour government pledged an additional 6,500 teachers by the end of the parliament. This laudable goal followed years of teacher recruitment and retention challenges. The details of this policy were somewhat opaque, and by July 2025 some were still concerned by the lack of a plan[51] and – amidst falling rolls in primary schools – the question of whether this 6,500 was merely for secondary, or for key subjects, remained unclear.

The NFER's annual **Teacher Labour Market in England**[52] report noted that "the latest data shows that teacher recruitment and retention in England remain in a perilous state and represents a substantial on-going risk to the quality of education". The report notes that for secondary mathematics, 73% of the target for initial teacher training was met; a marked improvement from the 63% in the 2023-24 year. Encouragingly, the NFER also suggest that with this trend, and reductions in targets by the DfE[53] the targets for secondary mathematics might be met in the 2025-26 year.

Secondary mathematics trainees continue to receive **bursaries**, which for mathematics in 2024-25 was £28,000, with a limited number of slightly larger scholarships of £30,000 also available. For some of those beginning their secondary mathematics teaching careers 'targeted retention incentives' (TRI) are available[54]. These aim to address the issue that the impact of weak teacher recruitment and retention is not felt everywhere. A particular challenge of teacher numbers is faced in the FE sector and in May 2025 it was announced that mathematics lecturers in FE who meet particular eligibility criteria would also entitled to a TRI[55].

A new innovation commenced in 2024 as eight universities started to recruit to **undergraduate teacher degree apprentices in secondary mathematics**[56] for first intake in September 2025 (though not all of these remain involved in this pilot).

In primary and early years there has been a concerted focus on **provision and evaluation of professional development** for teachers and practitioners. Mastering Number in Reception and Key Stage 1 continued at scale with an EEF trial[57] now underway and the programme extended into Key Stage 2 in Years 4 and 5. The DfE announced funding to implement the Maths Champions programme (developed by the National Day Nurseries Association) at scale[58] and in July published a report[59] on the previous government's flagship Early Years Professional Development Programme (EYPDP) which found significant improvements in practitioner knowledge and confidence in early mathematics. Along with the more entry level online mathematics Child Development Training module[60], the government seem to be forming a structured mathematics professional development offer for early years practitioners.

A fully-funded, above inflation, **teacher pay award** of 5.5% was announced in July 2024 for the start of the 2024-25 year and the government accepted the School Teachers' Review Body's recommendation of 4% for this current year. Despite this above inflation wage growth, teaching still compared unfavourably with other graduate professions[61]. All of this against a backdrop of concerns about workload and wellbeing[62].

2.6 Organisations supporting mathematical education

Developments in organisations supporting mathematics 2024-25

- The DfE published a report on engagement with the Maths Hubs Programme over the last decade from its £220m of funding.
- New Regional Improvement in Standards and Excellence (RISE) teams launched (£20m) with one priority being mathematics.
- Five teacher-facing associations agreed to merge to form a unified Association for Mathematics in Education (AMiE).
- Grant funding of £6m for the Academy for the Mathematical Sciences was not awarded but the Academy is growing, nonetheless.
- Two university maths schools opened, in Surrey (2024) and Aston (2025), but the DfE paused the opening of two more maths schools.
- The Richmond Project was created by Akshata Murty and Rishi Sunak to break down barriers and build confidence in numeracy.

Mathematical education takes place in, and is facilitated by, a huge number of organisations. Alongside schools, colleges and universities, there are a large number of so-called middle-tier organisations (e.g. Hubs, MATs, Local Authorities, NCETM) which support the teaching of mathematics for different subsets of the teacher population. The Observatory's Introductory Report mapped out the mathematics education organisational landscape and here we focus on some of the key changes seen in 2024-25.

The **Maths Hubs**[63] have spearheaded a new approach to supporting mathematics curriculum delivery in schools, focused more latterly on the delivery of government policy priorities (e.g. Mastery). The investment in the NCETM Hub network, and extension to supporting GCSE resit students in colleges signals the government's ongoing commitment to the professional development of mathematics teachers. NCETM funding decreased for 2024-25 to £29m (from a high in 2023-24 of £36.3m[64]). That said, not all schools and teachers are engaged with the Hubs - in the academic year 2023-24, Maths Hubs worked with 55.0% of primary schools (9,213) and 55.6% secondary schools (1,898) in England.

Whilst the Hubs focus on professional development, they do not have a school improvement function for supporting mathematics. The new **Regional Improvement in Standards and Excellence** teams launched this year aim to tackle longstanding areas of educational underachievement; they will facilitate school improvement planning and fill something of the gap left by the ending of funding for Priority and Education Investment Areas. The £20m RISE programme's first listed priority is on "attainment, with a focus on English and maths"[65]. The regional organisation addresses concerns that the loss of area-based local authority support, combined with networked MAT governance, can leave responsibilities for areas diminished[66].

Whilst the RISE programme is a new development, older organisations on the mathematical education organisational landscape are reforming. Many teacher associations and member organisations have suffered from falling memberships in recent years and in spring 2025, five teacher-facing associations agreed to merge to form a unified **Association for Mathematics in Education**[67] (AMiE). This process has been a long time in development.

Another development in the last year concerned the fledging **Academy for the Mathematical Sciences**. The hoped for founding grant from the Department for Science, Innovation and Technology (DSIT) did not materialise[68]. The new UK-wide Academy is progressing nonetheless and is currently recruiting its first tranche of fellows including wide representation across mathematical education.

Another funding decision in October 2024 paused the expansion of the free schools programme[69], one consequence of which was the suspension of plans to develop two further **university maths schools** in Durham and Nottingham, areas of the country with some of the lowest participation in advanced mathematics. The pause, however, did not stop the opening of the eighth and ninth university maths schools in Surrey and Aston in September 2024 and 2025, respectively. In October 2025 the Observatory published a commissioned report[70] into the short- and medium-term outcomes of pupils who attended the first three maths schools. The results showed that students who attend maths schools achieve significantly higher A level grades and are more likely to progress to mathematics degrees at higher tariff universities, than students in other institutions with similar prior attainment and demographics. The Observatory is currently analysing whether 11-16 students who take part in outreach and enrichment events run by maths schools are more likely to later enrol in A level Mathematics.

Other projects that have expanded this year include Axiom Maths, Get Further and the aforementioned Maths Excellence Fund, all of which have alignment to Purposeful Ventures[71], which rebranded from Ark Ventures in 2023. In recent months the **Richmond Project**[72] is the latest large philanthropic programme to enter the mathematical education space, though with arguably different motivations and priorities than the other projects.

Section 3
Trends in mathematical education

Evidence
Excellence
Equity

3. Trends in mathematical education

3.1 Overview and entries

Section 3 uses data from the National Pupil Database (NPD) and the Higher Education Statistics Agency (HESA) to examine trends in mathematics education over the past 10 years. The analysis considers all education phases but focuses on GCSE, A level and undergraduate participation and attainment – outcomes which measure the health of the mathematics education system and are the culmination of (typically) 16, 18 or 21 years of education both inside and outside the classroom. The Section starts by exploring entries and grade distributions before examining the effect of sex, socio-economic status, ethnicity and region and the onward destinations of those who leave mathematics education.

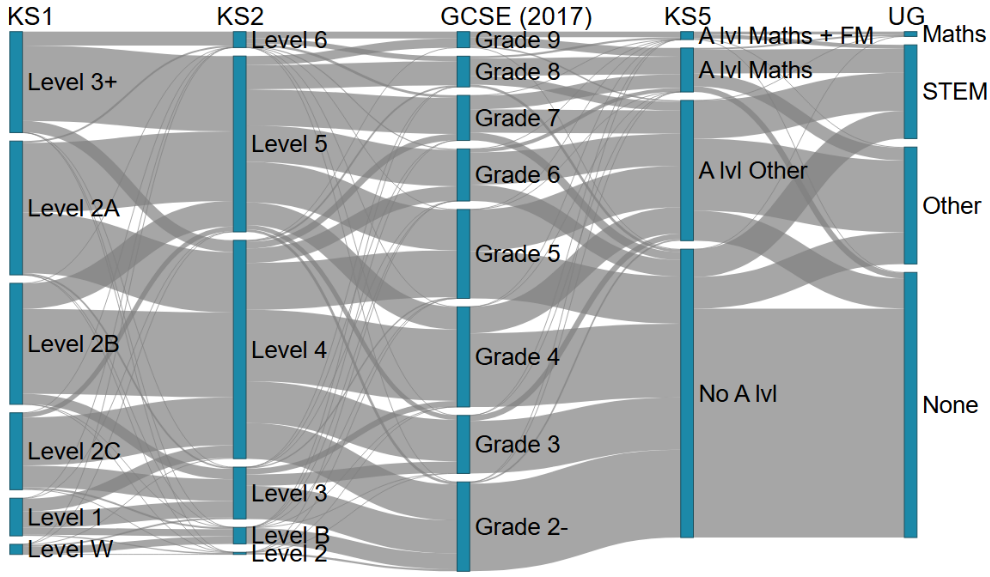


Figure 3.1 Sankey diagram of mathematics grades at Key Stage 1, Key Stage 2 and GCSE, and later participation in A levels and undergraduate study for the GCSE cohort of 2017.

The analysis below follows a 'cohort' approach. Students are grouped by the year they first attempted their GCSE Mathematics qualification, typically at age 16, and then tracked backwards and forwards in time, up to summer 2023. This means students are considered alongside their GCSE peers even if their education timelines later diverge due to 'gap' years. It also means results only contain students who took GCSE Mathematics in England so the effect of, for example, international students arriving post-16 is discounted.

An example of one cohort's flow through the system is seen in Figure 3.1. Their GCSE Mathematics grade in 2017 is related to their prior attainment at Key Stage 1 and Key Stage 2 and later participation in A levels and undergraduate education. Although there is some movement between grades it is apparent that strong mathematical outcomes in the later education phases are closely related to mathematical attainment at primary school. Conversely, there are many able mathematicians at GCSE and A level who choose to study non-mathematical A levels and degree subjects.

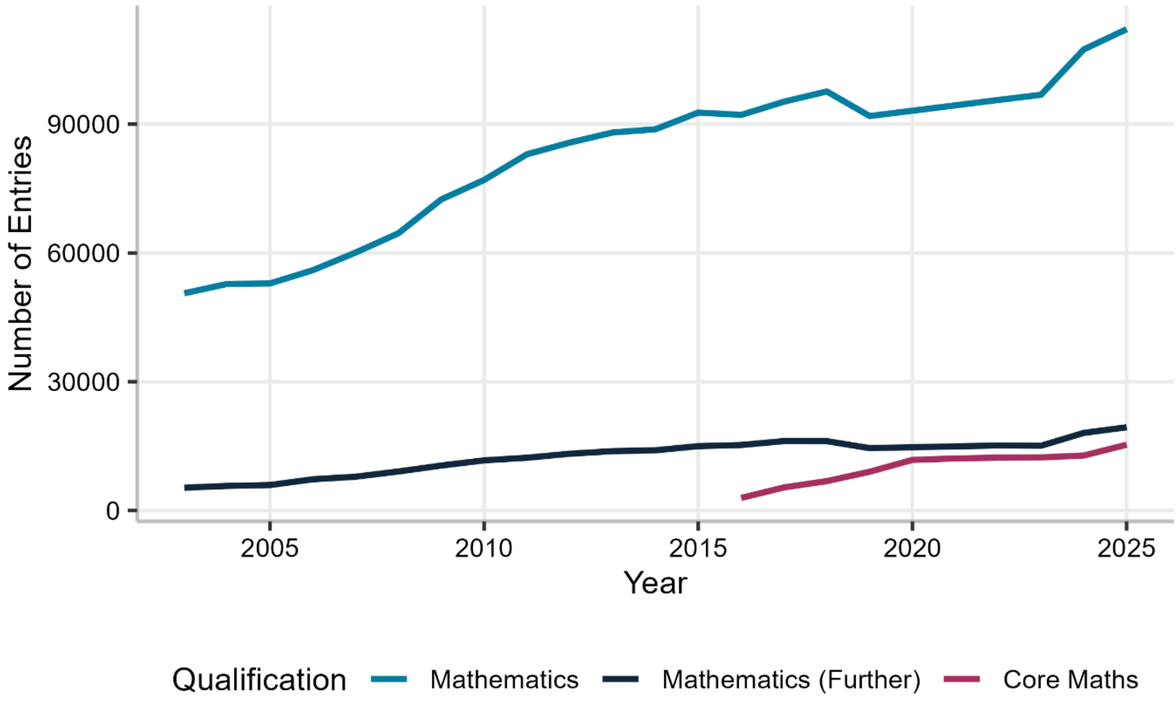


Figure 3.2 Number of entries to Level 3 qualifications (A level Mathematics, A level Further Mathematics and Core Maths) 2003 to 2025.

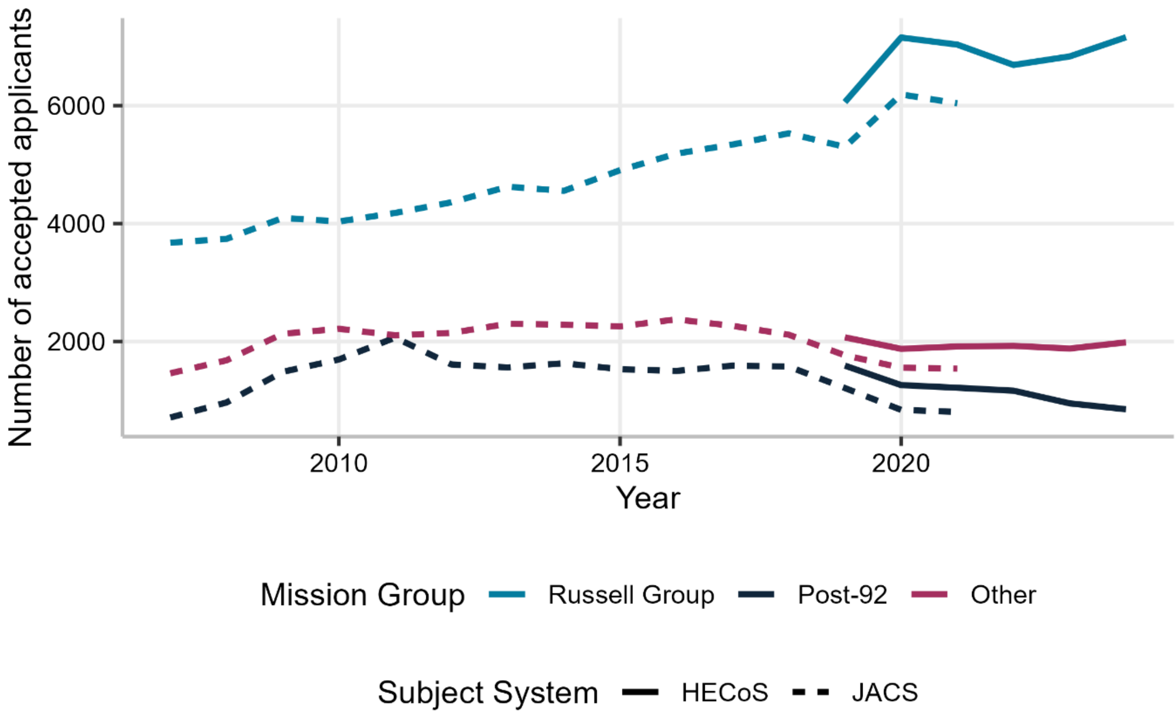


Figure 3.3 Number of accepted applicants to mathematics degrees 2007 to 2024. Note HESA changed the subject classification system, and therefore the definition of a mathematics degree, around 2020.

A consequence of the A level system is that England has one of the lowest post-16 participation rates in mathematics among the developed nations in the OECD. However, Figure 3.2 shows there was strong growth in both A level Mathematics qualifications prior to 2015, and this growth has restarted since 2023. In 2024 Mathematics became the first (and only) A level subject to exceed the 100,000 entries landmark, with a further 4.4% increase in 2025. A level Further Mathematics and Core Maths also grew by 7.2% and 19.6%, respectively, in 2025. However, this recent growth in Level 3 qualifications has not fed through to undergraduate study (Figure 3.3). Recent rises in mathematics degrees at Russell Group universities have been offset by reduced participation in post-92 universities which has led to some mathematics departments closing or scaling back their provision.

3.2 Grade distributions

Mathematics (along with English Language and Literature) was in the first wave of GCSE subjects to switch from letter (A*-G) to number (9-1) grading in 2017. Figure 3.4 shows how the A*/A bracket and B/C bracket were given greater granularity with grades 9-7 and 6-4, respectively. Comparing 2023 and 2014, the percentage of students awarded grades in these two brackets has remained around 20% and 50%, respectively, with the remaining 30% of students failing to achieve the standard pass. The exception to these proportions is during the Covid pandemic, where the pass rate was higher during 2020-2022 when awards were made on the basis of Centre- and Teacher-Assessed Grades. The stability of the grading distribution over time leads many teachers and parents to the misconception that grades are norm-referenced, but exam boards do not have a 'quota' or 'cap' on the number of students that can be awarded each grade[73]. Instead Ofqual state it reflects the 'stability at a national level in the performance of students in their assessments'. The National Reference Test estimates the percentage of pupils performing at grade 4 or above and has not changed significantly (70.8% in 2025 compared to 70.7% in 2017)[74]. The corollary is that students today are no more mathematically able than those 10 years ago.

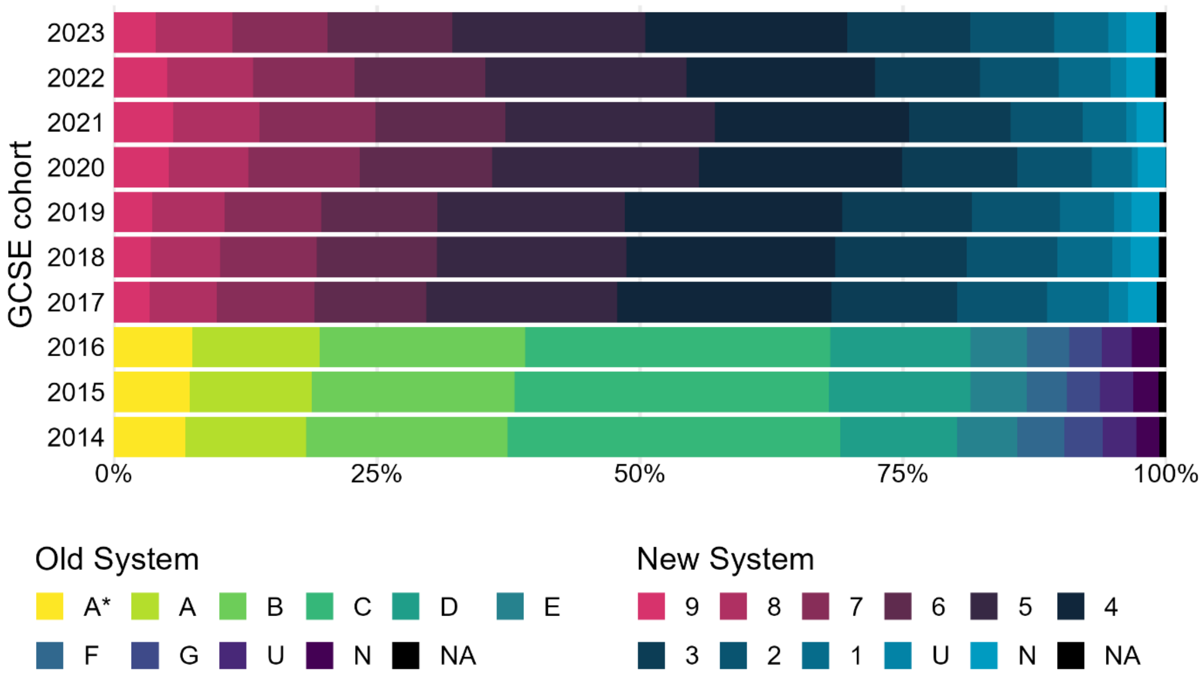


Figure 3.4 Grade profiles for GCSE Mathematics by GCSE cohort.

Figure 3.5 shows the grade distribution of A level Mathematics for each GCSE cohort. The pandemic 'bump' of 2020-2022 is apparent for those who took GCSEs in 2018-2020. Aside from the pandemic years, there was a contraction in the number of students achieving grade B in the 2017 and 2021 cohorts compared to earlier years. At a time when post-92 and other universities are struggling to recruit students with lower A level grades, this shrinkage of the applicant pool is unhelpful.

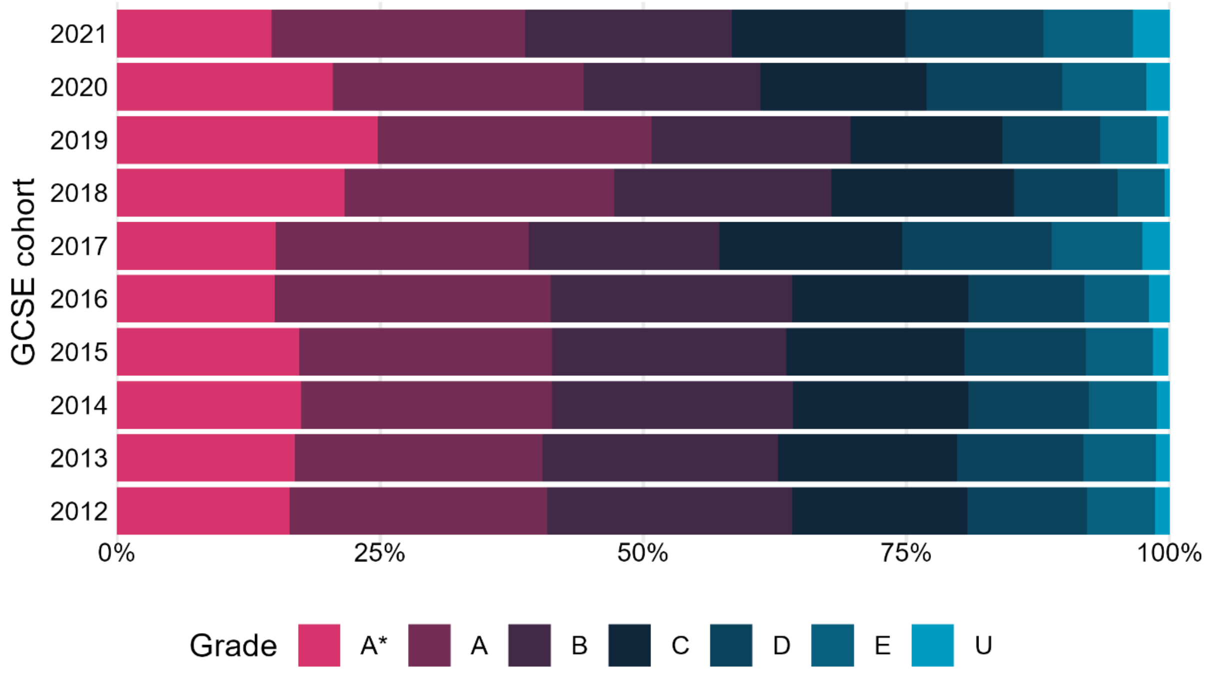


Figure 3.5 Grade profiles for A level Mathematics by GCSE cohort.

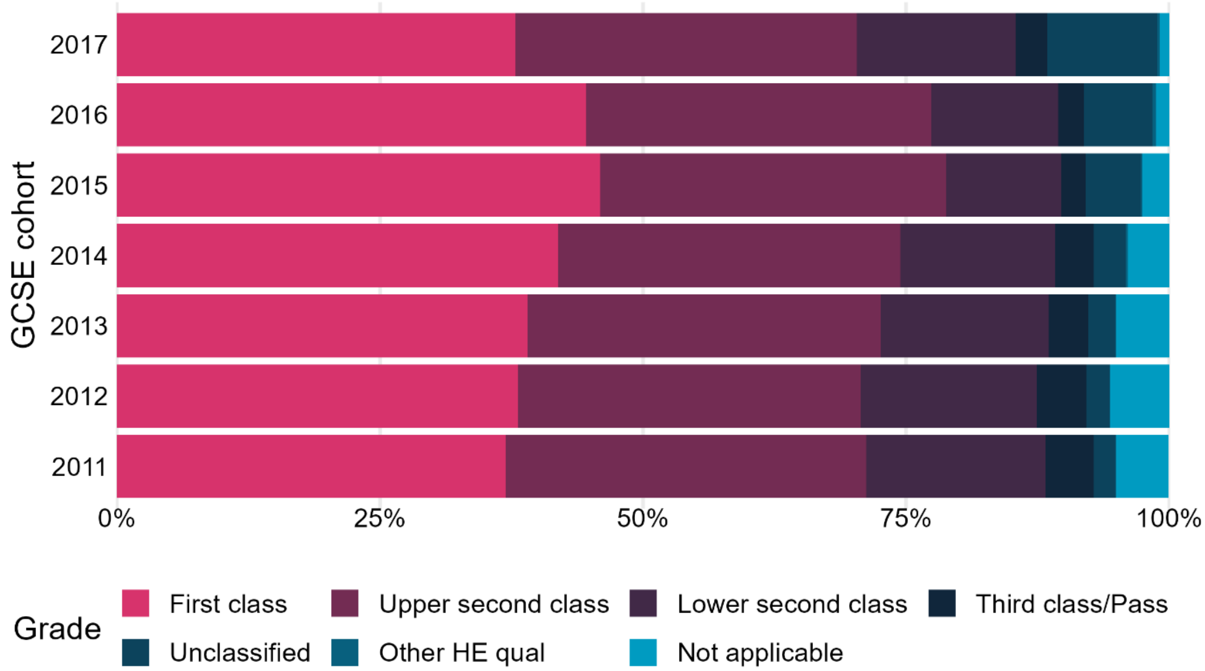


Figure 3.6 Grade profiles for undergraduate mathematics degree by GCSE cohort.

In contrast to GCSE and A level, the grade distribution of undergraduate mathematics degrees has not remained stable (Figure 3.6). The proportion of students achieving first class degrees was already increasing pre-pandemic before reaching close to half for the GCSE cohort of 2015 (who mostly graduated in 2020 or 2021). There was then a sharp correction to the grade distribution for the GCSE cohort of 2017. This may be partly due to a return to pre-pandemic assessment practices, but the Office for Students also published a report in 2022[75] which brought renewed focus on 'grade inflation' in universities. Their analysis showed that, across all subjects, the percentage of first-class degrees awarded to 'home' students in England had increased from 15.7% in 2011 to 37.9% in 2021. Figure 3.6 suggests that post-pandemic, mathematics degrees are in line with the all-subject average.

3.3 Female participation and attainment

It has long been established that there is a 'gender gap' in mathematics[76]. For the GCSE cohort of 2017 (first considered in Figure 3.1), Figure 3.7 shows the male to female ratio at each education phase. At Key Stage 1, the composition of students achieving the highest grades (level 3 or above) is weighted 56:44 towards male students. Moving through Key Stage 2 to GCSE, this 'gender gap' is largely removed. However, in the post-compulsory phases, female students are opting out of mathematics – for this cohort only 36% of A level Mathematics students and 32% of undergraduate mathematics students are female.

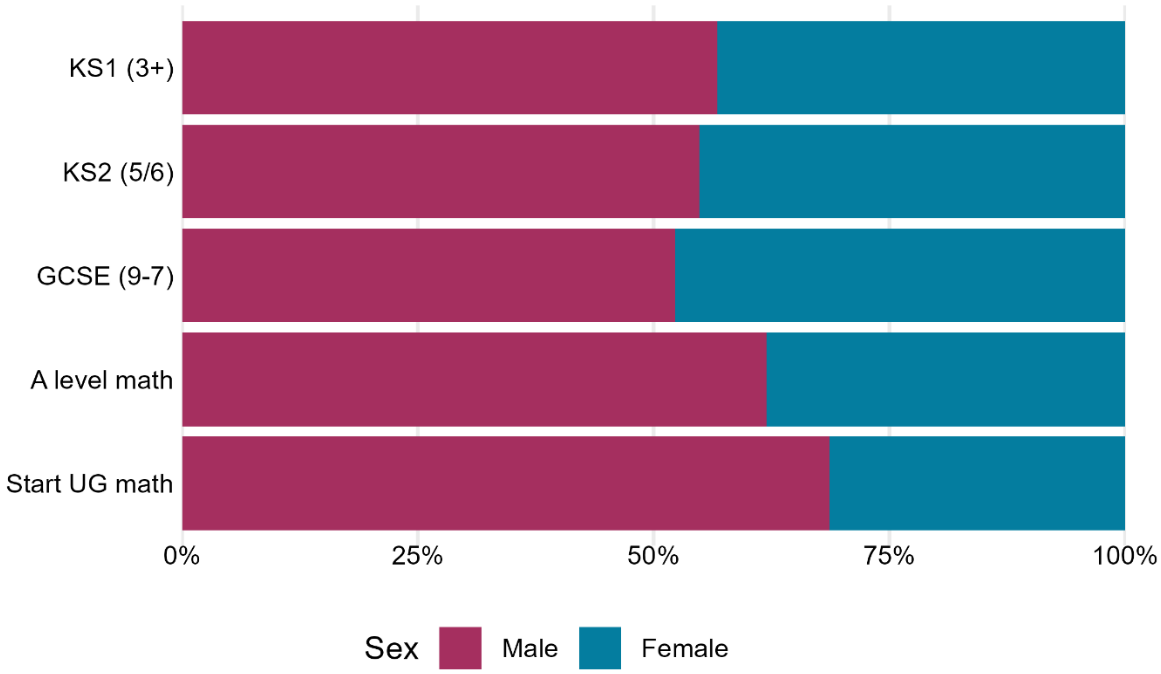


Figure 3.7 The male/female composition of students achieving high grades at KS1, KS2 and GCSE, and participation in A level and undergraduate mathematics for the GCSE cohort of 2017.

This gap in post-compulsory participation is not new. Figure 3.8 shows that the A level Mathematics female participation rate has slowly drifted down since the GCSE cohort of 2016. More concerning is the participation rate in undergraduate mathematics falling below 30% for the GCSE cohort of 2020 (who most likely started university in 2022 or 2023).

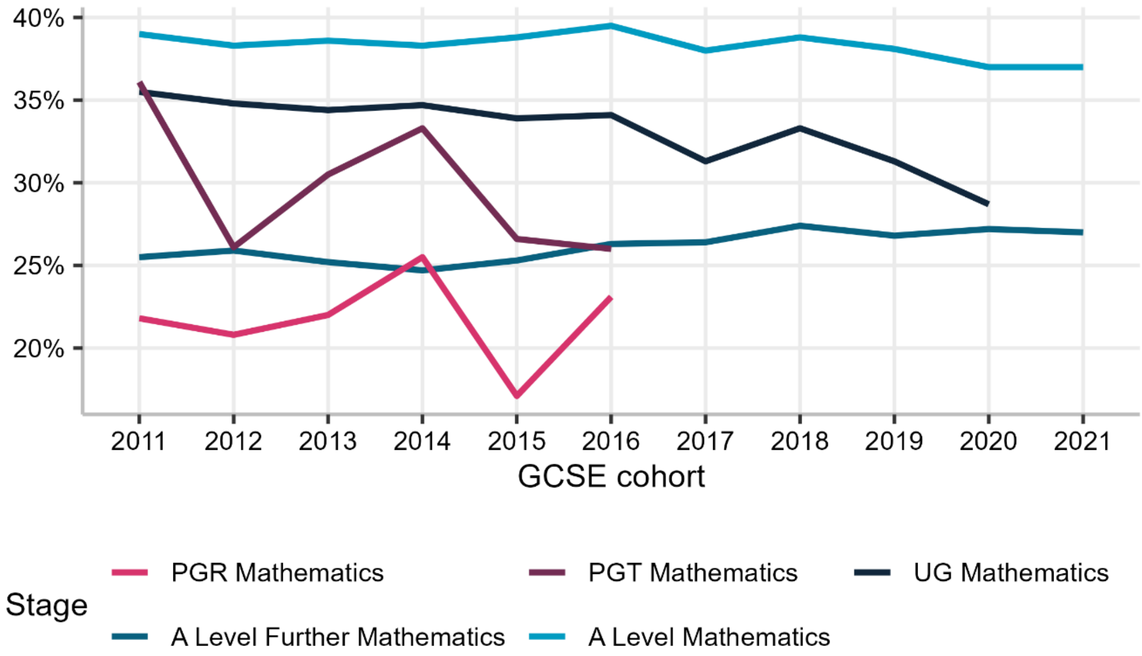


Figure 3.8 The percentage of participants who are female in different advanced and higher mathematics programmes by GCSE cohort.

Observatory analysis[77] shows that female A level Mathematics students are more likely to choose degrees in the life sciences compared to mathematics while their male peers are more likely to remain within mathematics and closely related subjects. The Observatory's longitudinal cohort studies will aim to establish when, how, and why female attitudes to mathematics diverge from their male counterparts. More positively, the female participation rate in A level Further Mathematics is rising, while participation in postgraduate mathematics is variable (due to the relatively small sample size).

Figure 3.9 shows the attainment gaps, calculated as the difference in the percentage of male students and the percentage of female students who achieve the highest grades. For GCSE, a small bias in favour of male students has emerged in recent years (aside from the pandemic years of 2020 and 2021). Larger attainment gaps in favour of male students are observed for A level Mathematics both pre- and post-pandemic, switching to favour girls for the cohorts of 2018 and 2019 (who took A levels during the pandemic).

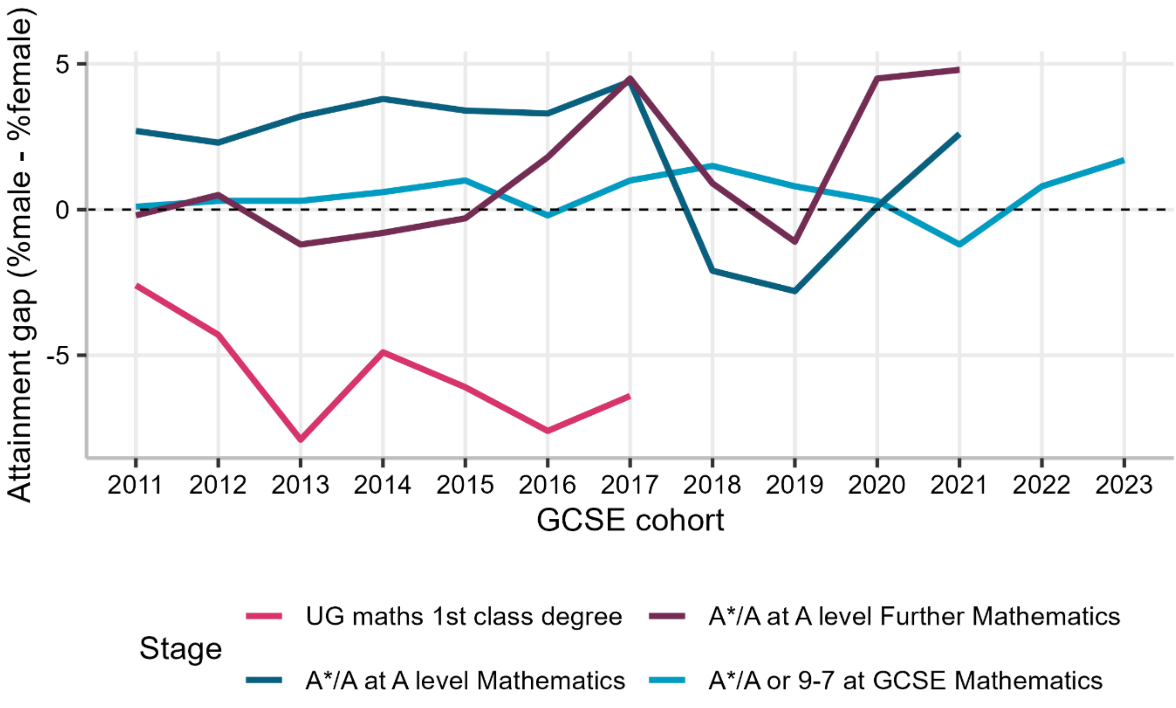


Figure 3.9 Male to female attainment gaps at GCSE, A level and undergraduate mathematics by GCSE cohort.

As recently as the GCSE cohort of 2015, there was little or no attainment gap in A level Further Mathematics but a similar trend to A level Mathematics has since emerged. These attainment gaps biased towards male students at A level contrast with undergraduate mathematics where female students are six percentage points more likely to achieve a first-class degree.

3.4 Effect of socio-economic status

Across many areas of education students from disadvantaged socio-economic backgrounds do not make as much progress as their more affluent peers[78]. Figure 3.10 shows the same is true throughout the mathematics education system in England. For every student in the GCSE cohort of 2017, their home council ward is used to determine their socio-economic quintile, as measured by the Income Deprivation Affecting Children Index (IDACI). If socio-economic status had no impact on attainment, then one would expect the composition of those achieving high grades at Key Stage 1, Key Stage 2 and GCSE to be equally distributed among the IDACI quintiles. However, over 30% of the students with the highest grades are from the least deprived (5th) quintile, with only 1 in 8 students from the most deprived (1st) quintile. This pattern stays remarkably consistent into A level and undergraduate participation rates suggesting that the education system does little to address the socio-economic inequalities in mathematical ability with which children start school.

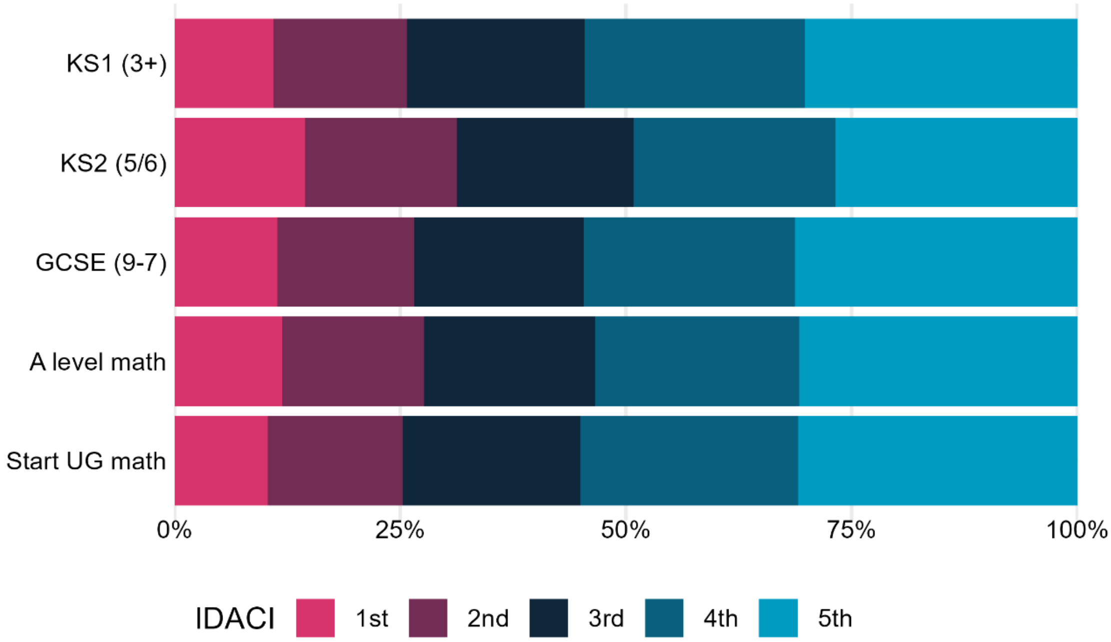


Figure 3.10 The socio-economic composition of students achieving high grades at KS1, KS2 and GCSE, and participation in A level and undergraduate mathematics for the GCSE cohort of 2017.

Of course, the causes (and solutions) of this inequality go beyond mathematics education but there are several mathematics-specific initiatives trying to address this issue. Figure 3.11 shows the participation rate for the most-deprived IDACI quintile is below the 20% benchmark for all post-compulsory phases. Participation rates for A level and undergraduate mathematics are similar, but this masks the fact that students with lower socio-economic status are less likely to achieve high A level grades. However, the Observatory's analysis also shows that, of those who do achieve high A level grades, those with lower socio-economic status are more likely to stay within mathematics. These two effects largely offset one another to produce the similar participation rates. Participation rates at postgraduate level, particularly taught programmes, are largely commensurate with undergraduate programmes (for all but the most recent cohort).

Figure 3.12 shows the attainment gaps, calculated as the difference in the percentage who achieve the highest grades between those who were not eligible for free school meals, and those who were. The attainment gap is consistently over 10 percentage points at GCSE and A level and there is little evidence that the gap is closing. The attainment gap is narrower at undergraduate level but still favours those with higher socio-economic status.

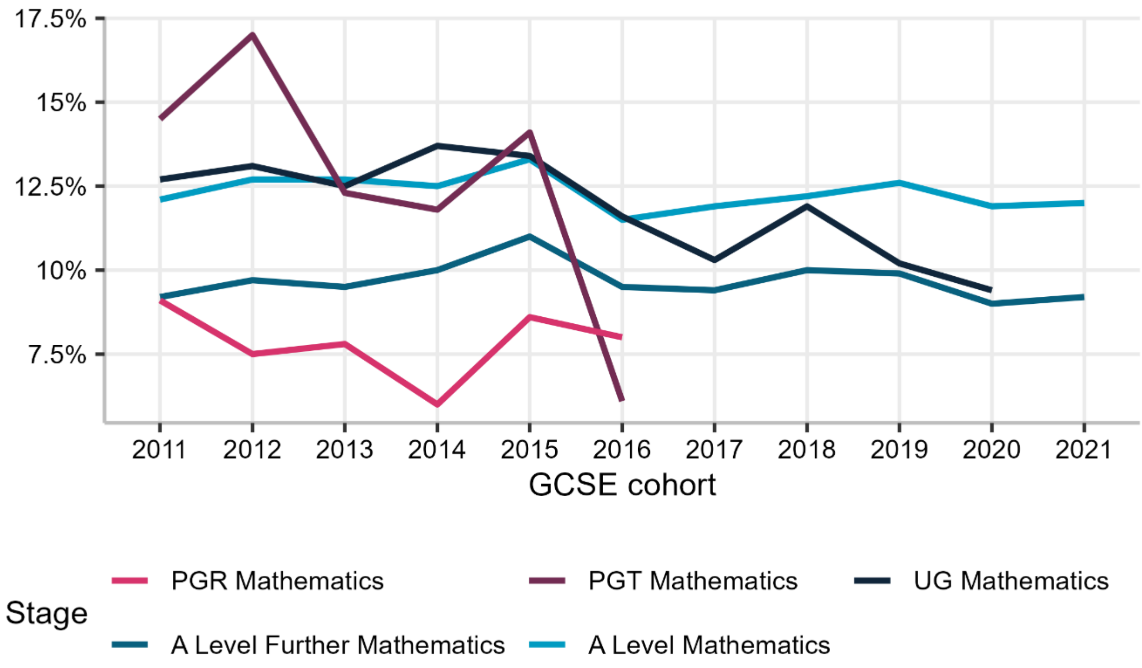


Figure 3.11 The percentage of participants from the most deprived IDACI quintile by GCSE cohort.

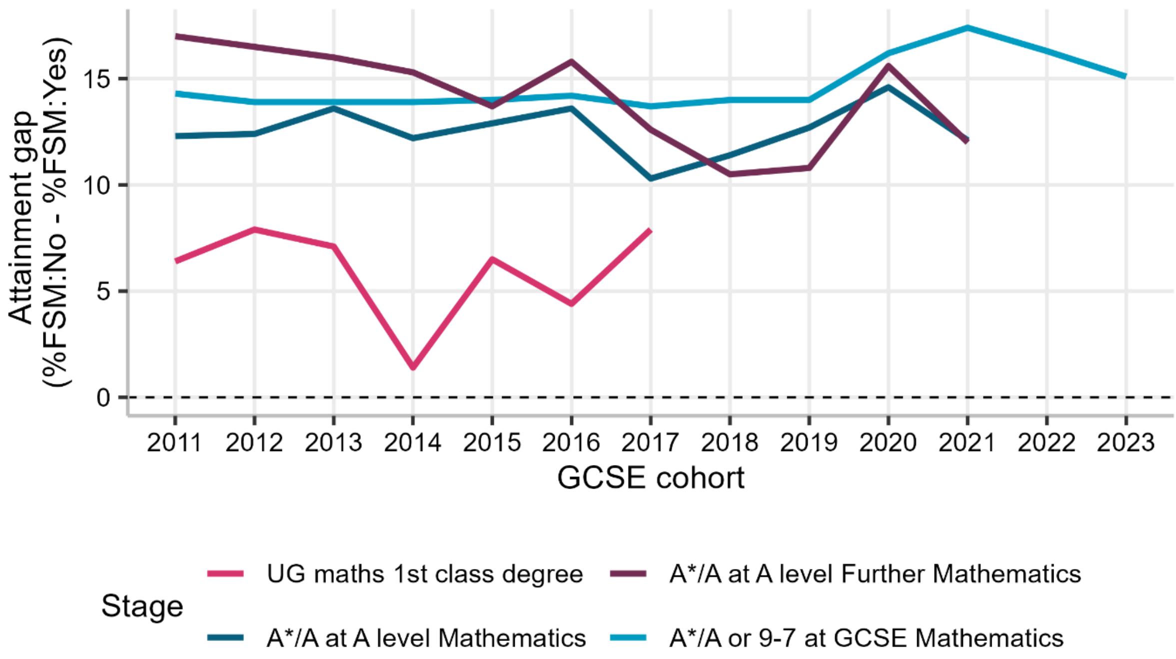


Figure 3.12 Free school meal attainment gaps by GCSE cohort.

3.5 Effect of ethnicity

For the GCSE cohort of 2017, Figure 3.13 shows the composition of those who achieve the highest grades at Key Stage 1, Key Stage 2 and GCSE. At Key Stage 1, over 80% of those who achieve level 3 and above are of White ethnicity. However, this percentage decreases for Key Stage 2 and GCSE where White students comprise less than 75% of those achieving grades 7 to 9. The change is accompanied by a corresponding increase in the percentage of students of Asian ethnicity who achieve the highest grades. The trend continues into post-16 where students of Asian ethnicity are disproportionally more likely to choose A level Mathematics given their GCSE attainment. However, the proportion of White students increases at undergraduate level with a corresponding decrease among students of Asian and Black ethnicities.

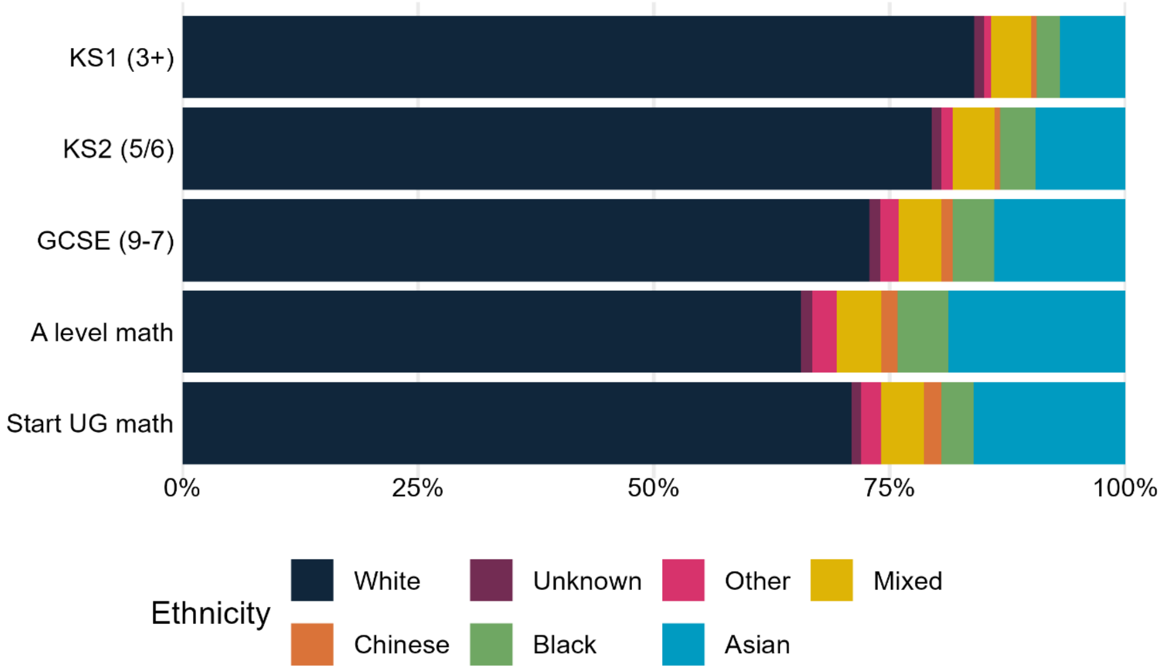


Figure 3.13 The ethnic composition of students achieving high grades at KS1, KS2 and GCSE, and participation in A level and undergraduate mathematics for the GCSE cohort of 2017.

These latter trends are partly explained by considering the proportion of students who achieve grades A* or A in A level Mathematics (Figure 3.14). For the GCSE cohort of 2017, Asian and Black students had lower attainment compared to other ethnicities. During the Covid years (GCSE cohorts of 2018 and 2019) the A level attainment gap between White and Asian students closed, but the attainment gap for Black students has consistently been around 10 percentage points below that of other ethnicities over the past 10 years. In contrast, those of Chinese ethnicity are around 10 percentage points more likely to achieve a grade A or A* than those of other ethnicities.

At undergraduate level, Figure 3.15 shows White students are most likely to achieve a first-class degree compared to other ethnicities. The results are more variable year-to-year because of the smaller sample size but there is some evidence that students of Asian ethnicity are closing the gap on their White peers. Once again, Black students are the least likely to achieve the highest grade. The difference in participation and attainment rates between the different ethnicities is related to a wide range of other variables, including socio-economic factors but also cultural and familial attitudes towards mathematics which the Observatory's longitudinal cohort studies are investigating.

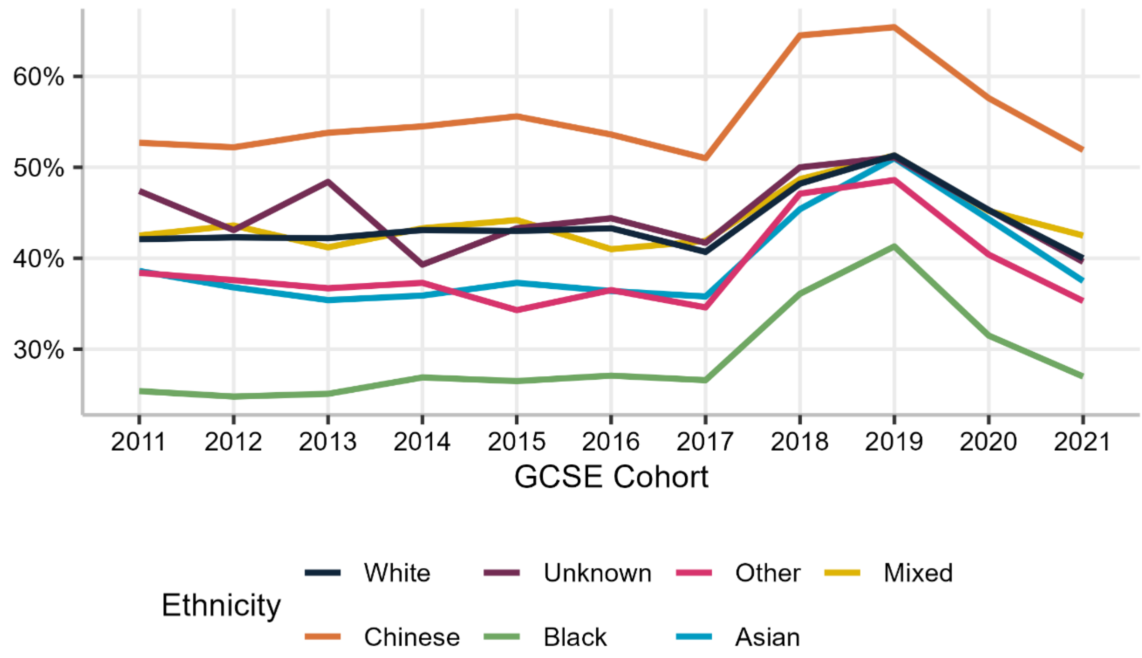


Figure 3.14 The percentage of A level Mathematics students who achieve grade A or A by ethnicity and GCSE cohort.*

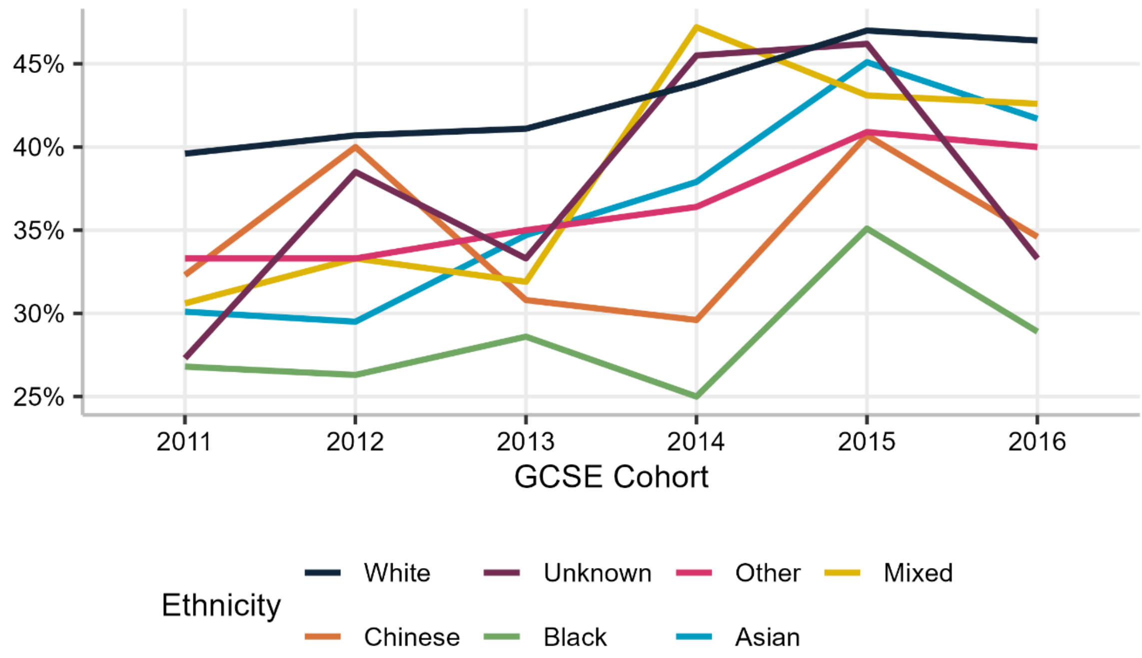


Figure 3.15 The percentage of undergraduate mathematics students who achieve a first-class degree by ethnicity and GCSE cohort.

3.6 Effect of region

Figure 3.16 considers the distribution of mathematical attainment across England based on the government region of a student's secondary school for the GCSE cohort of 2017. Although the population is not distributed evenly across the regions, by comparing one education phase to the next, patterns of over- and under-representation are revealed. For example, around 15% of the cohort lived in London, so the region is under-represented among those who achieved level 3 or above at Key Stage 1 but is over-represented among those who study A level Mathematics and undergraduate mathematics. In contrast, the neighbouring South-East region is home to 16% of the cohort, and its representation among high grades in school and participation in mathematics post-16 stays fairly consistent, while students from the North-East are under-represented in the latter phases.

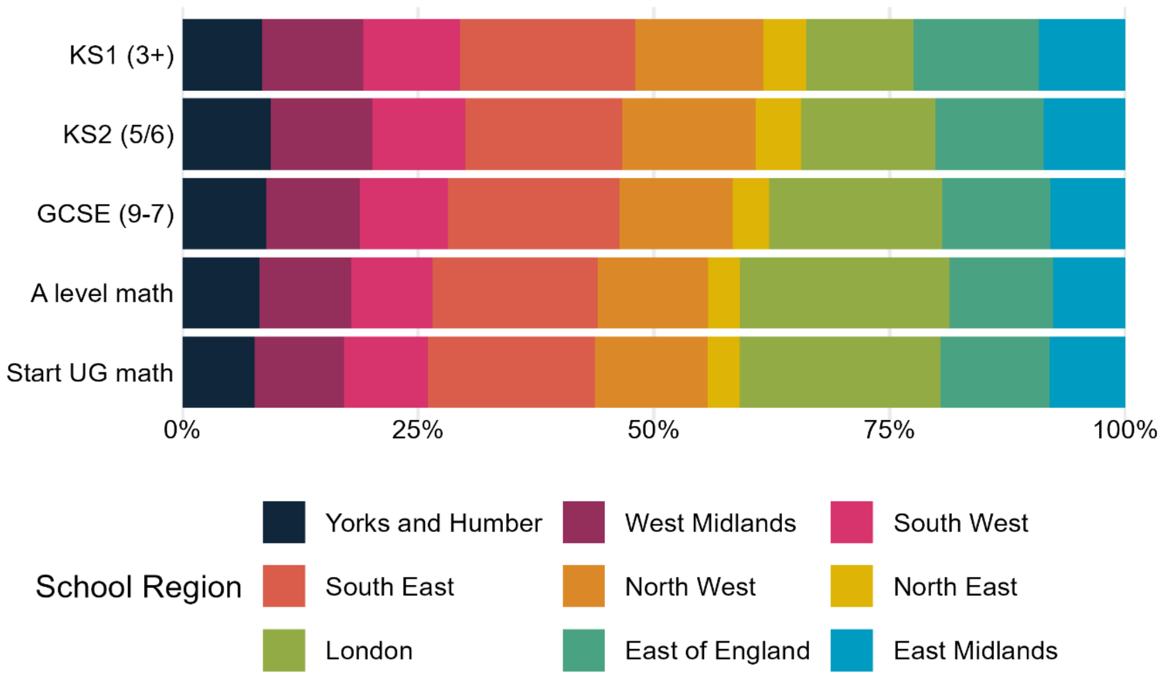


Figure 3.16 The regional distribution of students achieving high grades at KS1, KS2 and GCSE, and participation in A level and undergraduate mathematics for the GCSE cohort of 2017.

Figure 3.17 shows the A level Mathematics participation rate for each local authority district. The map shows large disparities with some participation rates three times that of other locations. The highest participation rates are in London, the South-East and East of England regions. Particular 'hot-spots' include south Buckinghamshire plus the London boroughs of Harrow and Redbridge where more than a quarter of students take A level Mathematics. Lower participation rates are generally found in more rural and less affluent locations, although there are some 'islands' of higher participation, for example, in Trafford (Manchester), Rushcliffe (Nottingham) and Winchester. Generally, these districts correspond to locations with high-attaining schools.

Figure 3.18 shows the corresponding map, at regional level, for undergraduate mathematics (single and joint honours) participation. Clearly the regional distribution of A level Mathematics participation feeds through into the higher education phase, with the participation rate in London double that of the North-East. These geographical patterns are related to the socio-economic and ethnicity patterns highlighted previously.

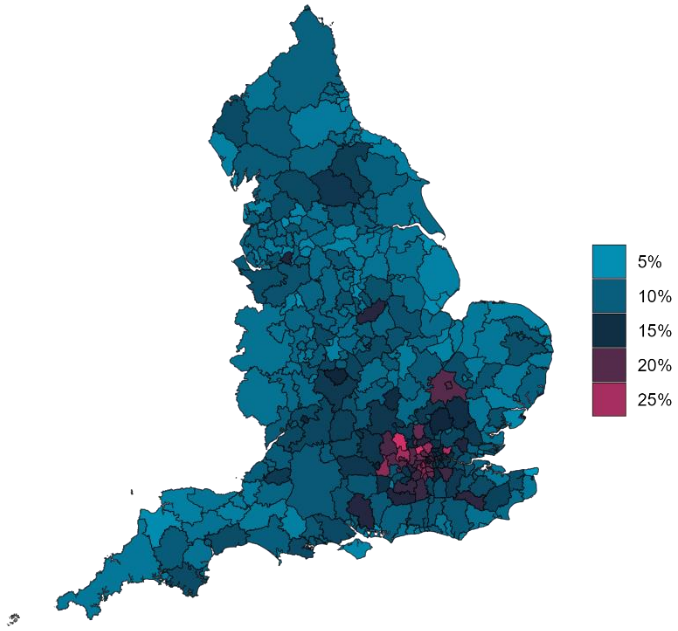


Figure 3.17 The percentage of students who entered A level Mathematics by local authority districts for the GCSE cohort of 2021.

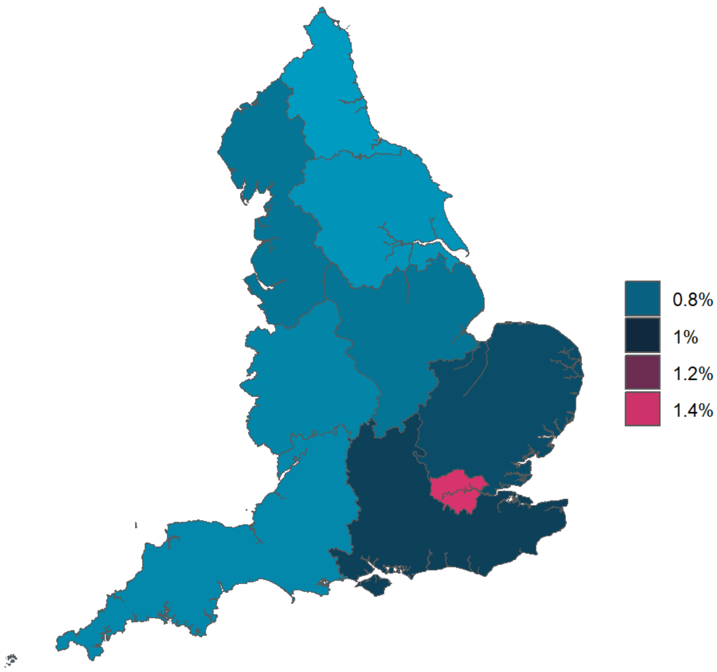


Figure 3.18 The percentage of students who entered undergraduate mathematics by region for the GCSE cohort of 2021.

3.7 Leaver destinations

Having successfully navigated their school education, and trends associated with their sex, socio-economic status, ethnicity and region, where do high attaining mathematics students go next? Figure 3.1 showed that most students with grade 8 or 9 in GCSE Mathematics continue to A level Mathematics but, post A level, most will not proceed to a formal mathematical qualification. Figure 3.19 gives a more granular breakdown of the most popular degree subjects studied by those with grade A* or A in A level Mathematics. While mathematical degrees (courses where mathematics comprises at least half the curriculum) are popular, the majority proceed to a wide variety of other STEM disciplines. The challenge for the A level Mathematics curriculum is that it needs to prepare students for all these disciplines as well as those who seek employment post-18. Previous Observatory research[79] shows there are differences in degree subjects related to sex and socio-economic status.

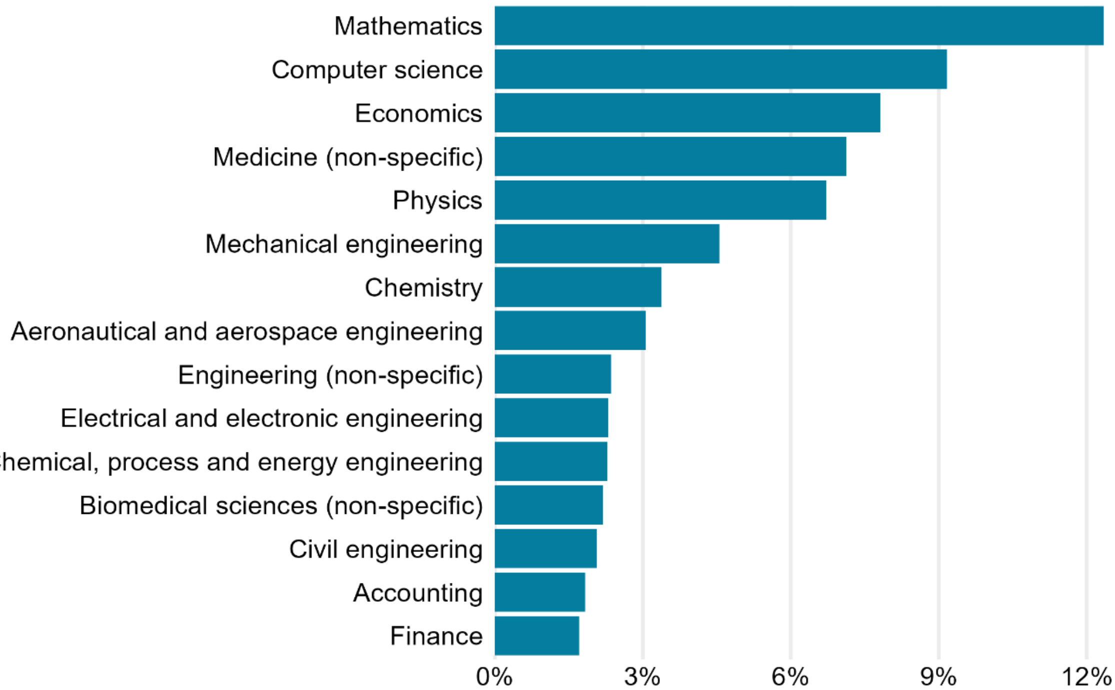


Figure 3.19 The 15 degree subjects most studied by students who achieved grades A or A in A level Mathematics in 2020.*

Figure 3.20 shows the employment destinations of mathematics graduates from 2018. Seven employment sectors dominate with 'professional, scientific and technical' roles being most common. Financial, education and computing sectors are also popular. It is unclear to what extent short-term post-graduation employment, and economic circumstances related to the pandemic, have had on these figures and will be the subject of further Observatory research.

The effect of mathematical attainment on career earnings for the GCSE cohort of 2007 is shown in Figure 3.21. Those whose best mathematics qualification is GCSE Mathematics gained a short-lived increase in earnings compared to those who continued in post-16 education. By 2020 those with grades A* to C earned 50% more, on average, than those with grades D-G. However, greater earnings were achieved by those with A level Mathematics and undergraduate mathematics. Those with a first-class degree in mathematics were earning almost double those with just GCSE Mathematics. For both A level and undergraduate mathematics there is an earnings premium for achieving higher grades. Those who study postgraduate mathematics have suppressed career earnings while they remain in education for eight or more years compared to GCSE leavers. Their earnings quickly rise once they enter employment, but their earnings curve still lags behind those with mathematics degrees in 2020.

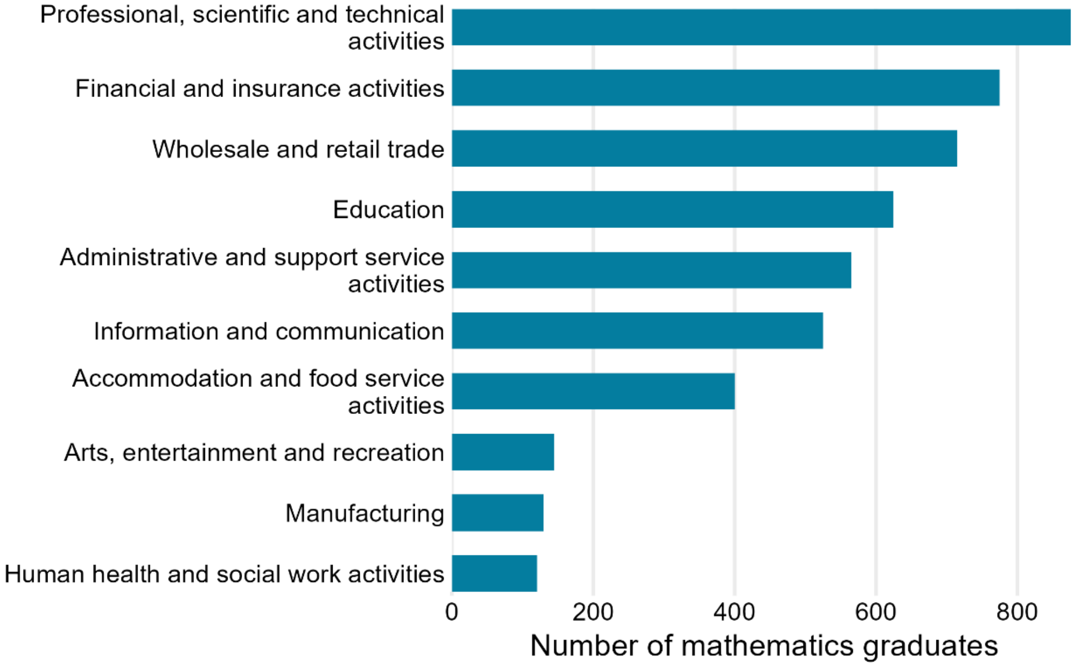


Figure 3.20 The top 15 employment sectors of mathematics students who graduated in 2018.

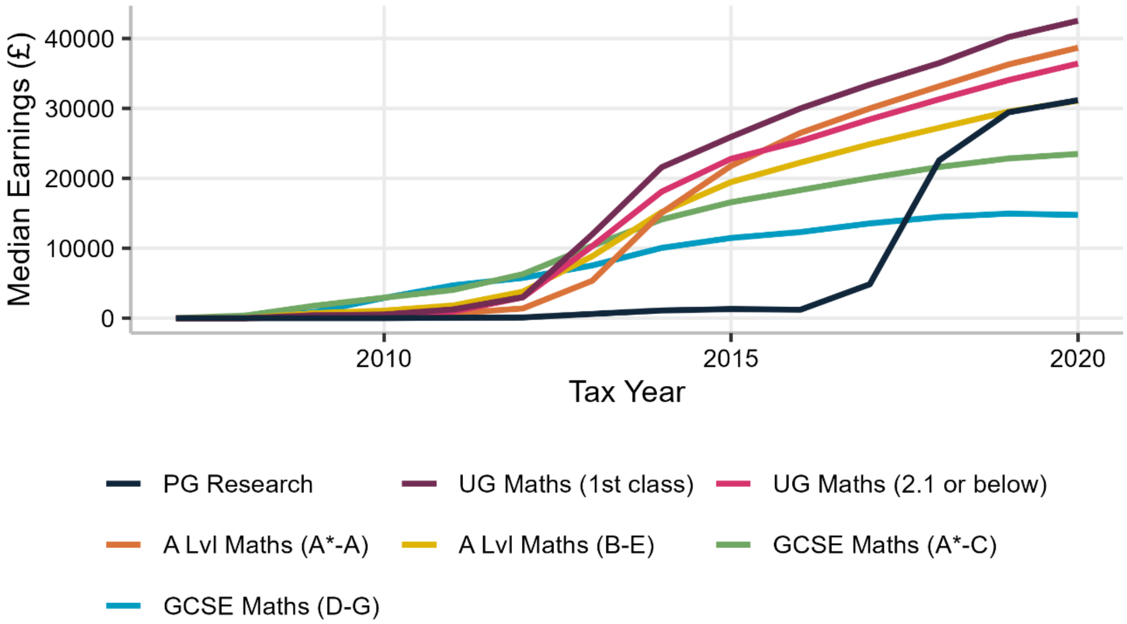


Figure 3.21 Median earnings per year for the 2007 GCSE cohort by best mathematics qualification.

3.8 Summary and next steps

Many of the trends reported in this Section are well-established and have proved intransient despite successive attempts to improve mathematical education by different governments and education leaders. The past 10 years have seen changes to grading systems, the introduction of Core Maths and disruption to national assessments due to the pandemic. Key Stage 1 tests are now optional whereas the Year 4 multiplication check has been introduced. While these changes make it harder to consistently monitor the system over time, some things appear to remain the same: for example, the over-representation of male students, the relative under-performance of Black students, the advantage of higher socio-economic status, and regional disparities. Delve a little deeper, though, and the closure of the attainment ‘gender gap’ at GCSE and A level during the pandemic starts to raise questions about how these patterns would change if mathematics were to be assessed, and therefore taught and valued, in a different way.

The analysis in this Section has focused on the effects of sex, socio-economic status, ethnicity and region in turn. In reality, all these characteristics and others are interlinked. The width of ‘gender gaps’ vary with ethnicity, while differences in outcomes may be masked by highly localised variation in socio-economic status in a major city such as London. Further analysis is needed to disentangle the different effects. Furthermore, the analysis will be considering the effect of specific policies. For example, do students who pass a GCSE resit enjoy the same economic benefit as those who pass at the first attempt, or is the policy ineffective in altering outcomes?

Analysis of these national datasets identifies problems and potential consequences in terms of qualifications and career earnings. To understand the reasons for these trends we need to shift to a smaller scale. Why does one student succeed while another falls short? The Observatory’s longitudinal studies at primary (Section 4), secondary (Section 5), and advanced and higher (Section 6) phases seek to understand how these national trends are the result of each learner’s attainment and attitudes and how these are shaped by their teacher, school, family and other factors.

Section 4
Primary mathematical education

Evidence
Excellence
Equity

4. Primary mathematical education

4.1 Introduction

As noted in Section 2, much policy attention is currently focused on the education of young children including bolstering early years education and building school readiness. Establishing strong mathematical foundations is necessary for tackling the disparities in the outcomes described in Section 3 since the gaps evident at the start of schooling are notoriously difficult to ameliorate; children experiencing greater socio-economic disadvantage are less likely to attain higher grades in national assessments or continue to advanced or higher mathematics study.

The good news is that international test performance indicates that primary mathematics attainment in England continues to compare favourably with that of other countries, as reported in the most recent TIMSS data for Year 5 (9-10 years)[80]. Notwithstanding this, the socio-economic status attainment gap continues to be a concern and in TIMSS (2023)[81] the average score for boys was significantly higher than for girls and the largest difference of any participating country.

The Observatory's study of primary mathematics education will, in time, help us to understand the genesis of these differences and how they vary across the sector. In addition to equity issues, TIMSS (2023) also showed that pupils in England perform less well in measurement and geometry relative to other areas of mathematics and most high-performing countries. Whatever happens in the current curriculum and assessment review in relation to this area of mathematics, this longitudinal study will help us to understand where, how and why these and other patterns emerge.

There are few large-scale system studies on the mathematics education of young children, in part due to the design and operational challenges of working with this age group. Researching the attitudes and experiences of 4- and 5-year-olds is no mean feat. This Section showcases headline findings from the analysis of data collected in Reception classes (5,457 children) in the Observatory's sample of 174 primary schools[82] at the mid-point of the 2024-25 school year when approximately half of the children were four years old. This data has been linked to National Pupil Database (NPD) records to explore the extent to which the attitudes of children in Reception are patterned by social background.

4.2 Attitudes to mathematics in Reception

Reception pupils were asked a set of questions about their enjoyment of, and confidence in, mathematics by a familiar adult. Their responses[f] generally showed high levels of enjoyment and confidence and these measures were combined to form a scaled measure of 'attitude to mathematics'[g]. Table 1.1 shows that pupils' attitudes to mathematics are similar for different groups, though already some 4- and 5-year-olds are not so positive about learning mathematics. Some differences are apparent in the pattern of attitudes for pupils with Special Educational Needs (SEN) when compared with their peers. That these children report similar levels of enjoyment and confidence is positive. It will be important to understand patterns in attitudinal changes over time.

NPD record	Pupils	High	Somewhat high	Somewhat low	Low	Sample size[h]
All		49%	37%	12%	1%	5,457
Sex	Girls	50%	37%	11%	1%	2,620
	Boys	47%	38%	13%	2%	2,560
Free School Meals (FSM)	Eligible	48%	38%	13%	2%	960
	Not eligible	49%	38%	12%	1%	4,210
Major language	English	49%	38%	12%	1%	4,140
	Not English	51%	36%	12%	1%	990
Ethnic group	White	48%	38%	12%	1%	3,650
	Not white	49%	35%	13%	3%	1,500
SEN status	SEN	41%	36%	18%	5%	440
	None	50%	38%	11%	1%	4,730

Table 4.1 Reception pupils' attitudes (confidence/enjoyment) to mathematics by demographic background.

As with EYFS (Early Years Foundation Stage) 'Good Level of Development' attainment outcomes[83], we see that month of birth is associated with Reception pupils' mathematics attitudes with younger pupils less likely to give positive answers to questions about their confidence and enjoyment (Figure 4.1).

[f] Pupils indicated their response using a toy which supported their access to the task and clarity over their answer.

[g] Computation of 'attitude to mathematics' is based on average item scores of the enjoyment and confidence scales where responses are –1, 0, and +1. 'Low' refers to an average score below or equal to –0.5, 'Somewhat low' refers to an average score above –0.5 but below or equal to 0, 'Somewhat high' refers to an average score above 0 but below or equal to +0.5 and 'High' refers to an average score above +0.5.

[h] As there are some unknown fields in individual pupil records in the NPD, the number of responses included in each category does not always match with the number of pupils who completed the survey. Figures in table rows may not total 100% due to rounding.

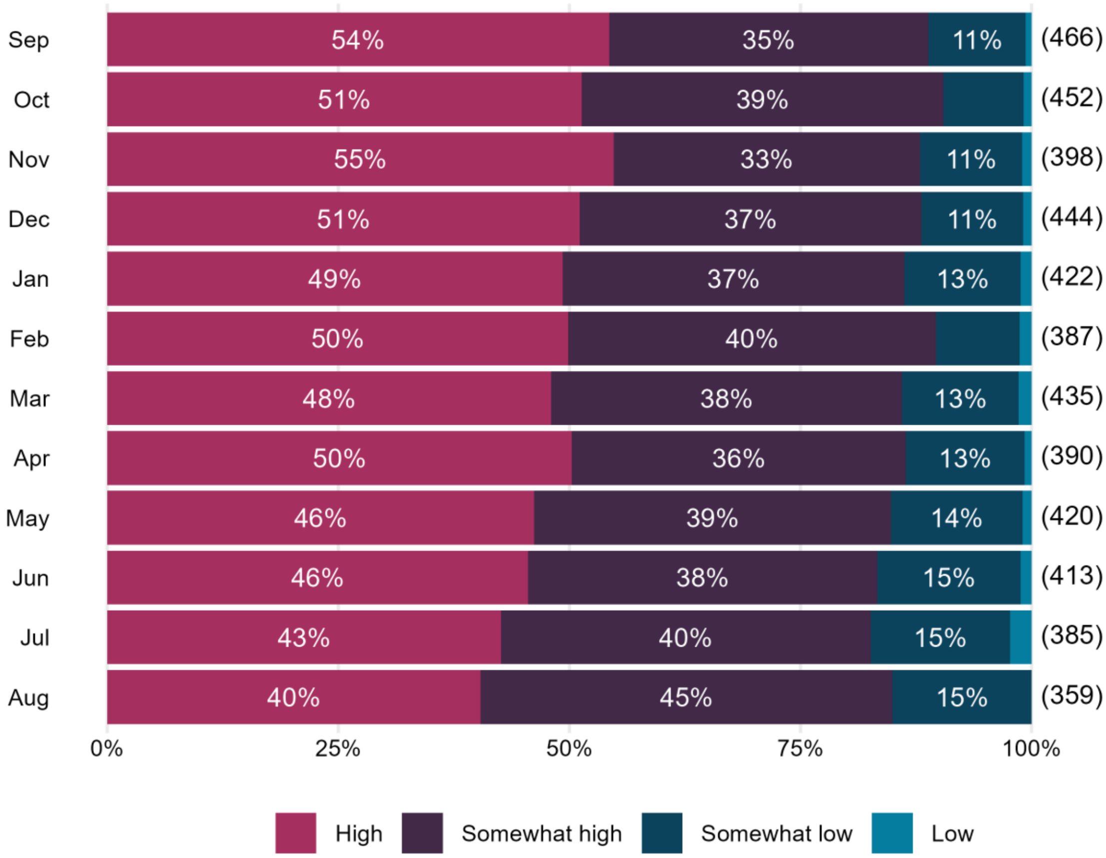


Figure 4.1 Reception pupils' attitudes (confidence/enjoyment) to mathematics by their month of birth.

Sex

Boys and girls (as recorded in the NPD) are both broadly positive about their experiences of mathematics teaching in Reception. Girls were very slightly more likely to report that they *talk to other children about maths* (45% do this 'a lot' compared to 40% of boys) or *work with a partner in maths* (48% do this 'a lot' compared to 44% of boys). Conversely, a higher proportion of boys than girls reported that they *choose what they want to do in maths* 'a lot' or 'sometimes' (Figure 4.2) though whether this reflects actual or perceived agency is unclear.

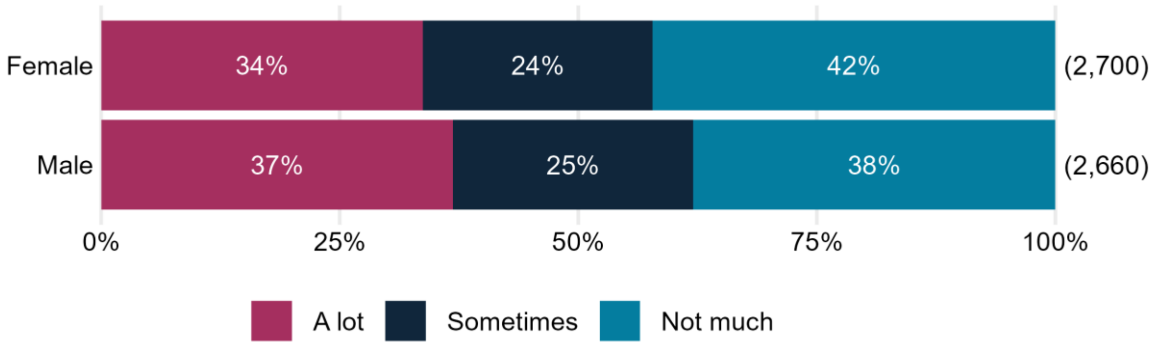


Figure 4.2 Reception pupil responses to how often they choose what they want to do in maths.

The greatest difference in the mathematics experiences reported by boys and girls was in how often they engage in block play (Figure 4.3). This too might be perception rather than reality, but in a similar question on using jigsaws, responses were very similar. It seems likely that this spatial learning activity is more common for boys which is noteworthy, and perhaps more could be done to support girls to access block play experiences more regularly.

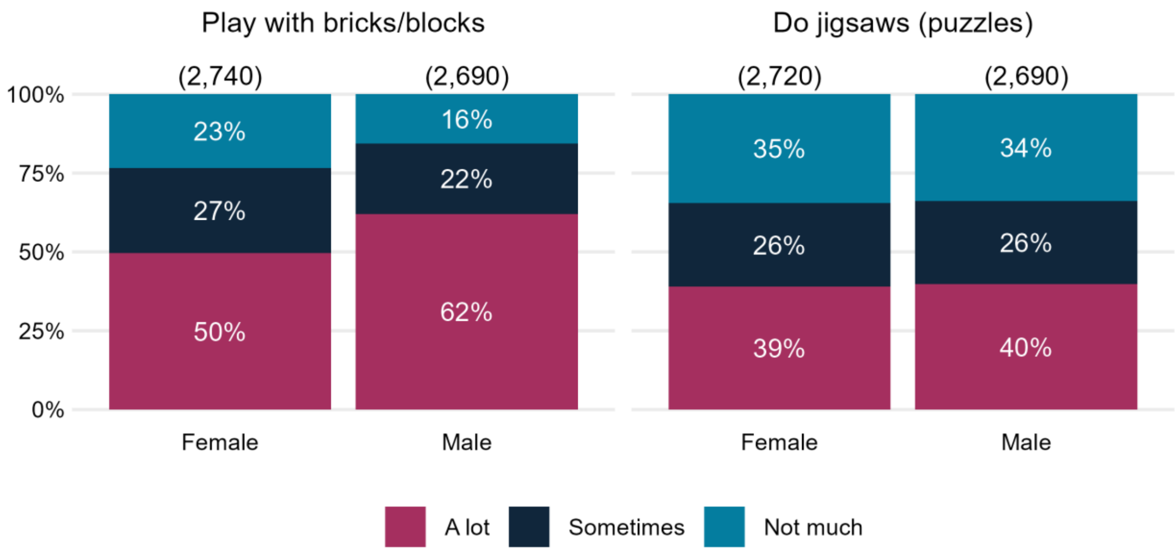


Figure 4.3 Reception pupil responses to how often they 'play with bricks/blocks' and how often they 'do jigsaw (puzzles)' at school.

Free School Meals

In Reception, pupils eligible for Free School Meals (FSM) have similarly positive attitudes to mathematics as their peers (Table 4.1). Pupils in schools with higher proportions of FSM-eligible pupils appear slightly more likely to report positive attitudes to mathematics (Figure 4.4) though the differences are small. This is not the case for individual pupils. Those who were not eligible for Pupil Premium Funding in the year before starting school were more likely than their peers to report positive attitudes (Figure 4.5).

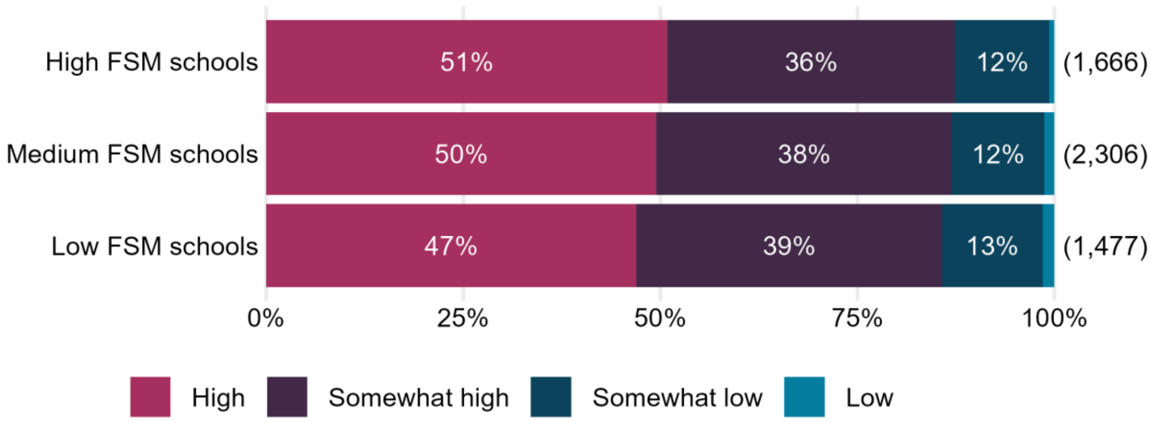


Figure 4.4 Reception pupils' attitudes to mathematics in schools with low, medium and high percentages of pupils eligible for Free School Meals.

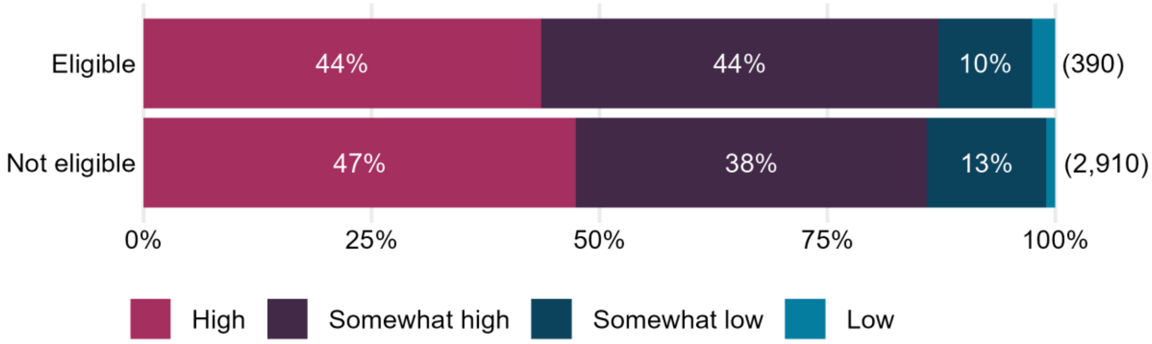


Figure 4.5 Attitudes to mathematics of Reception pupils that were and were not eligible for Early Years Pupil Premium Funding in the year before starting school.

Special Educational Needs

A higher proportion of children with Special Educational Needs (SEN) in participating schools did not engage with the survey. This, combined with lower identification rates for younger children, resulted in only 440 responses (8% of the sample) from pupils recorded as having a SEN status in the NPD. Participating pupils with SEN are less likely to report positive attitudes to mathematics than their peers and more likely to report negative attitudes (Figure 4.6).

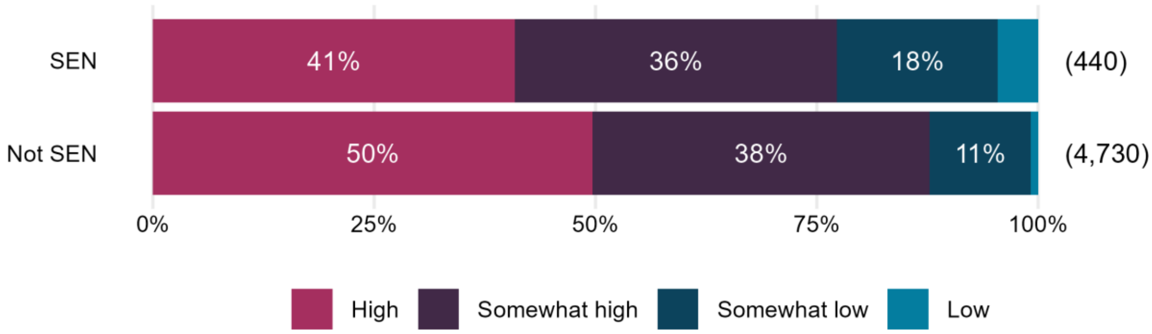


Figure 4.6 Attitudes to mathematics of Reception pupils with Special Educational Needs and their peers.

Pupils with SEN report slightly different experiences of mathematics learning at school. They were less likely to report frequently (‘a lot’) being *shown the right way to do maths*, *talking to other children about maths* or *working with a partner in maths* at school (Figure 4.7).

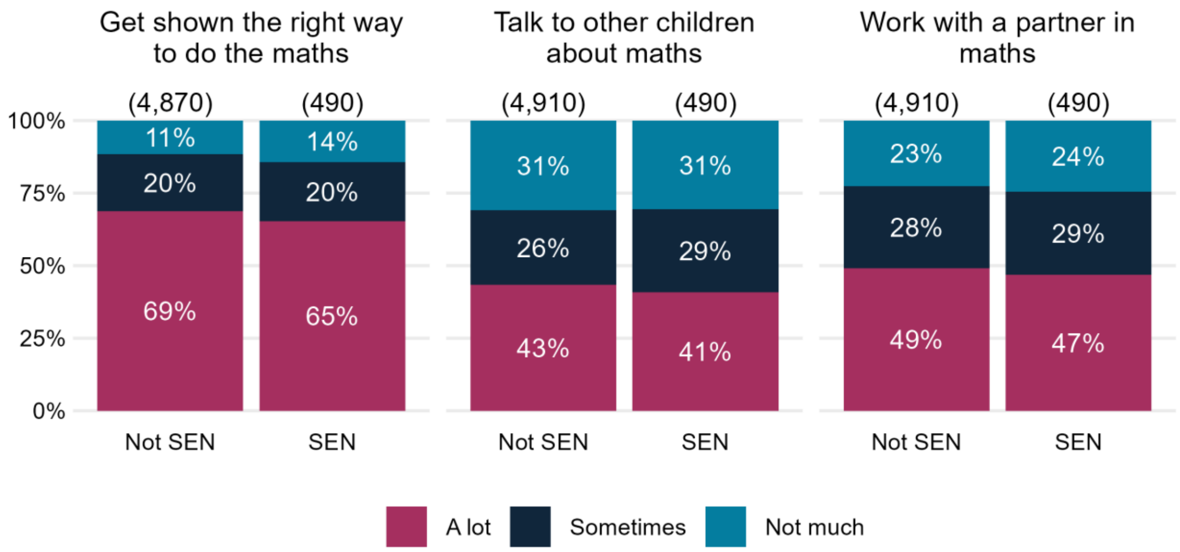


Figure 4.7 Frequency of adult modelling, child talk, and partner work reported by Reception pupils with Special Educational Needs and their peers.

Variation between schools

The structure of the data (i.e. pupils nested in classrooms in schools) allows us to compare variation between schools, and to a lesser extent between classes in large primaries. The average mathematics attitude score for Reception pupils varies between schools as shown in Figure 4.8. At present these differences are not particularly striking, but in future there is the potential to explore how these differences change, and what social, educational and instructional factors are associated with any differences.

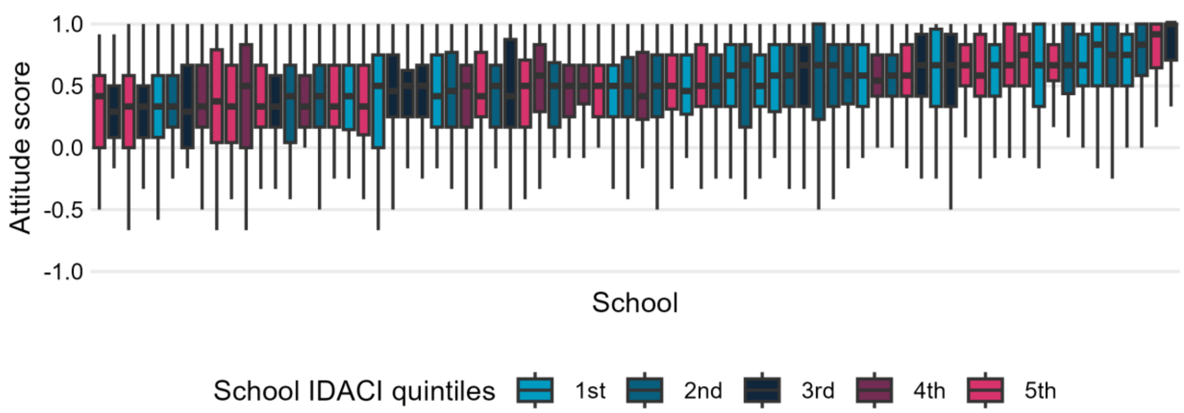


Figure 4.8 Box and whisker plots for Reception pupils' attitude to mathematics in each school with 30 or more participating pupils (1st IDACI quintile has the highest level of deprivation).

Exploratory analysis to date has not identified clear relationships between pupils' reported attitudes to mathematics and school type. There is no evidence suggesting that the variation in mathematics attitudes is clearly correlated with the percentage of FSM-eligible pupils in the cohort, the size of the school, school mathematics performance or rural-urban classification of the school location (rural, conurbation or urban).

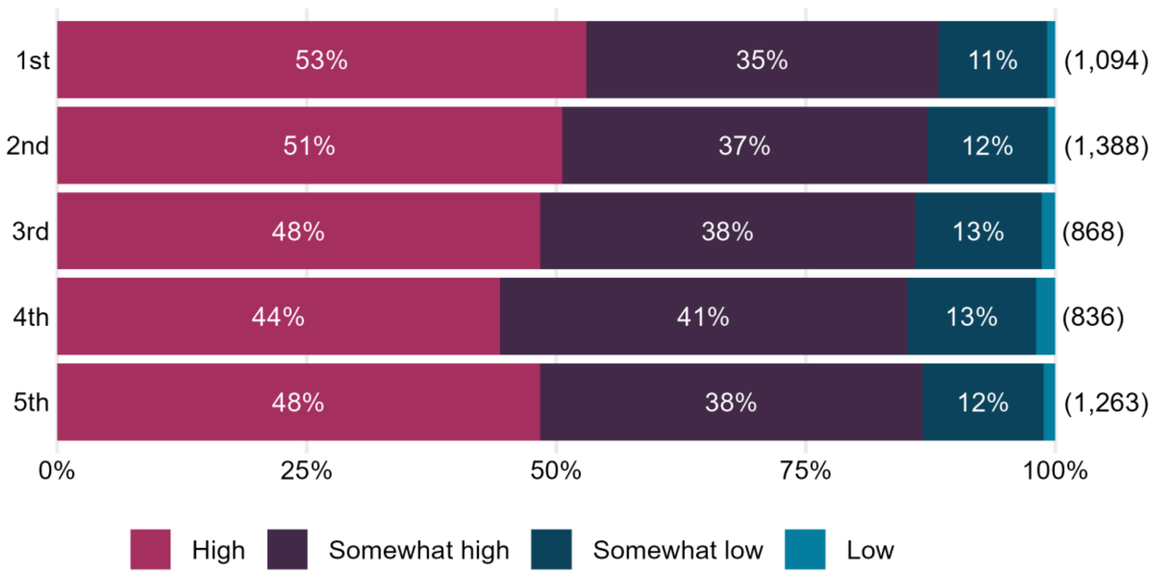


Figure 4.9 Reception pupils' attitude to mathematics scores by IDACI quintile of school postcode (1st IDACI quintile is highest level of deprivation).

Schools in more deprived areas have broadly similar proportions of pupils with more positive attitudes towards mathematics than pupils in schools in the least deprived areas. For example, Figure 4.9, in which school locations are grouped into IDACI quintiles, shows that attitudes in Reception appear unrelated to the level of deprivation in the locality of the school.

4.3 Mathematics teaching in Reception

At around the time Reception pupils completed surveys, 257 (60.6%) of their teachers in the 174 participating primary schools completed surveys about their mathematics teaching practices. One part of this survey asked about the last mathematics session they taught, thus providing a snapshot of Reception mathematics teaching. The teacher pedagogy survey asked about class size and whether it was a mixed-age group; it explored how mathematics is taught and the nature of pupils' learning experiences. The questions mirrored those asked of pupils where possible.

The mathematics curriculum in Reception classes

Reception teachers reported that in a typical day their pupils have an average of 24 minutes for whole class mathematics sessions and 94 minutes for child-initiated play, but this varies considerably between teachers as shown in Figure 4.10. Pupils experience quite different mathematics teaching in some classes compared with others. There are pupils in classes with very little whole class teaching and others with an hour or more of this in a typical day. Similarly, some children will learn mathematics through child-initiated play for two or more hours per day whilst many will be in classes where this is 15 minutes or less. It is important to recognise that periods of child-initiated activity are often not wholly child-directed as 60% of Reception teachers report that pupils need to complete teacher-directed mathematics activities within this time, and this may also be the case for literacy and other activities. Teachers report that children typically have slightly under two hours with access to outdoor learning (beyond recreational lunch and break times), although this also varies considerably between classes.

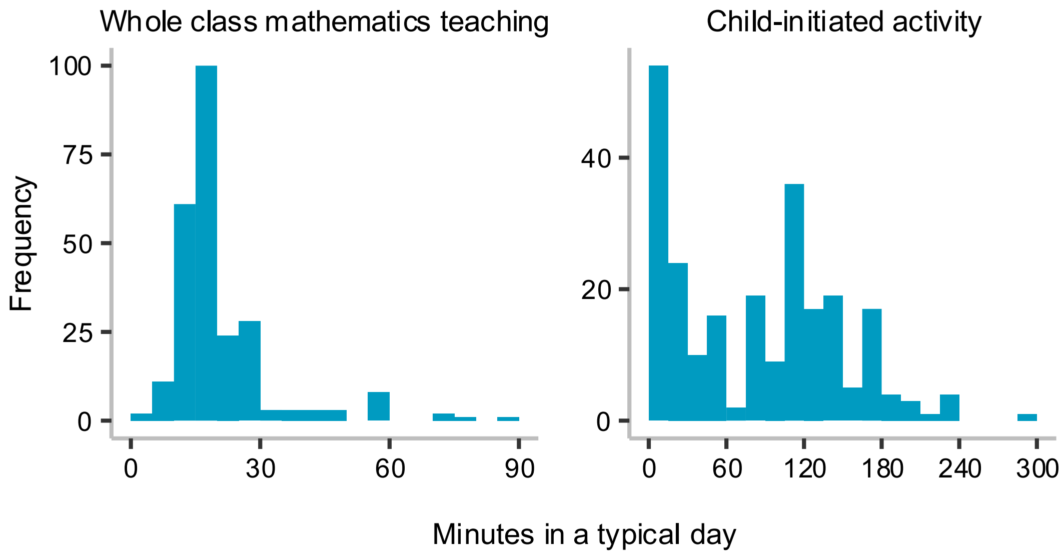


Figure 4.10 Amount of time spent on whole class mathematics sessions and in child-initiated play in Reception classrooms[i].

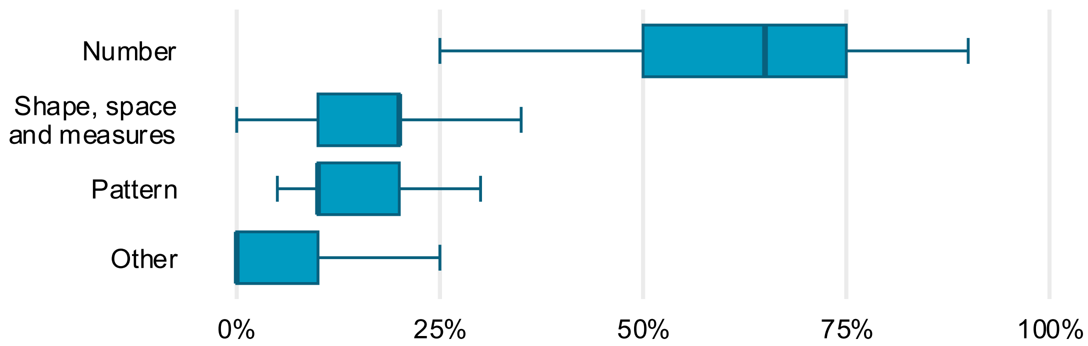


Figure 4.11 The proportion of mathematics teaching devoted to different topics in the Reception year.

Teachers report spending varied proportions of curriculum time on different topics (Figure 4.11), with the teaching of early number dominating. Shape, space & measures, pattern and other topics are reportedly taught much less by Reception teachers. These differences are likely influenced by the main mathematics scheme being used, with the large majority of schools using White Rose (48%) or Mastering Number (28%) in Reception classes. One in ten schools use a textbook to structure their mathematics teaching in Reception with 7% using no main published resource.

Despite the prominence of particular schemes, Reception teachers reported differences in their lesson planning processes. More teachers used collaborative and self-created plans in schools with a lower percentage of pupils eligible for FSM (Figure 4.12). Why these differences exist needs further investigation, as does the impact on the pupils' experiences.

---

[i] Erroneous responses have been omitted (two for child-initiated activity and one for whole class teaching).

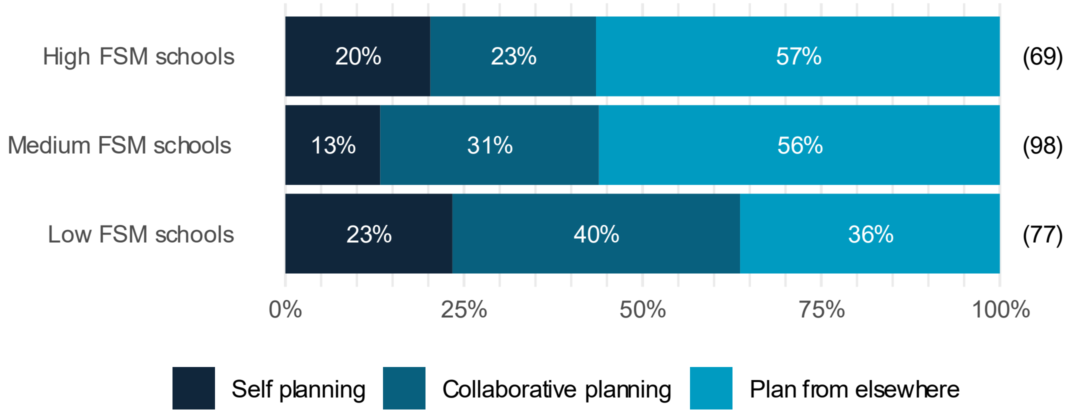


Figure 4.12 Reception teachers' mathematics planning.

Mathematics pedagogy in Reception

Reception teachers report using a range of practices in their mathematics teaching with *peer discussion* and *pair or small group* work more common than pupils *working on their own* and *working on paper* (Figure 4.13).

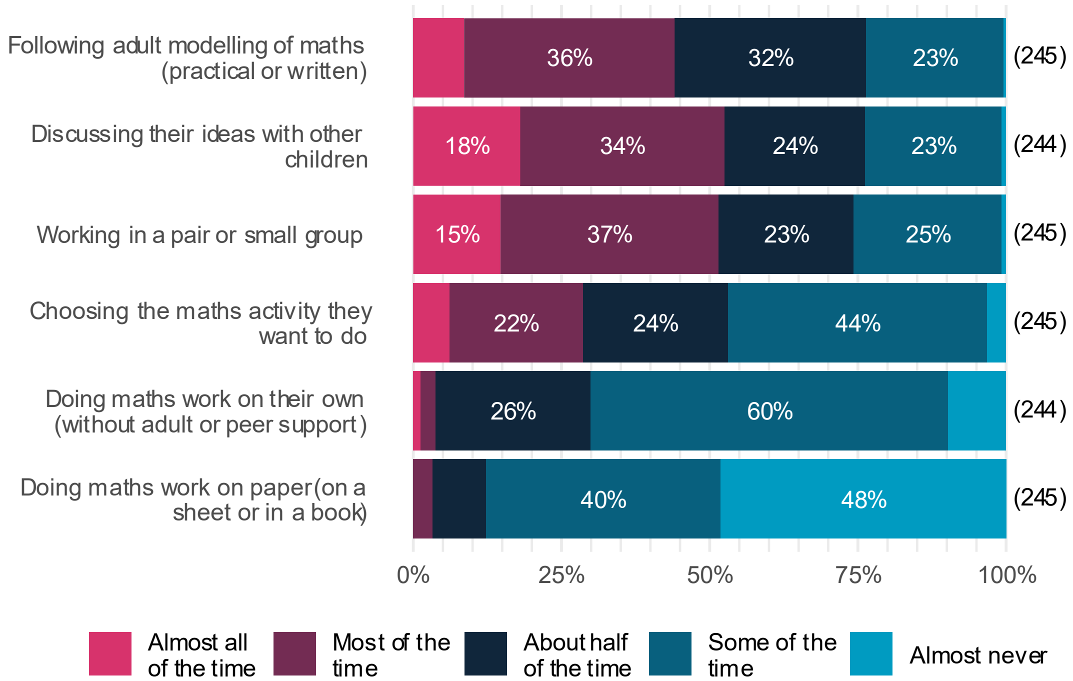


Figure 4.13 Teacher reported time that Reception pupils typically spend on mathematical activities.

A key question is whether these differences in the whole dataset are varied when subdividing the sample. For example, it seems that practices vary between schools serving communities with higher and lower levels of deprivation (see Figure 4.14). Reception pupils in schools in more deprived areas (IDACI quintile 1) tend to report doing more *maths work on paper (on a sheet or in a book)* than in schools in less deprived areas.

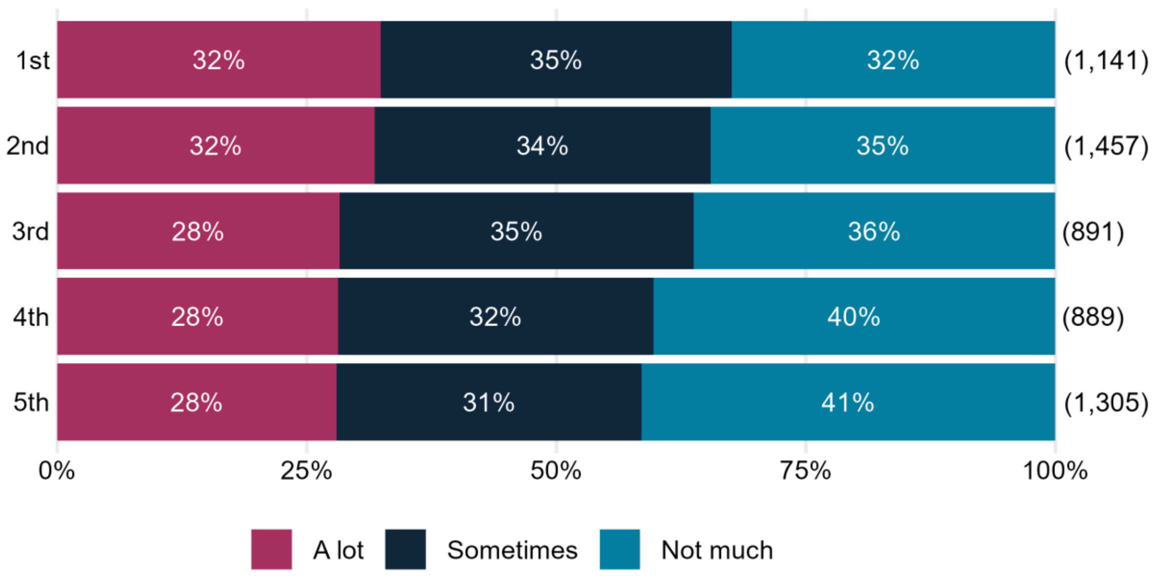


Figure 4.14 Pupil responses to how often they do maths on paper (on a sheet or in a book) by IDACI quintile of school postcode (1st IDACI quintile is highest level of deprivation).

Variation in mathematics pedagogy in Reception classrooms is evident across fifteen case study primary schools. There were key differences and similarities in the organisation of mathematics teaching, the planning of lessons as well as the resources and pedagogies used. Below are two examples.

Practice in Reception classrooms

In Beckle[j] Town Primary, leaders explained that the mathematics scheme was the 'bedrock' of their approach. In Reception, NCETM's Mastering Number was used with 20-minute sessions focussed on number every day of the week, with other areas of mathematics taught through child-initiated play. Teaching Assistants provided adapted versions of sessions for some groups. Staff consistently used repetition to support the development of mastery, with stem sentences helping to reinforce key ideas. The school's mantra was that 'all children have a floor but no ceiling' so practice was adapted for different groups of learners. The subject leader acknowledged, therefore, that they were not 'the perfect mastery school' because of their adaptive approach.

Lakeside Primary used a bespoke curriculum designed to meet the needs of their 'very diverse community'. Teachers all reported strong alignment to the Lakeside approach to teaching mathematics. Reception teachers reported that they 'focus on what the children need' and so adapt plans considerably for different classes. They teach daily 60-minute mathematics lessons with two practical, two written and one assessment lessons each week. Observed lessons in this school began with 20 minutes of explicit teacher modelling followed by all children working with manipulatives on tables with some paired work. Mathematics was also taught through child-initiated play outside of the mathematics lessons.

[j] All school names herein are pseudonymised so any resemblance to real school names is coincidental.

4.4 Primary teachers

In addition to the pedagogy surveys conducted with Reception teachers in 2024-25, the Observatory also conducted a workforce survey with teachers in the 174 participating primary schools. This Section therefore now ‘zooms out’ to consider more general matters of mathematics teaching in primary schools based on 1405 teacher responses across Reception to Year 6.

Generalist primary teachers have a breadth of disciplinary expertise and pedagogic knowledge. As class teachers, they typically teach one class for an entire year and there are some general assumptions about the year groups where more and less experienced teachers are deployed. The primary workforce survey shows, perhaps unsurprisingly, that teachers with less experience are most likely to be teaching at the start of Key Stage 2 in Year 3 (Figure 4.15).

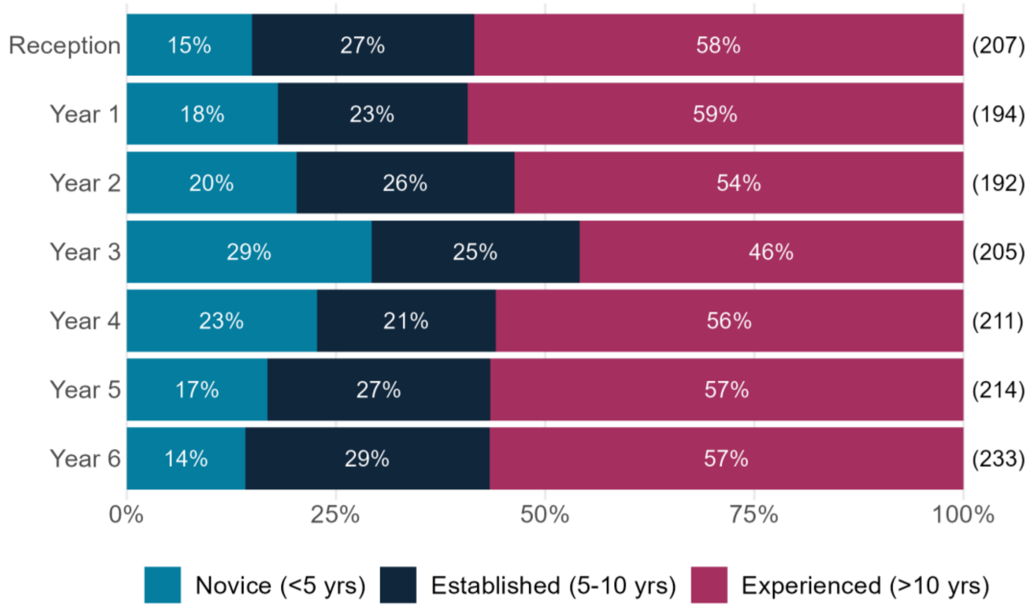


Figure 4.15 Experience level of primary teachers and year groups taught in current year.

Across the primary years, teachers report spending fewer hours teaching mathematics than English in a typical week (Figure 4.16). This is the case in every year of primary school, and most pronounced in Year 1, potentially due to preparing for the statutory phonics screening check. If this broadly reflects what happens in schools, the estimated effect is nearly 400 hours of additional English instruction compared to mathematics by the time pupils reach the end of primary schooling.

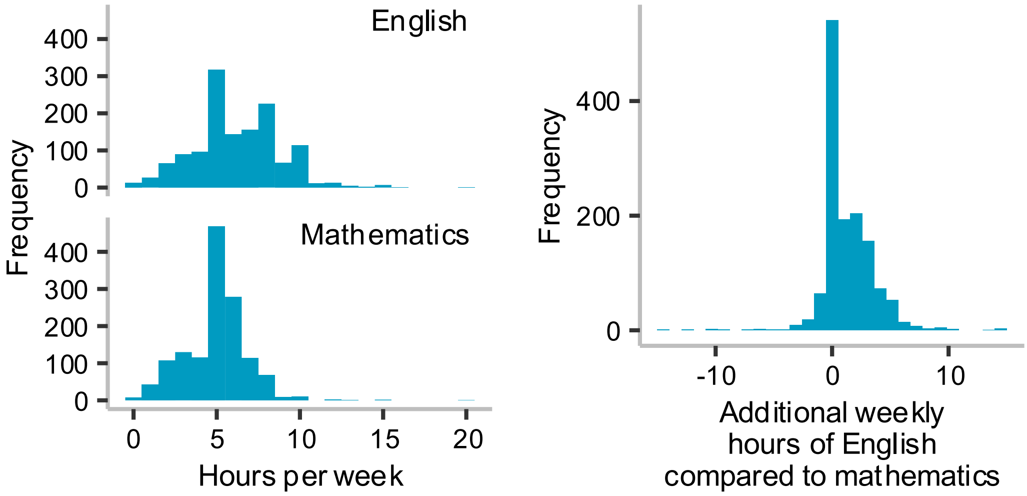


Figure 4.16 Weekly hours spent teaching mathematics and English reported by primary teachers.

Teacher subject knowledge

Despite the fact that 79% of participating primary teachers report that GCSE Mathematics (typically taken at age 16) is their highest mathematics qualification, most teachers agree that they have a strong understanding of the mathematics content that they teach to their current year group (Figure 4.17). Many are less confident that their understanding is strong for other year groups with just over half choosing ‘neither’, ‘disagree’ or ‘strongly disagree’. This raises questions about the breadth of teachers’ curriculum knowledge, understanding of where their teaching fits into longer conceptual and skill development, and has implications for schools in supporting the subject and pedagogic knowledge of teachers, particularly when they move to other year groups.

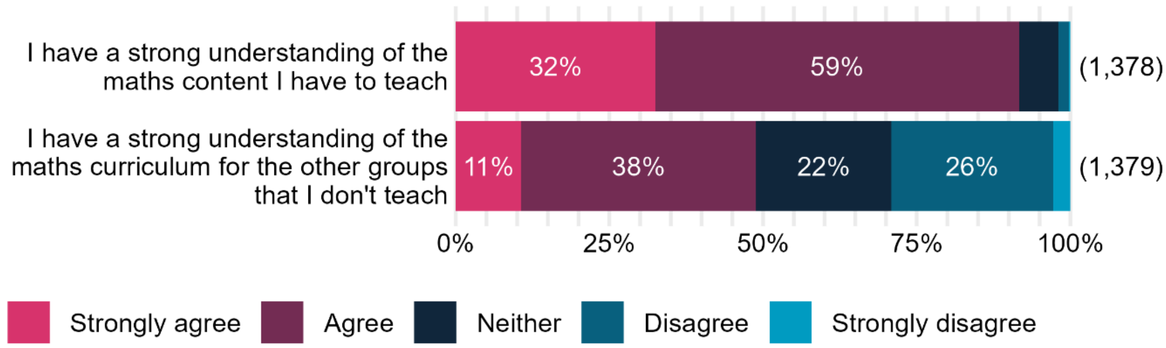


Figure 4.17 Primary teachers’ understanding of the mathematics curriculum content.

Enjoyment, motivations and workload

Figure 4.18 shows that the primary teachers in the study generally report enjoying teaching mathematics and feel confident doing it, with only a small number reporting this making them feel anxious.

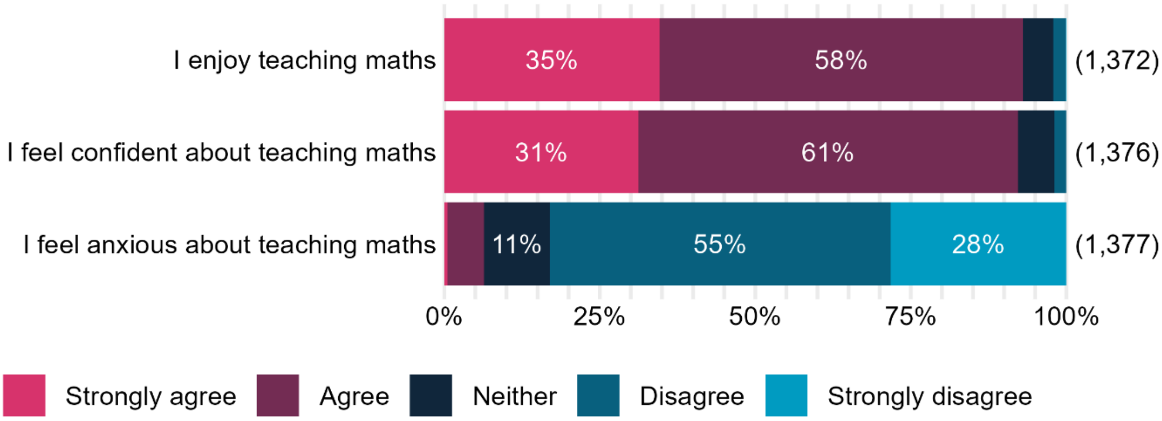


Figure 4.18 Teacher enjoyment, confidence and anxiety about teaching mathematics.

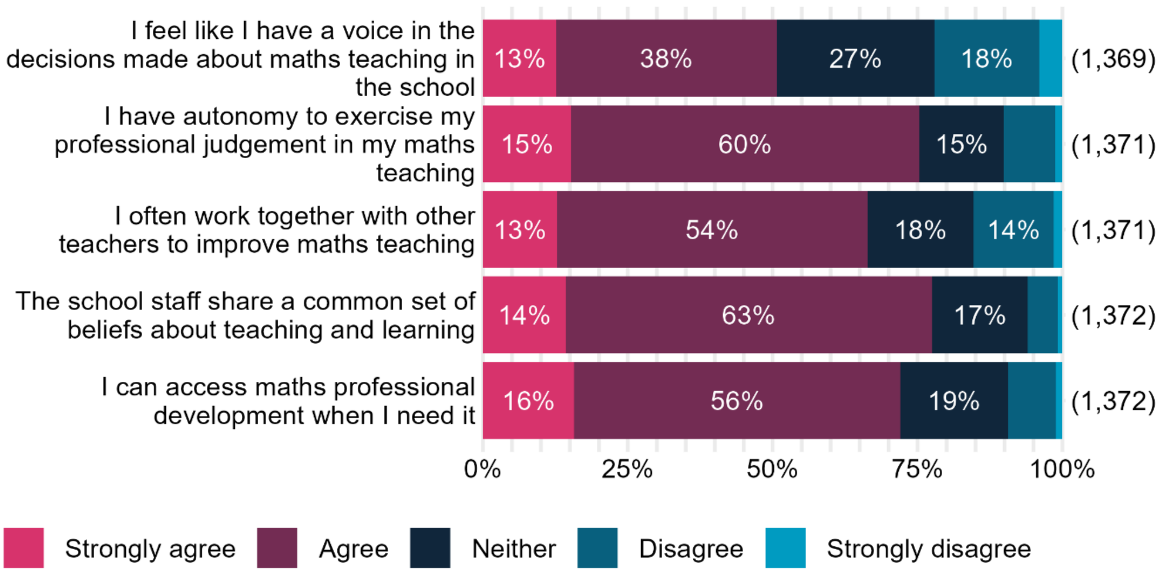


Figure 4.19 Teacher perceptions on their autonomy in teaching mathematics.

A very positive 90% ‘agree’ or ‘strongly agree’ that they do a good job teaching mathematics, and their views on their autonomy as a teacher are also positive (Figure 4.19). However, only 63% agree that they will still be in teaching in three years’ time. Whilst the reason for some might be retirement (although 83% were under 50 years of age) this is lower than expected given their general positivity and is perhaps reflective of their responses to questions about stress and workload. NfER[84] cited unmanageable workload as a key driver for teacher attrition, particularly amongst teachers of working age. In our study, over half of primary teachers reported finding the job stressful. 43% ‘disagreed’ or ‘strongly disagreed' that their workload was acceptable with indications that this is due to administrative work and, to a lesser extent, planning, as shown in Figure 4.20.

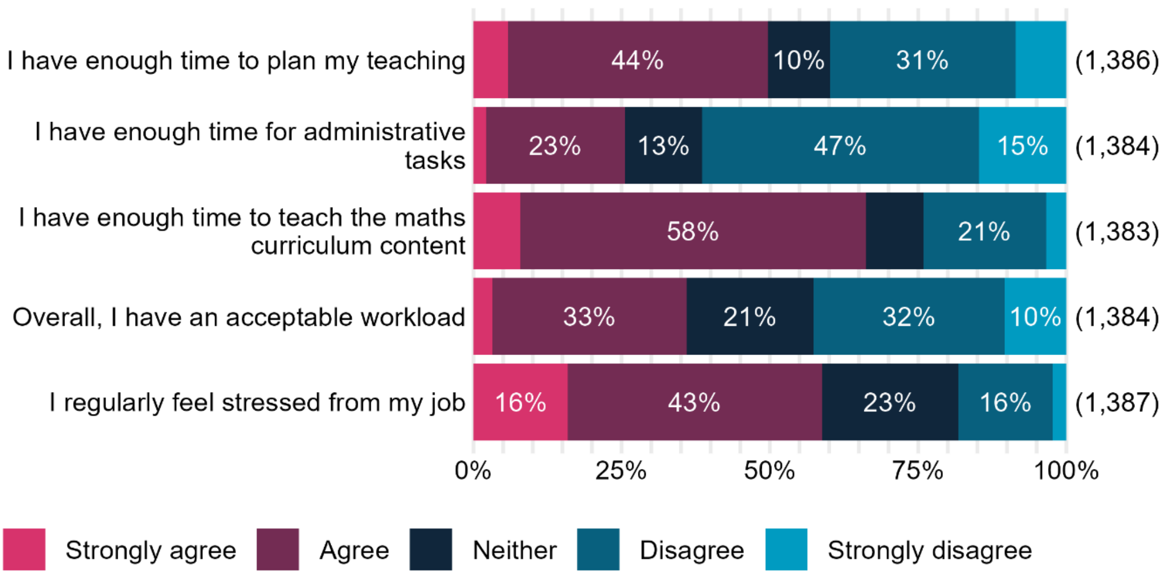


Figure 4.20 Primary teachers' views on stress and workload.

Consistent with teachers of mathematics in secondary schools, primary teachers cite wanting to make a contribution to society (91% rated this as 'high' or 'moderate' importance) as their reason for becoming a teacher. They also appreciate the job security teaching offers them (87% 'high' or 'moderate' importance) with few reporting becoming a teacher due to lack of alternative employment options (less than 10% said this had 'high' or 'moderate' importance for them). These results follow a similar pattern to teachers of mathematics in Key Stage 3[85].

Mathematics subject leadership

Nearly all (162 out of 174) of the mathematics subject leaders in participating primary schools completed a survey about mathematics education across the school. Leaders of primary mathematics are unlikely to be subject specialists in the way they are in secondary schools and Reception teachers are much less likely to be mathematics subject leaders than teachers of other year groups in their schools (Figure 4.21).

Subject leaders are less likely to be confident in their knowledge of how mathematics is taught in the earlier age phases with a small proportion stating that they are 'not at all confident' with early years mathematics, which none reported for the other age phases (Figure 4.22). As the survey was completed by the main subject leader in the schools, it is possible that some had two or more role holders to address this issue. Whether this is the case or not, it highlights an area for professional development for some mathematics leaders, particularly at a time when there is increasing focus on Early Years and transitions to Key Stage 1.

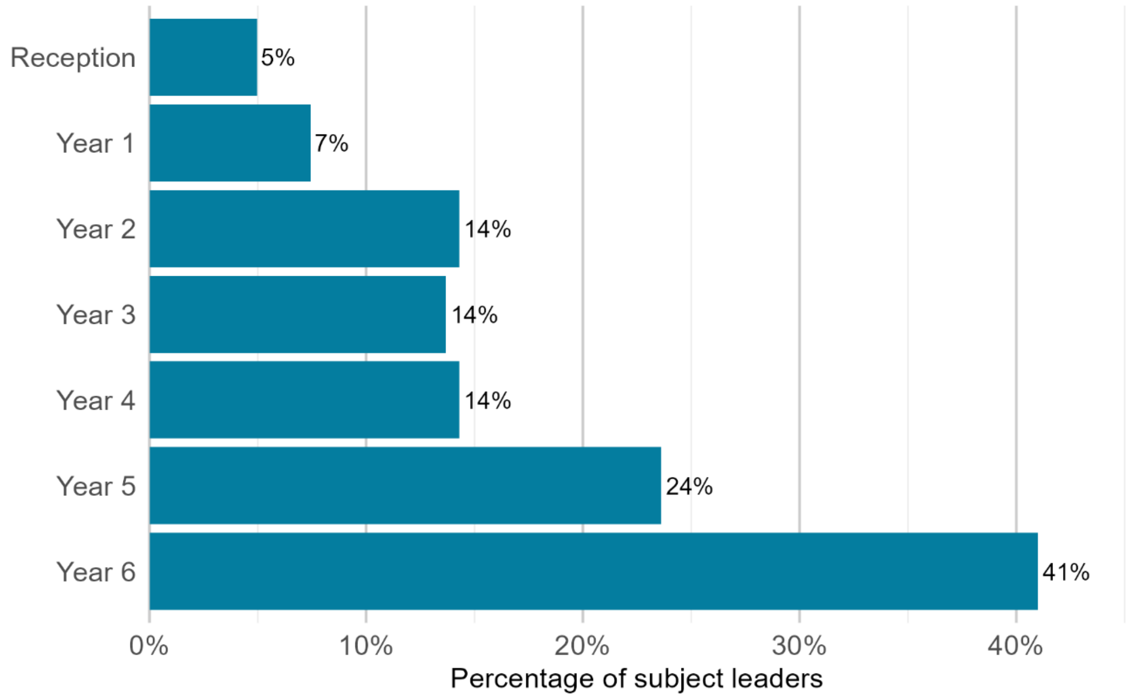


Figure 4.21 The year groups taught by primary mathematics subject leaders.

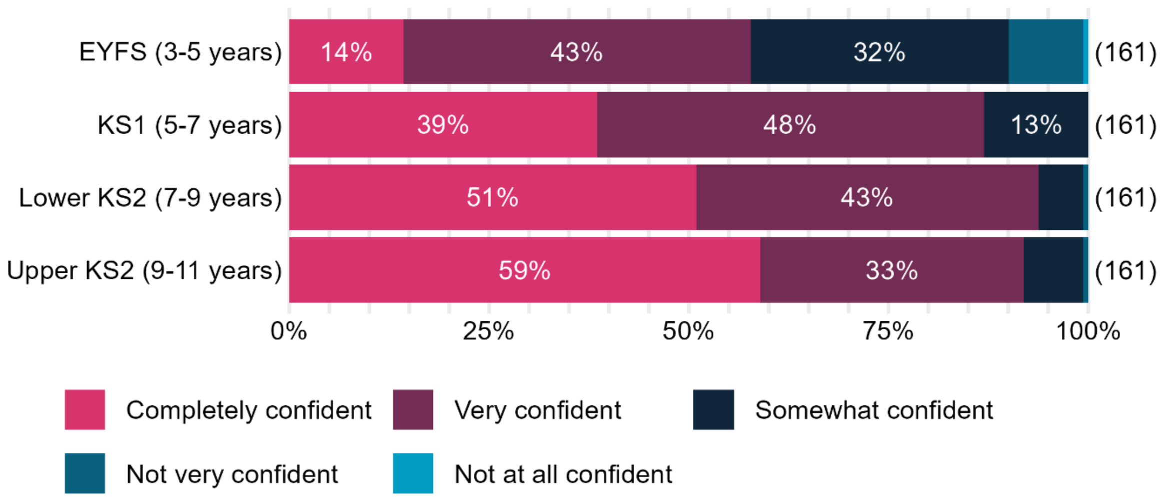


Figure 4.22 Mathematics subject leaders' confidence in their knowledge of how maths is taught in primary school age phases.

4.5 Summary and next steps

The findings outlined in this Section present a broadly positive picture of young children's attitudes and experiences of mathematics teaching at the beginning of statutory schooling. This is perhaps unsurprising given the positivity of young children in general, but we know that concerning differences in national assessments exist even at this young age. The EYFS Profile data has consistently shown a gap in mathematics attainment (Early Learning Goals) between children eligible for FSM and their peers[86]. This gap persists and widens throughout primary[87] and is particularly pronounced for children who remain eligible for FSM throughout. It will be important to identify how attitudes to mathematics change over time for different groups of learners and what social, pedagogic and institutional factors help to explain these changes.

The findings in this Section highlight variations in mathematics pedagogy in Reception classes and show that a small proportion of learners have less positive attitudes to mathematics than their peers even at this young age. Understanding what happens for this group in their mathematics education over time is a priority, as is understanding whether specific pedagogical approaches in Reception are associated with longer term attitudes, experiences and attainment for pupils. In 2025-26, the team will follow this cohort into Year 1 with surveys updated to reflect the kinds of educational changes pupils experience in these early years of primary schooling.

Section 5
Secondary mathematical education

Evidence
Excellence
Equity

5. Secondary mathematical education

5.1 Introduction

The transition to secondary school has been the topic of much debate over many years and it is at this point that the Observatory's secondary longitudinal study begins. The earlier Pipeline Report[88] noted important differences in progression from pupils from different backgrounds between the ages of 11 and 16. What that study, or other similar studies, has not been able to say is quite where and why those changes take place. In time, the Observatory's secondary longitudinal study will provide invaluable insights into how mathematical education through Key Stages 3 and 4 shapes learners' experiences, attitudes, attainment and progression.

In international tests, pupil performance in England compares well to those in comparable systems. The performance of Year 9 pupils has been stable since 2007 according to TIMSS (2023)[89] and 15-year-olds' performance has returned to previous levels following a spike in 2018 as reported by PISA (2022)[90]. The broadly consistent performance belies changing patterns in the data with a widening gap between the highest and lowest performing pupils reported in TIMSS and between boys and girls by both PISA and TIMSS[91]. It is important to note that these assessments measure different things with different pupils. In due course, the Observatory team will utilise the prior attainment measures and demographic variables in the National Pupil Database to understand the genesis of these and other patterns in the data.

Crucial to progression is the so called 'Key Stage 3 dip' in attainment which has been a recognised feature of England's mathematics education system in research and policy circles for decades[92]. This issue can get rather overlooked in the ebb and flow of interest between early mathematics and post-16 mathematics pathways, but Key Stage 3 is an important connector in the system. It is a period where changing pupil attitudes and behaviours shape outcomes and influence decisions regarding future study of mathematics and mathematically demanding subjects.

Year 7 marks the point at which pupils move from being taught by generalist teachers, with a broad understanding of individual children's strengths and weaknesses, to the more siloed secondary education where teachers typically have far greater specialism in the subject and spend much less time with each class. The question of teacher specialism and proportion of out-of-field teachers in mathematics has been a concern in recent years[93]. The distribution of out-of-field teachers and the relationship of this to school context is one of the issues that this longitudinal study is exploring.

This Section provides a brief overview of the attitudes of 25,437 Year 7 pupils (83.5% response rate), the curriculum and pedagogy offered to them by 693 (66.4%) of their teachers, and some more general issues relating to the current mathematics teaching workforce (1,043 teachers, 65.6%) in the 148 participating secondary schools. In contrast to the previous Section on primary mathematics in which social demographics were the main point of comparison for attitudes, this Section makes more use of the nested data structure to show that high-level descriptive statistics need to be examined at the level of school and classroom to better understand variations in pupil experiences and attitudes. This analysis will be combined with social demographic data in subsequent reports.

5.2 Attitudes and experiences in Year 7

Attitudes at transition

Given that pupils had only completed one term following the transition from primary school, the Year 7 survey began with broad questions about their experiences of mathematics at the start of secondary school. Figure 5.1 summarises participating pupils' views which were reasonably positive overall with 81% agreeing that they are *doing well in maths* in Year 7. Whilst the statements comparing current experiences to Year 6 are only a relative measure, around four in nine pupils (43%) reported *enjoying maths more now than I did in Year 6*, although one third (34%) reported the opposite view. Whilst three quarters (74%) agreed that they *learn new things in every lesson*, around one in eight pupils (12%) disagreed. Around two thirds of pupils (68%) agreed 'a little' or 'a lot' that they *understood topics before we move on*, leaving around one in seven pupils disagreeing with this statement. A key question for further exploration is which groups of pupils are represented in the 'disagree' statements.

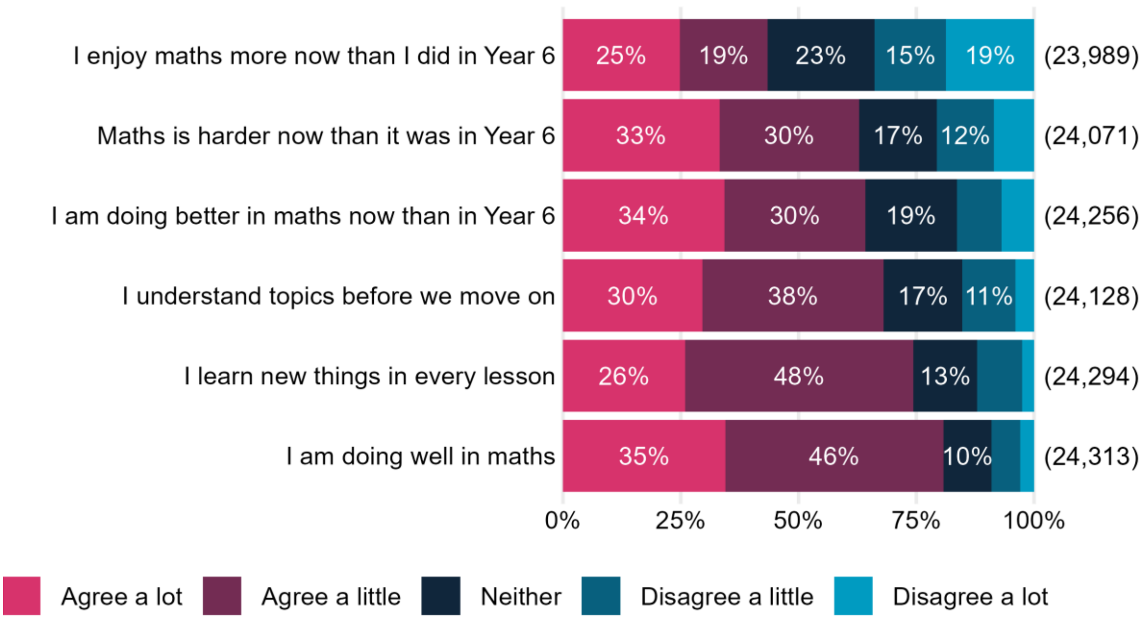


Figure 5.1 Year 7 pupils' views about school mathematics and self-assessments of their primary-secondary transition experience of mathematics.

Pupils' responses to four sets of questions formed scaled scores for key attitudinal measures: value of mathematics, confidence, enjoyment and anxiety[94]. In general, pupils in Year 7 held broadly positive attitudes to mathematics (Figure 5.2). Overall, the vast majority of pupils think mathematics is important with 87% attributing 'high' or 'somewhat high'[k] value to the subject. Seven out of ten pupils reported 'high' or 'somewhat high' levels of confidence in mathematics and 65% on the same categories for enjoyment. Underlying the broadly positive picture, there are indications that

[k] Computation of scaled scores is based on average item scores for each scale with responses assigned values of –2, –1, 0, +1 and +2. 'Low' refers to an average score below or equal to –1, 'Somewhat low' refers to an average score above –1 but below or equal to 0, 'Somewhat high' refers to an average score above 0 but below or equal to +1 and 'High' refers to an average score above +1.

mathematics learning can induce difficult emotions for some pupils. Two in five Year 7 pupils (40%) reported ‘high’ or ‘somewhat high’ levels of anxiety in relation to learning mathematics. As expected, anxiety is inversely correlated with confidence and enjoyment (c.f. the mirrored response distribution between anxiety and enjoyment). Given the association between attainment and mathematics anxiety[95], it will be interesting to understand patterns in the attainment and experiences of these pupils over time as the cohort moves through secondary education.

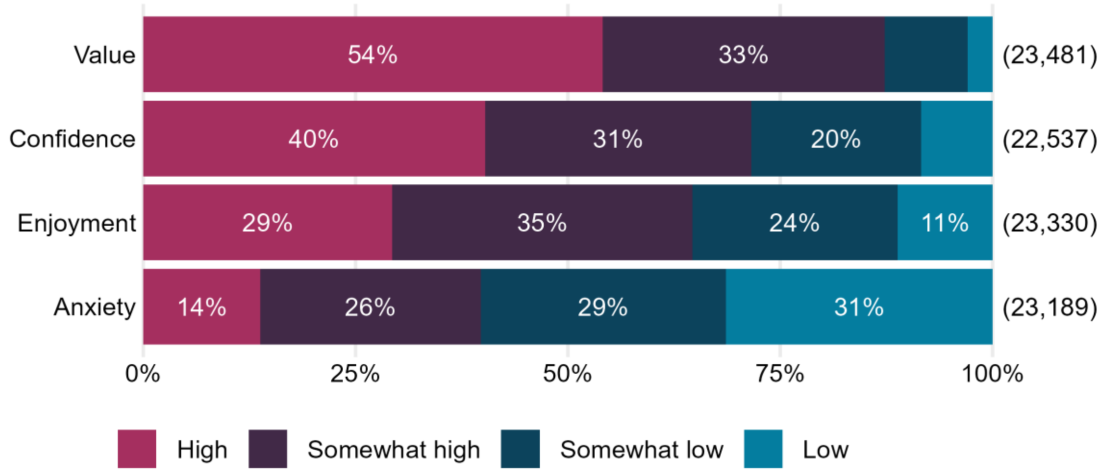


Figure 5.2 Year 7 pupils’ reported attitudes to mathematics.

Pupils’ classroom experiences of learning

Year 7 pupils were asked a set of questions about what typically happens in their mathematics lessons, and their responses have been ranked in Figure 5.3 according to the combined proportion of the following responses: ‘almost always’, ‘most of the time’ and ‘at least half of the time’. Just as the attitudinal items in the surveys are adapted from well-used scales, the items in Figure 5.3 have precedence[96] and have been used in several studies to differentiate broad types of classroom pedagogy. So, whilst pupil responses to individual items are interesting in their own right, there are more general patterns to note from grouping similarly oriented experiences together.

It is notable that the four practices most commonly reported by Year 7 pupils are what might be termed teacher-centred, whereas the four least reported classroom practices are more learner-centred. Teacher-talk, teacher modelling of a preferred method and working through exercise sets are the most common approaches to mathematics teaching according to Year 7 pupils. Less commonly, pupils report that teachers encourage the discussion of mistakes and pupils’ ideas. Practices which are more connectionist[97] in nature seem less commonplace (comparing methods and linking topics) and are about equally likely to be reported as happening ‘almost always’/’most of the time’ as ‘some of the time’/’never’. For comparison, these types of practices are more commonly reported by Year 12 A level Mathematics students (see Figure 6.7). It is possible that different forms of teacher-talk are experienced in higher attaining classes or with teachers of differing levels of experience. With further analysis by prior attainment and by teacher experience, it will be possible to test hypotheses such as these.

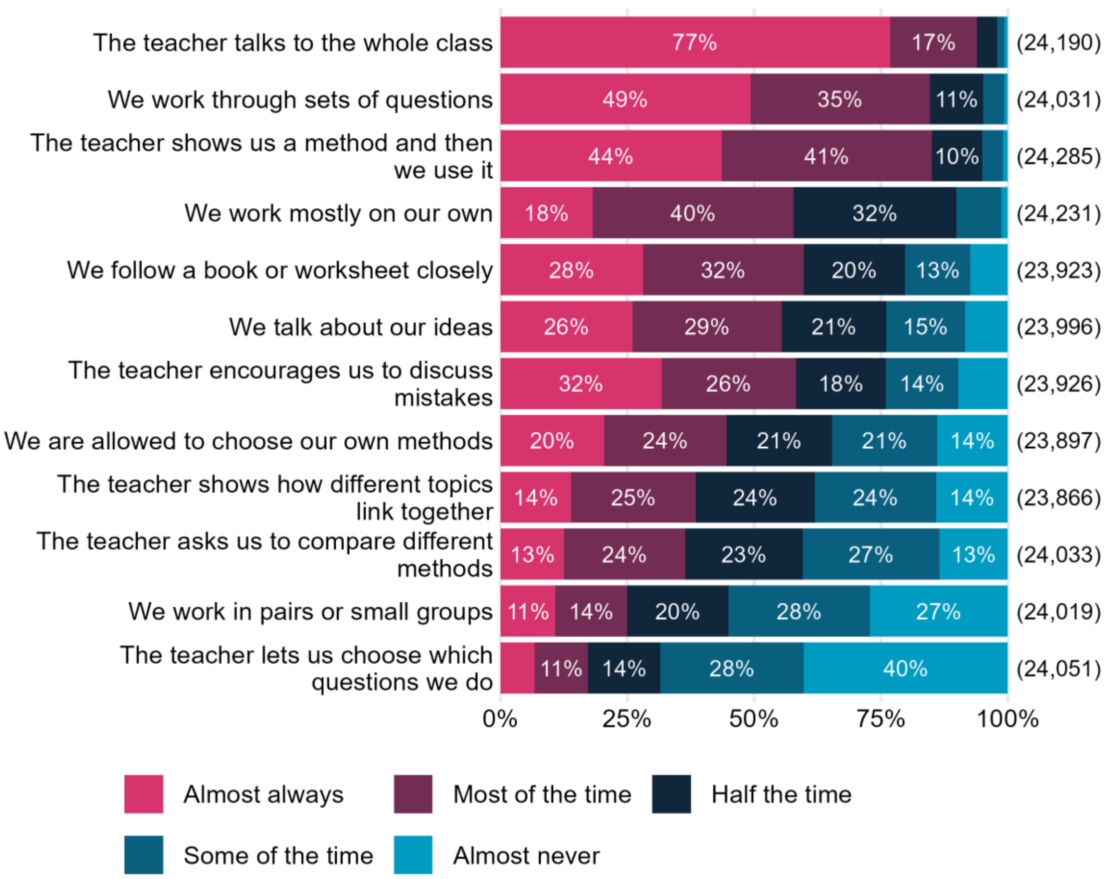


Figure 5.3 Year 7 pupils' reported experiences in mathematics lessons.

Some of the statements reflect aspects of Teaching for Mastery pedagogies advocated by the NCETM and England's Maths Hubs, including the focus on whole class teaching and pupil talk[98]. It seems that there is considerable variation reported by pupils in the use of these teaching approaches. Moreover, there are indications of areas for potential improvement in Year 7 teaching such as in developing a clearer understanding of the interconnected nature of mathematics where one in seven pupils report that their teacher 'almost never' *shows how different topics link together.*

Learning mathematics outside school

In addition to their classroom learning, Year 7 pupils were asked about learning mathematics outside of school lessons (Figure 5.4). The majority of pupils (81%) reported getting help from their family (31% of them 'often') or the internet (67%). Just under half (42%) reported working with friends at least 'sometimes'. Only 13% of pupils reported having a private tutor but the numbers are expected to increase as the cohort progresses towards GCSE examinations.

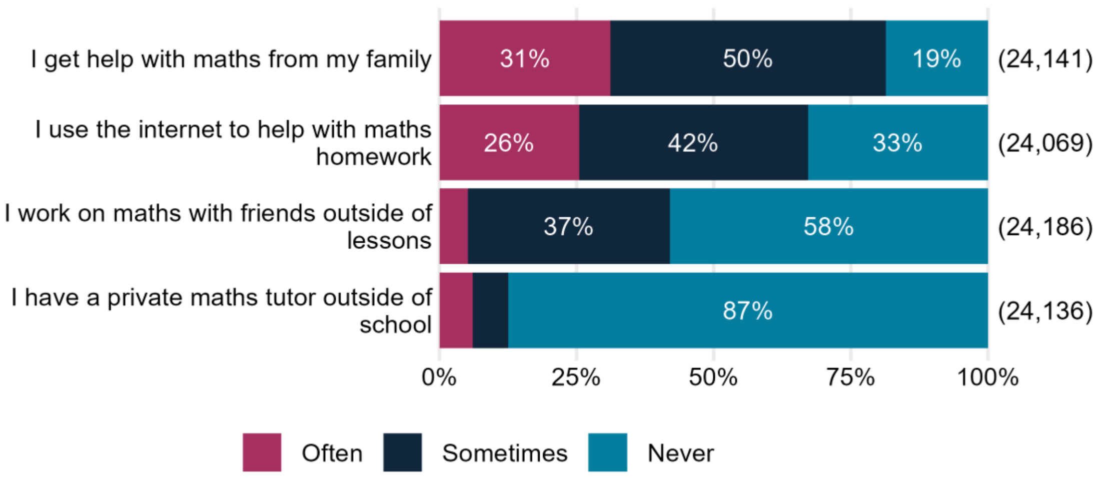


Figure 5.4 Year 7 pupils out of school mathematics learning.

5.3 Curriculum and teacher pedagogy in Year 7

Analysis of mathematics curriculum and pedagogy in Year 7 combined evidence from the pupils together with a pedagogy survey with Year 7 teachers of mathematics (693 responses) and a survey of Head of Mathematics (141 responses). The pedagogy survey explored general approaches to planning and pedagogy but, given the acknowledged differences between teachers' espoused and enacted practices[99], the survey also included specific questions about the last lesson taught (similar to the 'target class' questions in TALIS 2018[100]). Responses regarding these 693 Year 7 lessons are influenced by the timing of the survey, but it is instructive, nonetheless.

A snapshot of Year 7 lessons

The 693 teachers of Year 7 reported how much lesson time comprised teacher instruction, in some cases interspersed with short pupil activities. There was considerable variation across the lessons. Half of lessons comprised 35-60% of the time on teacher instruction, but one in ten lessons used less than 25% of lesson time in this way and another one in ten lessons used over 70% of lesson time on whole class instruction. This broadly accords with how pupils reported their experiences of classrooms and helps explain how they can be discussing their ideas often but working in pairs and small groups less frequently.

Teachers were asked to describe the main topic of their last Year 7 mathematics lesson. 578 teachers responded to this open response question. Of the mathematics subject content areas in the National Curriculum, almost half of all these lessons focused on number (51%), followed by algebra (24%), geometry and measures (17%) and statistics (4%). The National Curriculum introduces two 'new' content areas at Key Stage 3, but only a small proportion of the lessons at the time of the survey focused on each of these areas: 2% of lessons on ratio, proportion and rates of change, and 1% on probability. Just 3% of all lessons were related to problem-solving, almost all of which were in the context of number.

Teachers reported using presentational software during almost all the lessons (84%) and a whiteboard or chalkboard in around two-thirds of lessons. The government-funded provider for teacher professional development (NCETM) encourages the use manipulatives and representations in Key Stage 3[101]. Teachers reported using representations in just over half the lessons (52%) and manipulatives much less often

(7% of lessons), suggesting that there are barriers to their use. Further investigation in the Observatory case study schools is aiming to shed light on this.

Schemes and grouping

Heads of Mathematics reported on the scheme of work used in Key Stage 3 in their schools (Table 5.1). In around two fifths of schools, the Head of Mathematics reported that their scheme for Key Stage 3 was developed in-house by the school, either entirely (29%) or based on an examination board scheme (10%). This is a much greater proportion of schools than the 11% of primary schools not using a published scheme.

Scheme	Proportion
School developed scheme	39%
White Rose Mathematics	20%
MAT developed scheme	14%
Ark Mathematics Mastery	11%
Sparx	5%
Other	12%

Table 5.1 The main scheme of work used by schools at Key Stage 3 as reported by the Head of Mathematics (N=140).

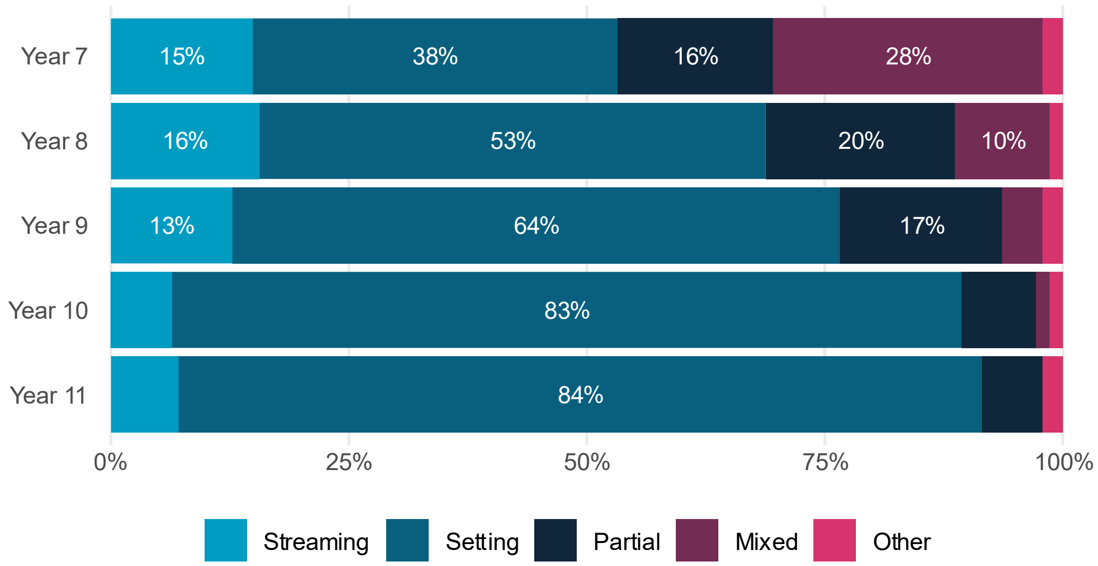


Figure 5.5 Grouping practices in Year 7 to Year 11 mathematics in secondary schools.

Around three in ten schools (28%) had mixed attainment classes in Year 7 with 69% using some form of setting or streaming[i]. This is a marked difference from the 13% of primary schools who reported setting in Year 6. According to current reported grouping practices in these schools, the cohort is likely to experience increased attainment grouping as they progress through Key Stage 3 and 4 with a marked decline in the use

[i] Mixed: all classes include full range of attainment; Partial: some classes grouped by attainment, such as a top and/or bottom set, but others broadly mixed attainment; Streaming: attainment classes grouped for multiple subjects.

of mixed attainment grouping apparent through Key Stage 3 in the sample schools (Figure 5.5).

5.4 Teachers of mathematics

The Observatory has previously published a report on the mathematics teacher workforce in Key Stage 3[102]. The use of out-of-field teachers at this Key Stage has been a cause of concern in the past and there is no analysis that we know of that explores the relationships between teacher deployment in early secondary with pupils' engagement and progress. In that earlier report we noted that teachers allocated to Key Stage 3 classes are generally less experienced and less well-qualified in mathematics than those who only teach older year groups, which is probably not surprising given the historical challenges of teacher recruitment in England. In line with primary teachers, Key Stage 3 teachers of mathematics reported that they overwhelmingly enjoy teaching the subject and the majority believe that they have sufficient autonomy as teachers.

In what follows we set out some of the key features of the survey of teachers of mathematics across the sample of schools, including those in 11-16 and 11-18 schools, but not those in sixth form colleges. For secondary teachers of mathematics, as for primary colleagues in Section 4, their motivations to teach are mostly influenced by a strong sense of civic contribution - something which features in teacher training advertising campaigns - and job security (Figure 5.6). The 'teaching schedule' of the working week and holiday patterns is also appealing for many and it is clear that having inspiring teacher role models and mentors also plays its part.

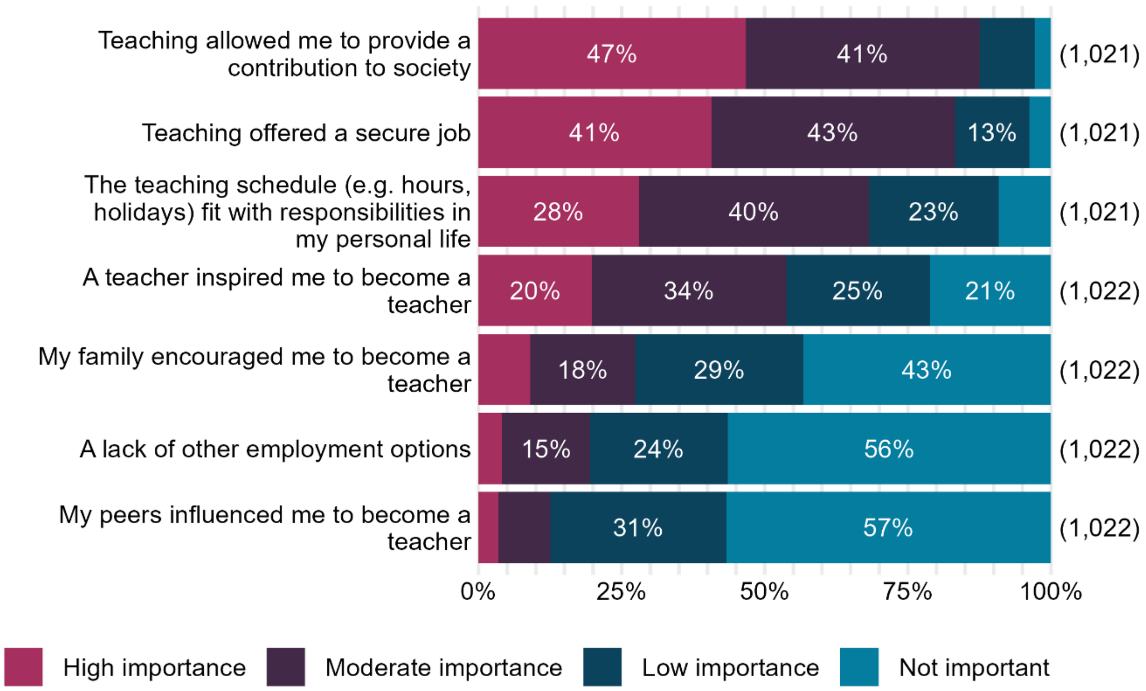


Figure 5.6 Secondary school mathematics teachers' reported reasons for becoming a teacher.

For our sample of secondary teachers of mathematics, just over half report that their highest mathematics qualification is an undergraduate degree (47%) or postgraduate degree (8%). Around one third have an advanced level mathematics qualification at AS (2%) or A level (30%) and a much smaller number (8%) report that GCSE Mathematics is their highest subject level qualification. Many of those with advanced mathematics qualifications have proceeded to undergraduate study in a range of STEM and non-STEM related degree subjects. Figure 5.7 shows that teachers of mathematics with these various levels of mathematics qualification are not evenly distributed through the school system, though exactly what the implications of this are for different groups of learners is unclear.

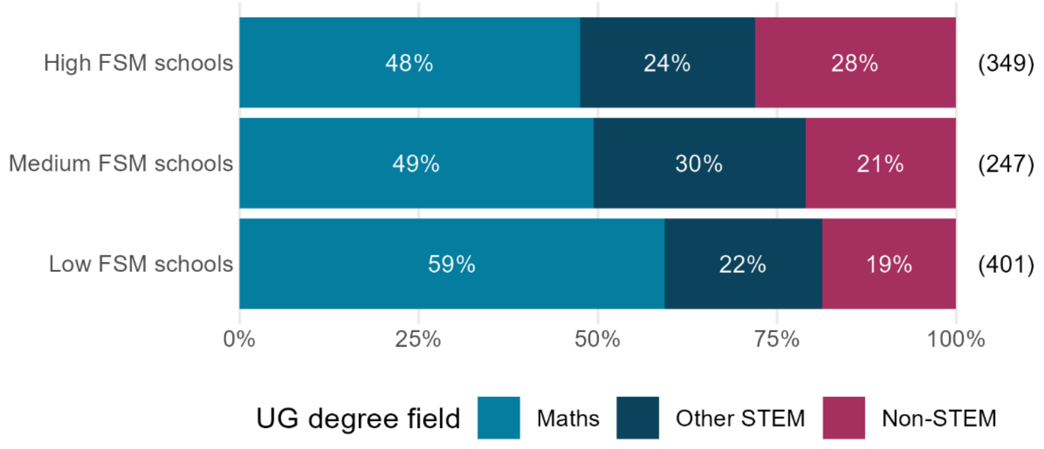


Figure 5.7 The undergraduate degree field of teachers of mathematics in schools with high, medium and low proportions of pupils eligible for free school meals.

Heads of Mathematics in secondary schools are broadly consistent in reporting the challenges of recruiting teachers. Only 12% of them agreed that it was easy to recruit teachers and 75% of them 'disagreed' or 'strongly disagreed'. Around three-quarters of the participating schools had vacancies for teachers of mathematics in the last year (nearly 200 vacancies between them) and on only 20% of occasions did Heads of Mathematics consider there to be more than one appointable candidate following interviews.

Workload, enjoyment and professional development

Teacher workloads have been increasingly under the spotlight in recent years. As with primary teachers, secondary teachers of mathematics were more often positive than not about having sufficient time to teach the curriculum and around half reported having *enough time for planning*, but many felt the administrative burden of teaching more heavily (Figure 5.8). Over half (53%) 'agreed' or 'strongly agree' that the job was stressful, compared to 40% who 'disagreed'. That said, a surprising number reported having paid roles in education outside of school, mainly relating to assessment marking (13%) and private tuition (12%).

Teachers reported having experienced reasonably high levels of professional development over the previous two years, focused mainly on *general pedagogy* (75%), *maths pedagogy* (70%), *maths curriculum* (63%) and *subject knowledge* (55%). In terms of the professional development needs (Figure 5.9), the clearest demand reported by this large group of secondary teachers was regarding the *use of digital technologies in maths* which only 12% of teachers said they had 'no need' for at present. This suggests that teachers are aware of the potential but currently feel ill-equipped to utilise digital technologies in mathematics teaching and learning, providing evidence that this might be a priority area for development in departments, MATs and for providers such as Maths Hubs.

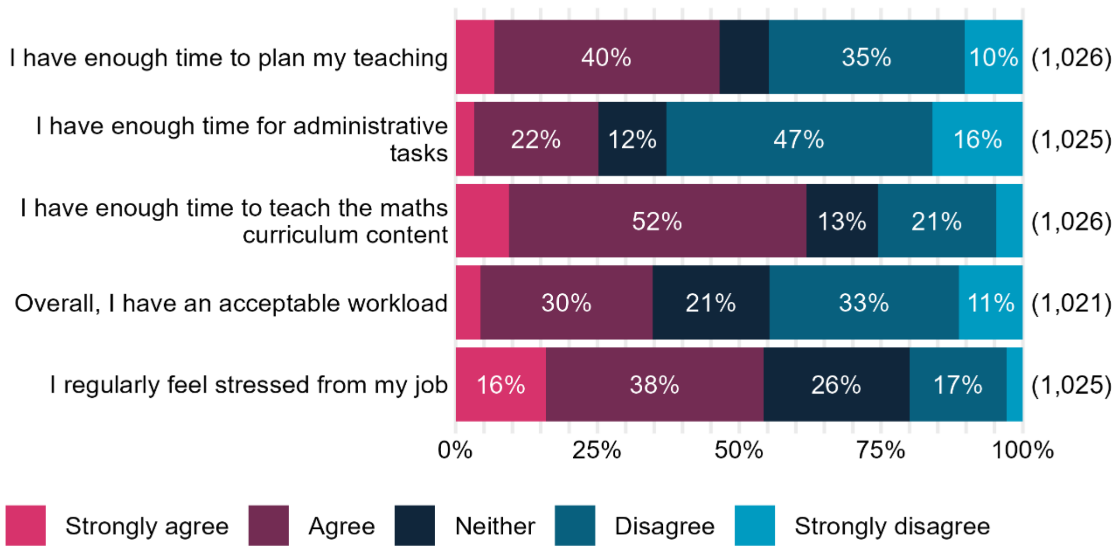


Figure 5.8 Secondary teachers of mathematics views on workload and time.

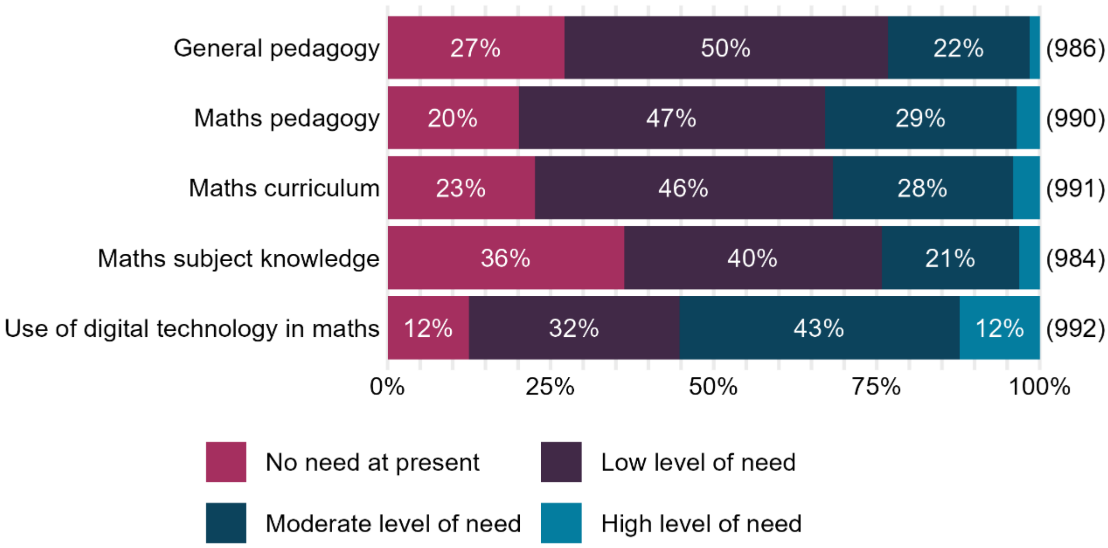


Figure 5.9 The professional development needs reported by secondary teachers of mathematics.

5.5 Exploring variation between schools

So far in this Section, findings have been reported as aggregated statistics, but this takes no account of the differences *between* schools, something which Attainment 8 and Progress 8 – and the earlier Value Added and Contextual Value Added measures – seek to measure[103]. And those measures can tell us nothing about the variation between classes *within* schools.

In due course the Observatory team will aim to better understand the contributions of policies and practices at different scales to pupils' attitudes, experiences, attainment and progression. Here we exemplify this by exploring patterns in the data across the full sample of 148 schools, and then in a smaller sample. The aim herein is not careful modelling and inferential statistical analysis, or attribution of causality between practices and attitudes, but rather to highlight the challenge of understanding the system.

Figure 5.10 shows variation in levels of pupil confidence in the participating cohort study schools. Fifteen of these schools are case studies, which the team has visited to observe lessons, interview teachers and the Head of Mathematics. Initially these case studies had an exploratory function, informing the design of research instruments. As time progresses, and with a growing database, we are now pivoting to use these schools in a more explanatory way to help explain the trends seen in the full dataset. For example, how does careful analysis of school cultures, policies and practices help to explain patterns in pupil confidence?

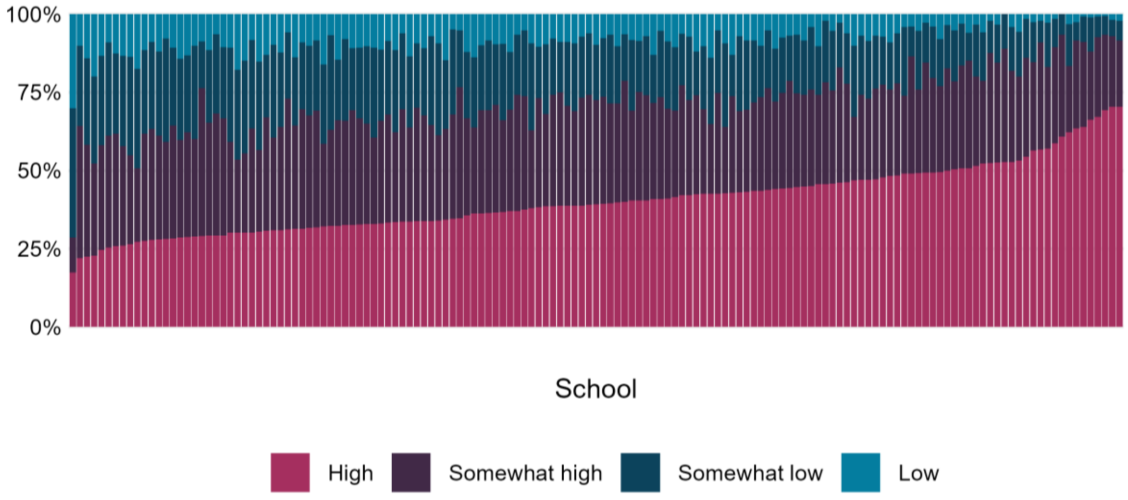


Figure 5.10 Range of confidence measures for pupils in participating secondary schools[m].

The measures of pupil confidence for the fifteen case study schools can be seen in Figure 5.11. In reading these - or any other of the measures of pupil attitudes and experience - it is all too easy to make assumptions about what might be happening in these schools, or the communities served by them. Such assumptions are often misleading. For example, the three schools with highest proportions of FSM eligible pupils are 207, 222 and 293, whilst the three with the lowest proportions of pupils eligible for FSM are 270, 235, 304.

To illustrate the importance of examining the data at multiple scales consider two of the schools in which confidence levels are in the middle and lower end of this distribution. At Tunney Academy (222) 69% of pupils report 'high' or 'somewhat high' levels of confidence compared to 61% at school Eastmont Academy (207). Looking at the class level (Figure 5.12) one can see the variation between classes in each school. Both schools use some form of attainment grouping and although the numbering system in the figures does not imply the grouping structure, the contrast between 222-7A and 222-7F at Tunney, for example, is striking and suggestive. It is also worth noting that apparent differences between schools can sometimes be the result of just one or two classes being different to the remainder.

Below are two brief vignettes of Eastmont and Tunney Academies, abridged versions of much longer and richer case studies. They shed some light on each school and what might explain the patterns seen in the survey data.

[m] Schools with fewer than 30 pupils are omitted.

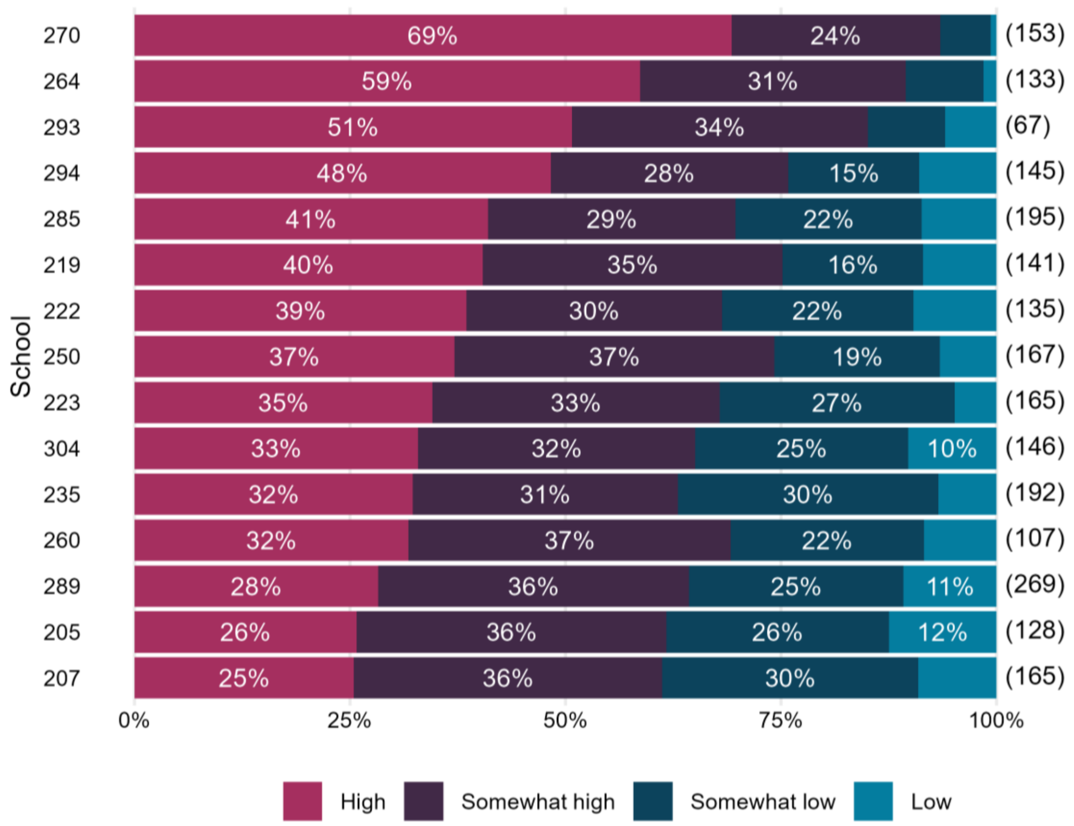


Figure 5.11 Pupils reported levels of confidence in mathematics in fifteen case study schools.

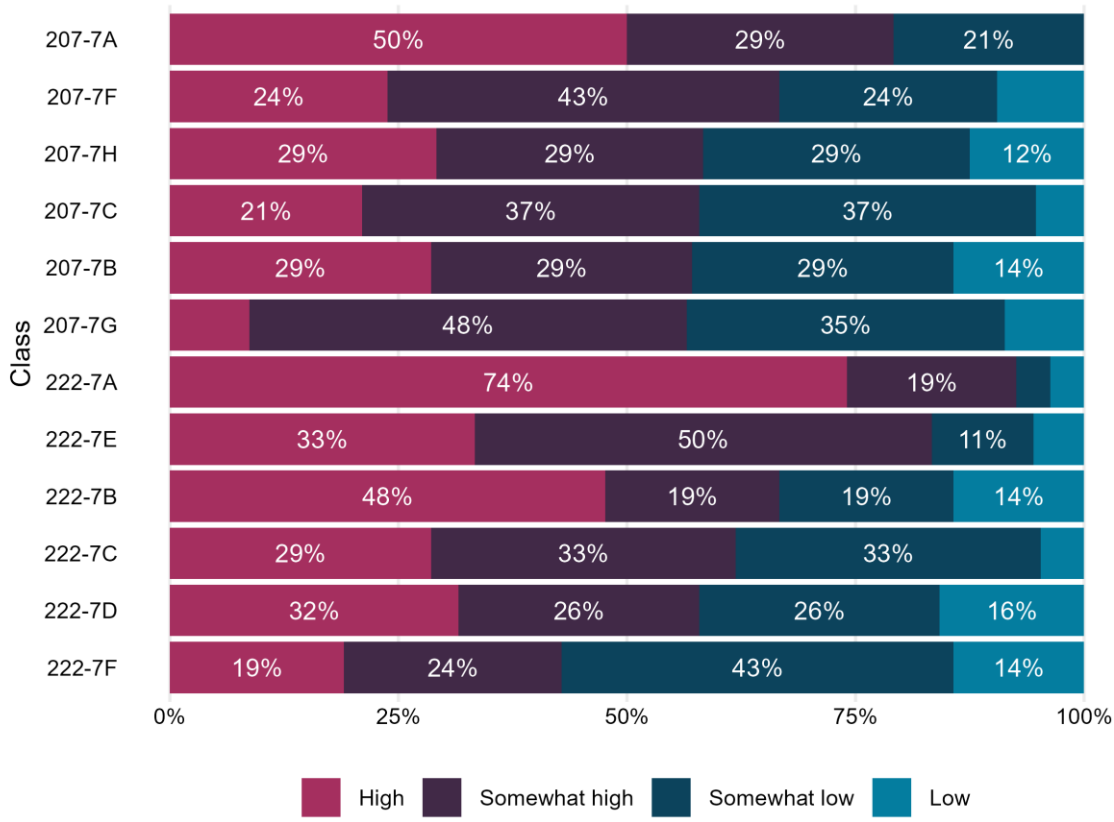


Figure 5.12 Pupils confidence in mathematics, aggregated for each class in Eastmont (207) and Tunney (222).

Eastmont Academy (207)

Eastmont Academy is a medium-sized 11-16 urban secondary school and part of a multi-academy trust. Year 7 pupils are streamed by attainment in mathematics and English. The school use Ark Mathematics Mastery and a partially adaptive assessment system as recommended by the MAT. The Head of Mathematics is aiming to achieve a consistent approach to teaching mathematics that is "*very similar in terms of its information, check, check, check…new piece of information, check, check, check …adapt the question check, check, check.*" Whiteboards are used to provide immediate "*active feedback*" to enable teachers to adapt their teaching. Lessons begin with a retrieval task, and all lessons involve the Ark Mastery talk tasks. Pupils in different classes report different levels of paired or groupwork and of opportunities to talk. Most pupils reported that they were doing well in mathematics and that the mathematics was harder compared to Year 6. There was wide variation in pupils' reported confidence between classes and some differences in the pedagogies reported by pupils in different classes. The Head of Mathematics reported that they have been able to appoint fully qualified teachers to recently advertised posts. The department uses a MAT-led coaching programme with additional professional development provided by the Head of Mathematics and another teacher on a weekly basis. Each teacher has a dedicated hour for planning each week.

Tunney Academy (222)

Tunney Academy is a medium sized 11-16 urban secondary school and is part of a multi-academy trust. At the beginning of Year 7, the pupils are grouped into seven attainment groups. The school uses a scheme of work and assessment system developed by the MAT. The Head of Mathematics reported that lessons are '*very regimented here, very structured'* and '*every single lesson follows the same routine and the same expectations and the same everything.'* Lessons are centrally planned and follow a standard structure, beginning with a common retrieval worksheet, followed by a teaching sequence using a 'I do, we do, you do' format. Teachers and pupils reported limited opportunities for paired or group work. The Head of Mathematics expressed a desire to provide more paired work but felt that disruptions to staffing hindered this. Most pupils reported that they were doing better in mathematics compared to Year 6, and most also reported that the mathematics was harder. Levels of confidence and pupil-reported pedagogy varied greatly between classes. Teacher recruitment has improved recently. The school is part of a school-led initial teacher training programme, which they consider enables new teacher recruits to be aligned to the school's practices and ethos. The school is well-connected to their local Maths Hub, and the MAT organises a biannual meeting for school Heads of Mathematics. The school's senior leadership team carry out weekly learning walks, adopting a whole school approach to school improvement with a common focus across all subjects.

Further analysis of these case studies can happen in different directions in accordance with approaches to mixed methods research paradigms. This Section began with the full dataset and tens of thousands of pupils, before zooming in to fifteen schools for which there is much richer data, and then into the classes within them, some of which have been observed. Alternatively, one might build hypotheses by starting from the case studies conducted through visiting the schools and interviews with teachers and leaders and then using the wider dataset to provide evidence to confirm or refute each hypothesis across a broader representative sample of schools.

To take an example, the brief descriptions of Eastmont and Tunney Academies above suggest that some teachers at Eastmont use much more paired and group work in their lessons than others; at Tunney this is not a typical part of classroom practice. Figure 5.13 shows pupils' views on how frequently they work *in pairs or small groups*. On this aspect of classroom pedagogy, the culture in these schools appears very different and very much in line with that reported by teachers and Heads of Mathematics. It is interesting to note that despite the centralised lesson structure and 'regimentation' in pursuit of consistency described at Tunney, the levels of confidence reported by pupils vary considerably.

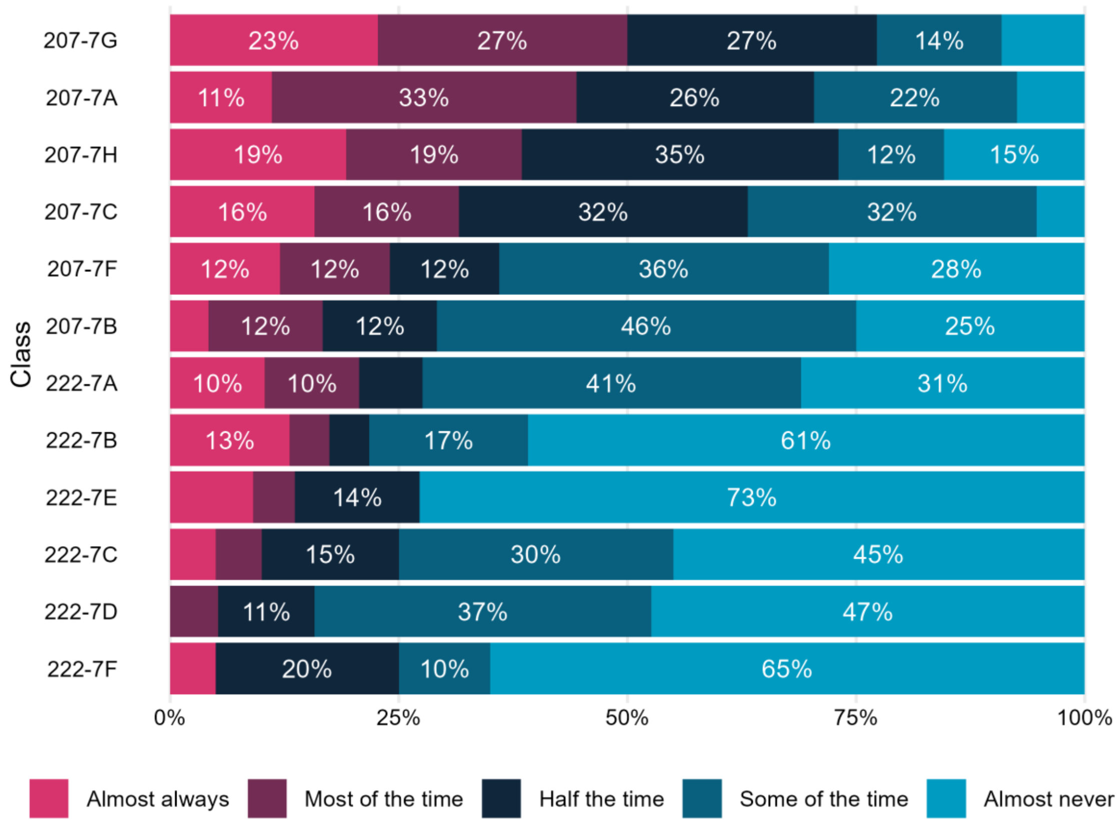


Figure 5.13 Pupils' responses to 'we work in pairs or small groups' grouped at class level in Eastmont (207) and Tunney (222).

5.6 Summary and next steps

Whilst most Year 7 pupils are generally positive about their confidence, enjoyment and valuing of mathematics in the secondary cohort study schools, many report some anxiety about their mathematics learning. Most pupils view the differences between Year 6 and Year 7 mathematics positively (more so for challenge and success than for enjoyment). Many have been placed into some form of attainment classes in Year 7, having typically been in mixed attainment classes (probably in within-class attainment-based groups) in Year 6.

The next steps will be to better understand patterns in pupils' reported attitudes and experiences and then using linked NPD data to investigate the extent to which these can be predicted by social background (e.g. FSM eligibility, sex, ethnicity and SEN status), prior attainment at Key Stage 2, and school and classroom practices. Furthermore, the Observatory team will identify schools which buck trends (positively) for different pupil groups and use these to understand the conditions that seems to be supporting better learning trajectories in mathematics.

Forthcoming pupil surveys in Years 8 and 9 will be similar to those used in Year 7 so enabling the team to explore changes over time, in particular the attitudes and experience of different subgroups of pupils. Those who did not meet the expected standard in the Key Stage 2 SATs as well as the highest attainers can both be tracked to investigate the progression patterns and better understand their various experiences. There is currently no standardised assessment point at the end of Key Stage 3 and the team is investigating the potential for generating this data so that we can better understand pupil attainment trajectories across Key Stages 3 and 4.

Section 6
Advanced and higher mathematical education

Evidence
Excellence
Equity

6. Advanced and higher mathematical education

6.1 Introduction

Compared to the pre-16 phases, the post-16 mathematical education landscape is a more complicated system due to its multiple pathways, qualifications, transitions and contexts. That said, there is much to celebrate: A level Mathematics remains the most popular A level with 105,755 entries in 2025, up 4.5% from 2024[104]. There was also 7.5% growth in A level Further Mathematics with 18,730 entries in 2025. Core Maths entries also increased in 2025 by almost 20% to 15,316[105], with specific additional government funding for level 3 providers for each student enrolment (see Section 2).

For most students, however, the 16-18 phase contains no formal mathematical qualification though many A levels in other disciplines require mathematical knowledge and skills. The Royal Society's 2024 report *a new approach to mathematical and data education*[106] highlighted the need to review and redesign 16-18 mathematics pathways. The report proposed a flexible system that would enable learners to develop, as appropriate to their needs and interests, mathematical knowledge and quantitative literacy in the context of mathematics and its application to other subjects.

Post-18, the uptake of degrees in the mathematical sciences remains a concern despite the popularity of A level Mathematics. While some larger institutions have increased their market share of students, others are closing mathematics programmes and departments. Overall higher education funding pressures, largely caused by tuition fee income not keeping pace with inflation for home students, and international student fee income being restricted as the government tries to reduce immigration, means mathematics is not alone in experiencing funding pressures.

The Observatory's research shows that 47% of Year 12 teachers only encourage students on track for at least a grade A in A level Mathematics to apply for mathematics degrees; while 28% believe it is essential for students to be studying A level Further Mathematics. These perspectives are particularly unhelpful for lower tariff mathematics programmes that are typically found in post-92 institutions.

The Observatory's report on the mathematics degree landscape in England and Wales[107] highlights a strong correlation between entry qualifications and department size and, therefore, the amount of module choice available to students. There is also variation in terms of curriculum, pedagogy and assessment between programmes. If the mathematical community can better articulate these differences, then more students may find a programme that attracts them to undergraduate mathematics study. This would also underline the cost of closing programmes, in terms of reducing variety of provision.

6.2 Advanced cohort study

Year 12 is a key point in the education pipeline. For the first time students can opt-in or opt-out of mathematics education. For those that opt-in to A level Mathematics they may also have the option to opt-in to A level Further Mathematics. There is greater diversity of provision with some continuing to study in 11-18 schools and others enrolling in 16-18 colleges.

The transition to Year 12 sees gender gaps appear in participation and attainment (see Section 3). Mathematics participation and attainment at A level is also predicted by strong GCSE grades, more commonly achieved by students with higher socio-economic status, for example. Understanding how these patterns are related to individual attitudes, classroom practices and policy decisions at institutional and national levels is the focus of the Observatory's advanced cohort study.

In 2024-25 the advanced cohort study included an online survey of Year 12 A level Mathematics students and an online survey of their teachers. Table 6.1 gives an indication of the scale of the study. Most respondents (65%) are in 16-18 colleges but 11-18 schools comprise 65% of participating institutions. See the technical report[108] to understand the representativeness of the sample[n]. Interestingly, the gender participation gap is more extreme in colleges, though the reasons for this need further investigation. Entry grades and A level Further Mathematics participation (21% of respondents) are similar between the two types of institution. A total of 460 of their teachers responded to the survey, 60% of whom teach in schools.

Institution type	Student survey responses	% female / male / other term	% GCSE Maths grade 9 / 8 / 7 / 6 or lower	Number of institutions	Mean/median responses per institution
16-18 colleges	4,661	36 / 61 / 3	32 / 36 / 26 / 7	42	111 / 92
11-18 schools	2,515	42 / 56 / 2	32 / 39 / 23 / 6	77	33 / 22
Total/overall	7,176	38 / 59 / 3	32 / 37 / 25 / 6	119	60 / 36

Table 6.1 Number of respondents to the Year 12 A level Mathematics student survey and some of their characteristics, both overall and by institution type.

The Observatory recently published a report[109] on what motivates Year 12 students to choose A level Mathematics. Around 60% of respondents cited the encouragement of parents, compared to 50% for the encouragement of teachers and only 23% reported being influenced by their friends' choices. Around half of respondents had attended extra-curricular activities such as summer schools, maths challenges or university visits. Over 90% of respondents report that they think A level Mathematics will look good on future university or job applications, with it being an essential requirement for 73% of their future plans. It will be interesting to see whether these plans have changed when we survey them in again in Year 13.

This Section proceeds by summarising the attitudes of Year 12 students to mathematics, their experiences of learning mathematics in the classroom and elsewhere, and their

[n] While the participating schools and colleges are representative of their respective institution type, there are a disproportionate number of college students in the sample. We highlight in the following analysis instances where there are notable differences in responses between schools and colleges.

post A level plans. Their perceptions of A level teaching practices are also compared to those reported by teachers.

6.3 Student attitudes in Year 12

Confidence

Over three-quarters of Year 12 A level Mathematics students (surveyed in March 2025) believe they will achieve a high grade, with the majority confident they could handle more difficult mathematics (Figure 6.1). This indicates substantial self-confidence since fewer than two-thirds will go on to achieve grades A* to B. Around half of students are confident they could do university mathematics which far exceeds the numbers who will later enrol on mathematics degrees and points to the untapped potential for training more mathematicians. At the other end of the scale, a quarter of students half-way through Year 12 are already finding the course difficult even when they work hard.

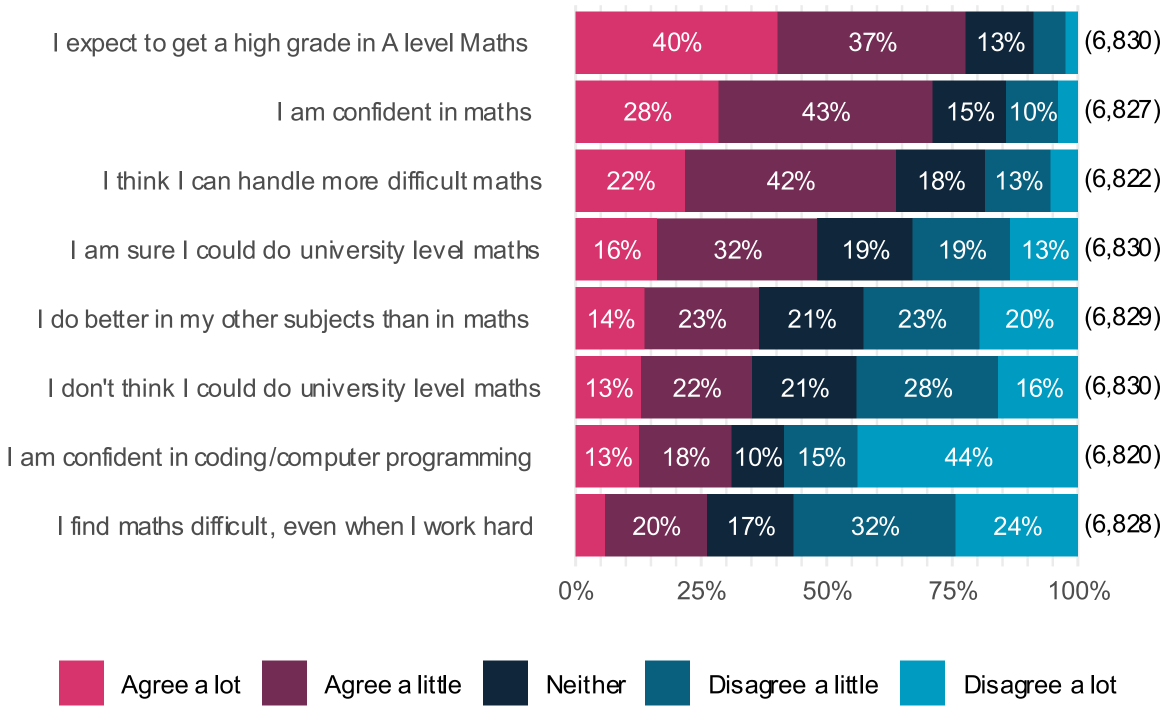


Figure 6.1 Year 12 student responses to statements pertaining to mathematical confidence.

As expected, most students (71%) who have chosen A level Mathematics are confident in mathematics, with the proportion increasing to 97% amongst those who are also studying A level Further Mathematics. Confidence levels are strongly linked with achieving grade 9 in GCSE Mathematics, however around half of the students with grades 6 and 7 remain confident (Figure 6.2). Male students report higher levels of confidence despite there only being a small gender attainment gap at GCSE. There is no difference in confidence levels between those in 11-18 schools and those in 16-18 colleges.

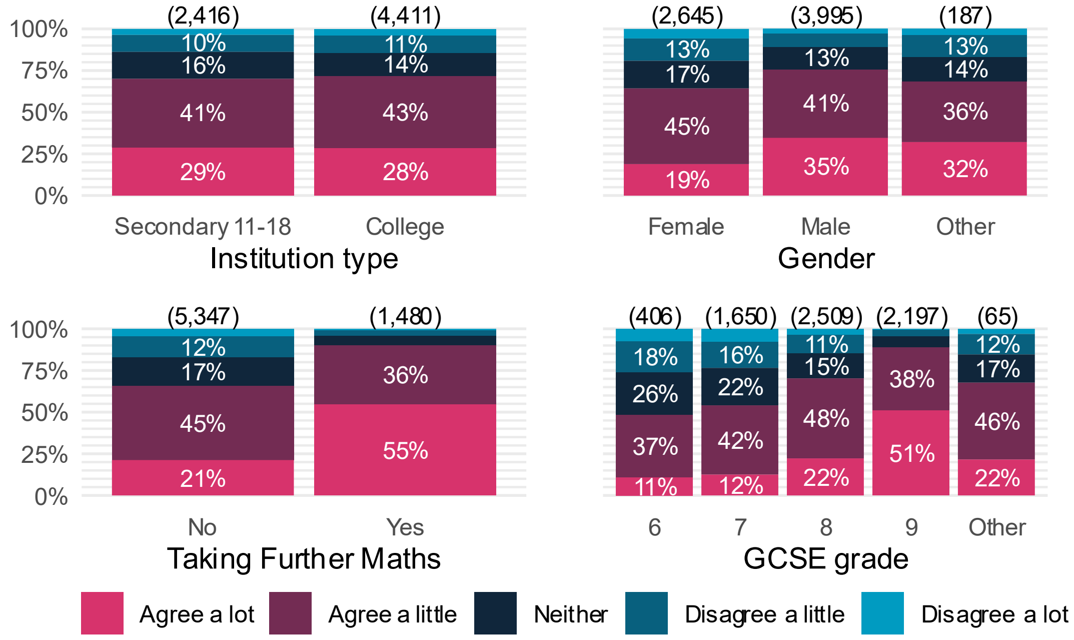


Figure 6.2 Levels of agreement with the statement 'I am confident in mathematics' by institution type, gender, Further Mathematics participation and GCSE grade.

Enjoyment

Most Year 12 A level Mathematics students enjoy studying mathematics (Figure 6.3), and they certainly prefer it to writing essays. In particular, they *get satisfaction from solving mathematics problems* and *like to solve new problems*. Most students are *comfortable expressing their own ideas for approaching difficult mathematics problems*, although this is below the proportion reporting confidence and enjoyment overall. For most survey items, enjoyment was notably higher among students also studying A level Further Mathematics with 61% of them strongly agreeing that they *really liked mathematics*. Students with GCSE Mathematics grade 9 also reported higher levels of enjoyment than those with lower grades, but there was no difference between students studying at schools and colleges.

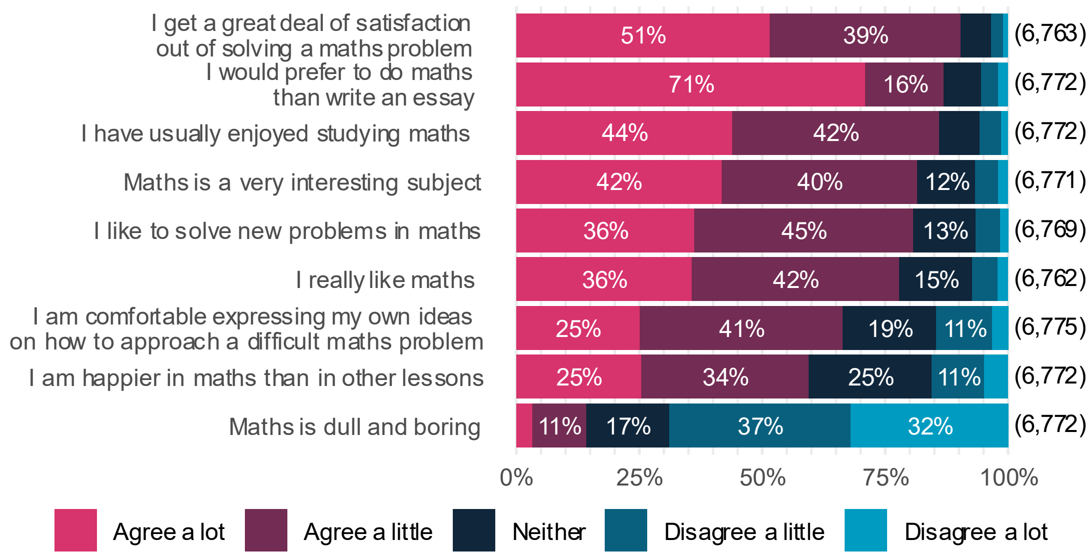


Figure 6.3 Responses to items comprising the enjoyment scale for Year 12 students.

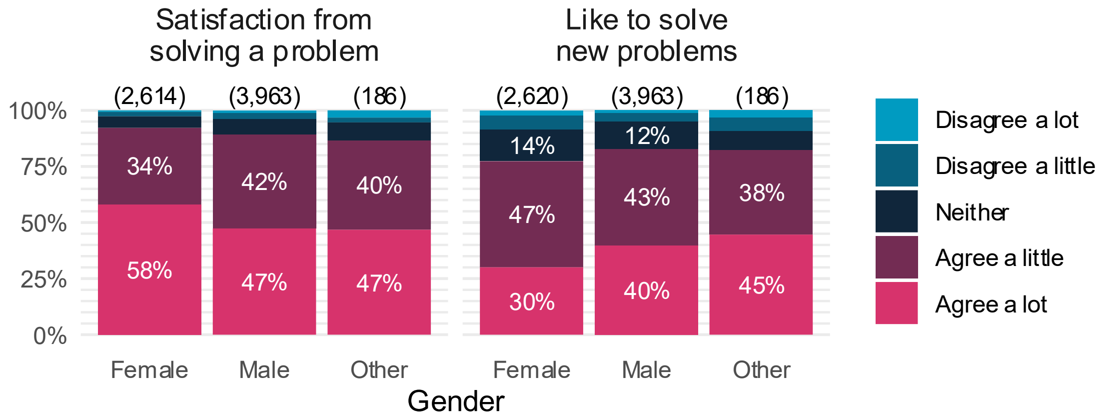


Figure 6.4 Levels of agreement with the statements 'I get a great deal of satisfaction out of solving a maths problem' and 'I like to solve new problems in maths' for Year 12 students.

The proportion of males and females who reported they *enjoy studying mathematics* and *really like mathematics* are very similar. However, female students were more likely to report satisfaction from solving problems, even if they were less likely to enjoy solving new problems (Figure 6.4) which may link to lower confidence levels among female students. Similarly, female students were less likely to feel *comfortable expressing their own ideas* and less likely to find mathematics *a very interesting subject*. This suggests male and female students both enjoy mathematics, but it may be different facets of the subject which appeal.

Nature of mathematics

Figure 6.5 shows the views of Year 12 A level Mathematics students on the nature of mathematics. Most students express the belief that mathematics is both procedural (*using rules and equations*) and open-ended (*new ideas and creative*). Encouragingly, there is recognition that mathematics is about problem-solving and that it helps in understanding the world, but less than half of students think mathematics can be used to communicate. Students starting an undergraduate degree in mathematics (see Transition to university mathematics report[110]) agree more strongly to all these statements (except *remembering definitions, formulas and facts*) reflecting that Year 12 students are earlier in their mathematical development and are more diverse in their views given they constitute a broader group of students.

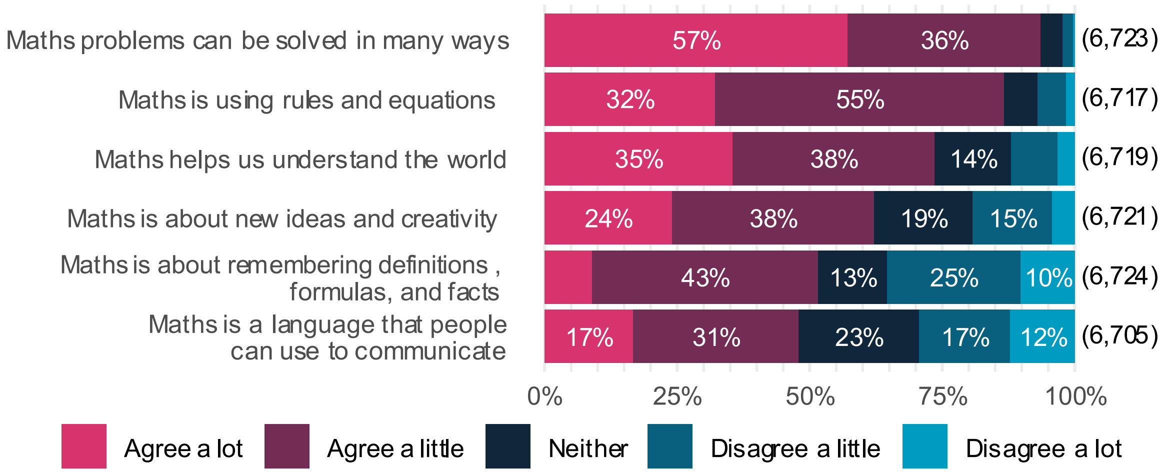


Figure 6.5 Year 12 students' views on the nature of mathematics.

Perceptions about mathematics are correlated with prior mathematical attainment. Those with grade 9 in GCSE Mathematics are less likely than students with lower grades to agree with procedural views of mathematics (*remembering definitions, formulas and facts* and *using rules and equations*) and more likely to agree with open-ended views (*problems can be solved in many ways* and *helps understand the real world*). This suggests it is mostly the higher-attaining GCSE students who are being exposed to mathematics as an exploratory subject where students discover mathematical patterns, structures and concepts for themselves. This attainment-related dichotomy is also observed between those who do and do not study A level Further Mathematics (Figure 6.6).

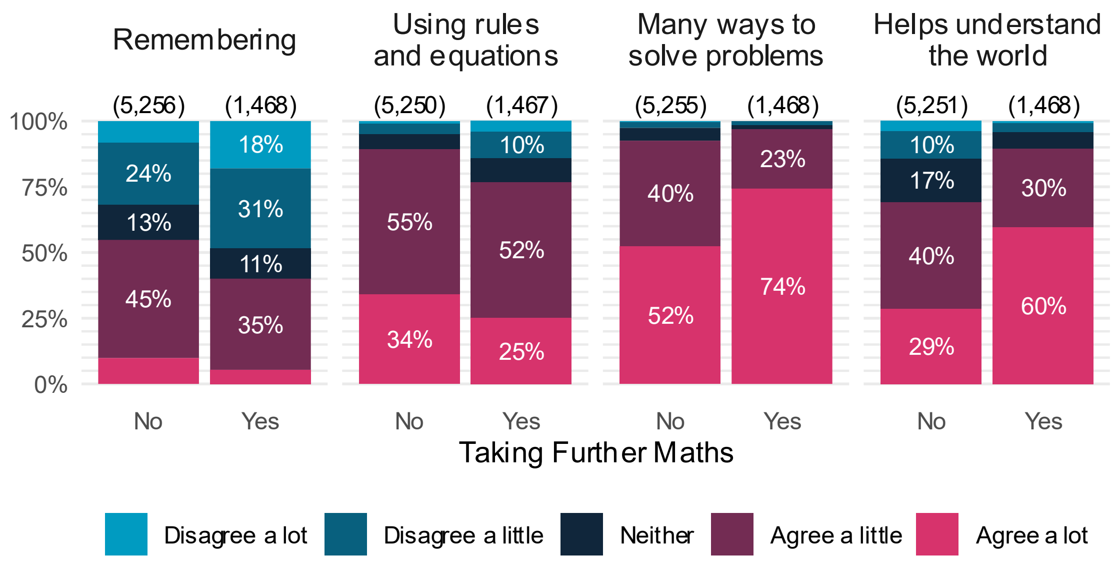


Figure 6.6 Year 12 students' levels of agreement with the statements 'Maths is about remembering definitions, formulas, and facts', 'Maths is using rules and equations', 'Maths problems can be solved in many ways', 'Maths helps us understand the world' about the nature of mathematics, by whether or not students are taking A Level Further Mathematics.

6.4 Year 12 A level Mathematics teaching

The Observatory's surveys of Year 12 students and teachers enables a comparison of student perceptions of the pedagogical practices used in A level Mathematics lessons (Figure 6.7) and how commonly A level Mathematics teachers use these approaches (Figure 6.8). Overall, both students and teachers agree that the dominant teaching approach is a combination of whole class instruction followed by student practise working through questions. Teachers reported that they teach *all students the same content at the same pace* either in almost all lessons (26%) or in most lessons (53%).

Less common pedagogic strategies include students *comparing different methods*, *students choosing questions* and *students using mathematical software*, all of which are used in less than half of lessons. Despite these approaches being used less often, over half of students recognise these as activities they do in A level Mathematics lessons. The vast majority (85%) of teachers report that *students work on their own* in 'almost all' or 'most' lessons, but only half of students report they *work mostly on their own*. There is broad agreement between students and teachers that collaborative learning (*discussing mistakes*, *working in pairs or small groups*, and *talking about ideas*) is used in A level Mathematics lessons.

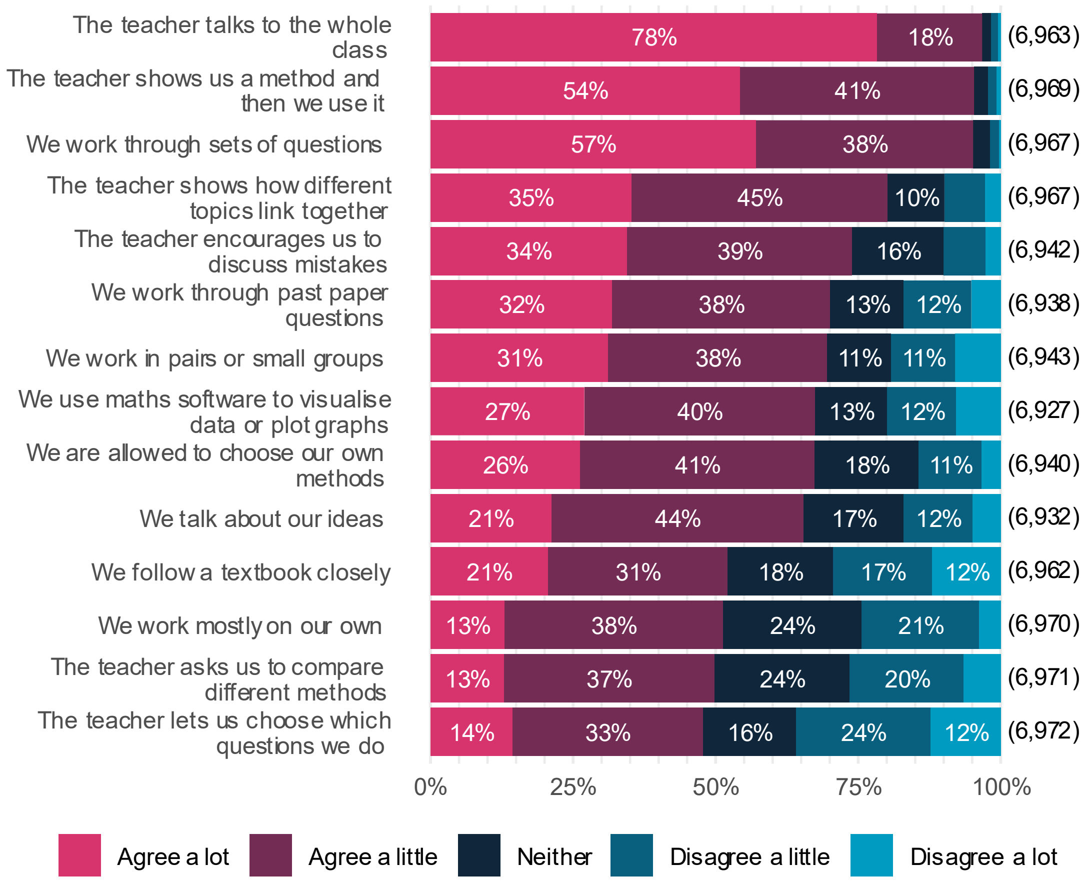


Figure 6.7 Year 12 student perceptions of lessons, items ordered by the proportion who agreed (either a little or a lot) with those statements.

Looking across the different institution types, there is evidence that students taking A level Further Mathematics and those in 16-18 colleges experience a different blend of pedagogies to those only taking A level Mathematics and those in 11-18 schools, respectively. Broadly speaking, those who also study A level Further Mathematics are more likely to report *talking about their ideas* (36% of Further Mathematics students strongly agree compared to 17% of Mathematics students), being *encouraged to discuss mistakes* (43% vs 32%), being asked to *compare different methods* (19% vs. 11%) and being free to *choose which questions to do* (19% vs 13%) than those who only study A level Mathematics. These differences are not apparent when analysing responses by GCSE grade, suggesting that there are differing perceptions amongst these two groups of students or differing practices in classes also being taught Further Mathematics rather than differences in teacher practices with higher attaining students.

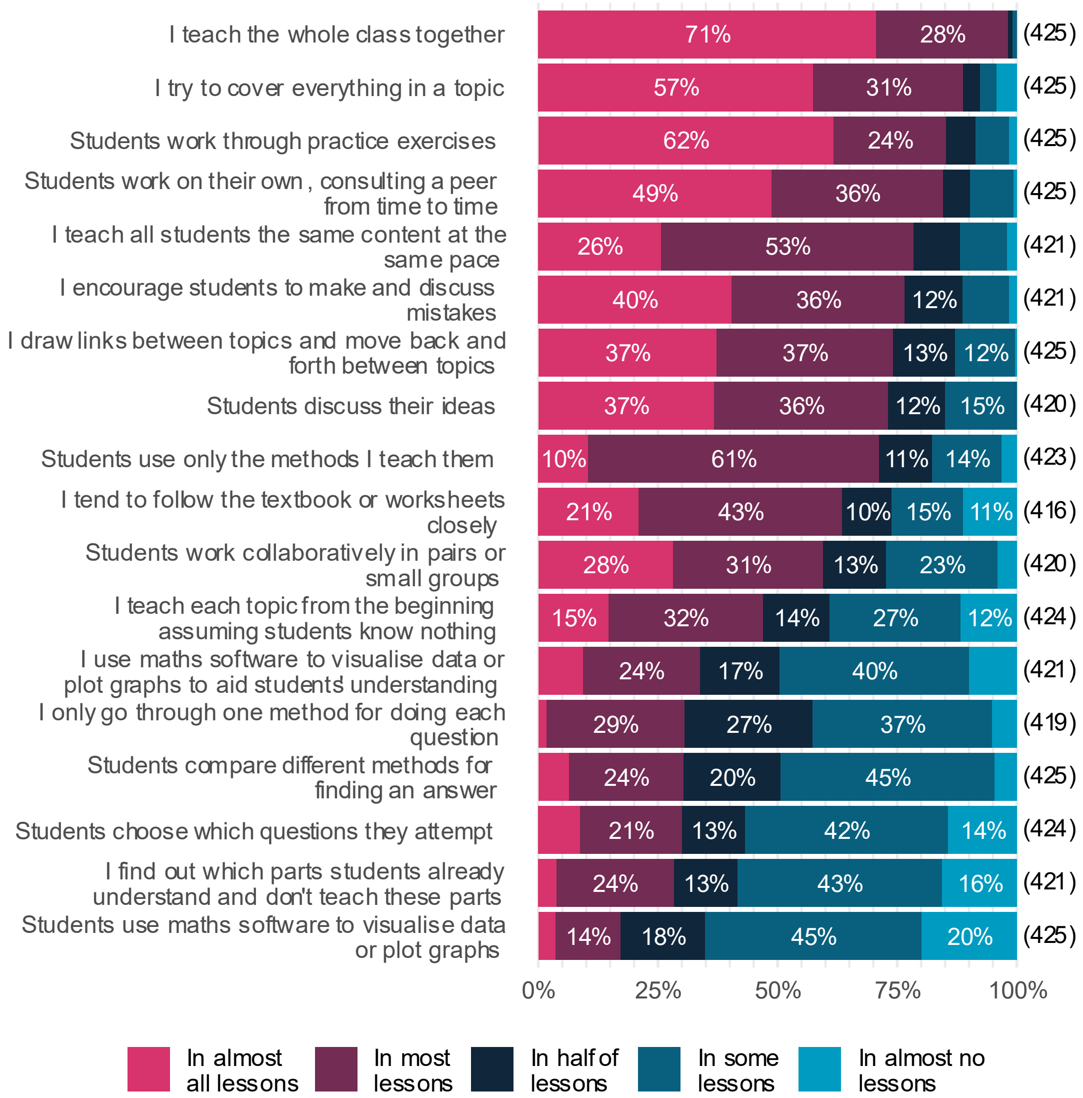


Figure 6.8 Summary of Year 12 teachers' practices, items ordered by the proportion of teachers who said they use those approaches in almost all or most of their lessons.

Two further experiences reported more frequently by A level Mathematics students that are also studying A level Further Mathematics is whether *the teacher shows how different topics link together* (Figure 6.9) and whether students *use maths software to visualise data or plot graphs* (Figure 6.10). Again, these higher order concepts and skills are more commonly experienced by students also studying Further Mathematics according to their survey responses. Compared to those in 11-18 schools, students in 16-18 colleges are more likely to report these practices which could suggest that teachers who specialise in teaching advanced mathematics are more likely to use these practices, although there will be specialist advanced mathematics teachers in 11-18 schools also. In colleges 46% of teachers ask students to use mathematical software in half or more lessons compared to 26% of teachers in schools.

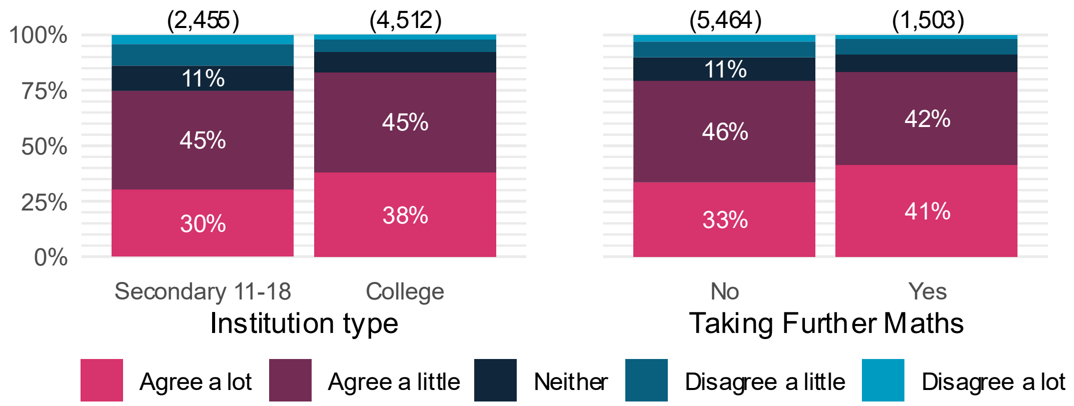


Figure 6.9 Year 12 A level Mathematics student responses to 'the teacher shows how different topics link together'.

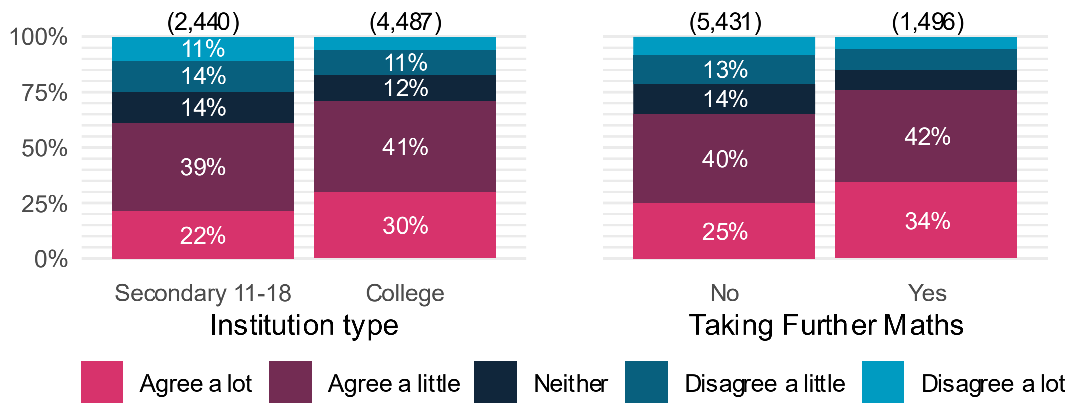


Figure 6.10 Year 12 student responses to 'we use maths software to visualise data or plot graphs'.

Two areas where students report experiencing different practices based on their prior attainment are *working in pairs or small groups* (Figure 6.11) and *following a textbook closely* (Figure 6.12). Aggregating across all settings, 38% of students with GCSE mathematics grade 9 'strongly agree' that they *work in pairs or small groups* as part of A level Mathematics lessons. This drops to 29% of grade 8 students and 24% of grade 6 students. The practice is also more commonly reported by students who are also studying A level Further Mathematics and those studying at 16-18 colleges. Conversely, 17% of students with a grade 9 in GCSE Mathematics 'strongly agree' that they *follow a textbook closely*, compared to 30% of those with a grade 6. Following *a textbook closely* is common practice in Year 12 according to teachers but much more prevalent in 11-18 secondary schools with 71% of teachers reporting using textbooks in 'almost all' or 'most' lessons compared to 54% of 16-18 college teachers.

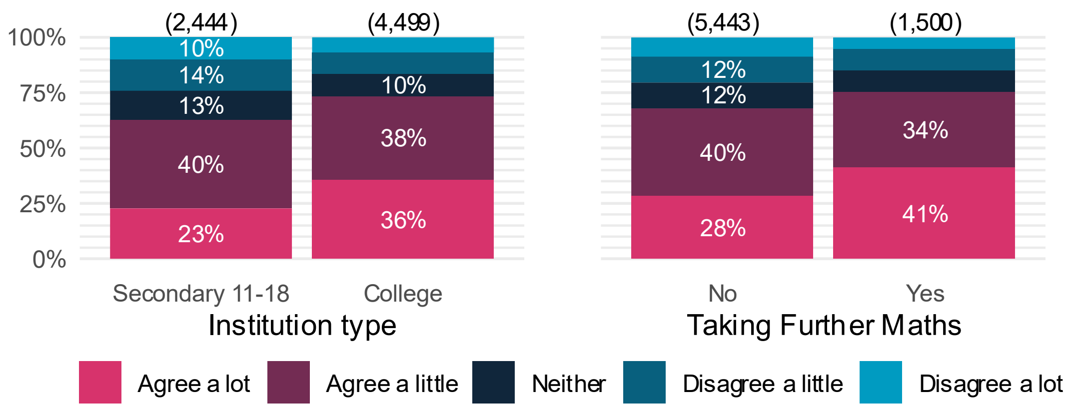


Figure 6.11 Year 12 student responses to 'we work in pairs or small group'.

There are no notable differences across these groups in student survey responses about their experiences of the teacher *showing us a method and then we use it* and *we work through sets of questions*. This suggests that differences found between groups are evidence of some teachers integrating a greater variety of practices into their teaching than others, or their students noticing these more.

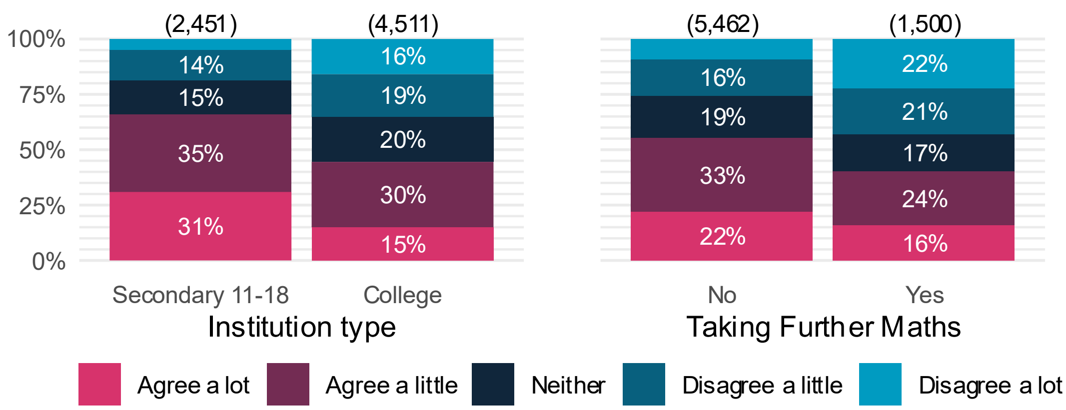


Figure 6.12 Year 12 student responses to 'we follow a textbook closely'.

Observations of A Level lessons in colleges

Observatory researchers observed nine lessons in five sixth form colleges. The lessons observed, which varied in length from an hour to two hours, generally followed a similar structure. In all lessons the teacher had a starter activity ready for the students as they came into the classroom; projected on the screen, written on a whiteboard or on paper. The activity involved revisiting a topic previously covered. The teacher usually worked through the questions with the class. In some cases, the entire starter activity took up to 20 minutes.

All lessons went on with some teacher input on a mathematical topic and then the whole class worked together through two or three examples. Typically, the teacher led the discussion, asking the students to suggest what came next from time to time, and in some cases asking them to make calculations to add to the worked solution. Students were expected to make some notes and copy down the worked examples. In some cases, the teacher wrote a heading and the notes on the board for copying down and in others students were expected to make notes themselves.

There usually followed some form of structured practice questions, labelled as something similar to ‘Your turn’, during which the students attempted the question on their own or in ad hoc pairs and then the teacher went through them in some detail. After the structured practice questions, students were given further examples to work on. Generally, there was some self-marking of the questions, often with the teacher displaying the marking scheme.

There was variation between lessons in the use of technology. Two lessons involved computer-generated sets of questions, using MathsBox or the Dr Frost app, whereas others shared questions via PowerPoint, paper handouts or in textbooks.

6.5 Student learning outside the classroom

The Observatory’s survey of Year 12 A level Mathematics students also reveals how they are learning mathematics outside the classroom. Figure 6.13 shows that less than half of A level Mathematics students are *working on mathematics with friends outside of lessons* on a weekly or fortnightly basis. Around two-thirds never *get help from family members* and the vast majority do not *see a private tutor*. Combined, these results point to A level Mathematics study being a largely solitary activity despite recognition (see Figure 6.5) that mathematics involves communicating ideas.

In response to the question - How do you use the Internet to help with maths homework or revision – two-thirds of students report *watching online videos (e.g. YouTube, Instagram, TikTok…)* (66%), while assessment-driven practices such as *downloading past papers and mark schemes* (67%) and *using online tools to find solutions (e.g. ChatGPT, Wolfram Alpha, Microsoft Maths Solver…)* (46%) are also commonly reported by students. It is likely that the use of technology and artificial intelligence, both inside and outside the classroom, will be increasingly influential in subsequent years.

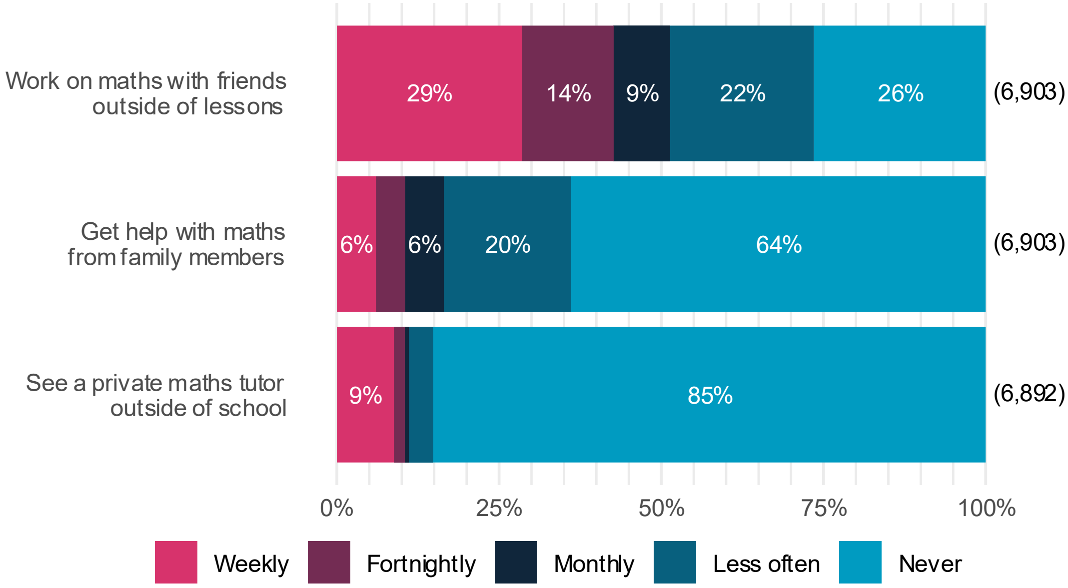


Figure 6.13 Year 12 responses to how often they seek external help.

6.6 Post-18 plans

Around two-thirds (65%) of Year 12 students studying A level Mathematics intend to include as much mathematics as possible in their post-18 plans, although only a small fraction will go on to study mathematics degrees. This figure is notably higher among students also studying A level Further Mathematics (84%), but there is little difference between those who previously attained GCSE grade 9 and those with GCSE grade 6 in Mathematics suggesting motivation rather than attainment profiles is the key factor.

Overall, 77% of respondents intend to *go to university* whilst smaller numbers plan to *start employment or work-based training* (9%) or *have no clear plan* (11%). The intention to *go to university* is higher among female students (85%), those studying A level Further Mathematics (87%) and those who previously achieved GCSE Mathematics grade 9 (86%). While the majority intend to study degree subjects that include mathematics (e.g. STEM subjects), only 7% of them plan to study mathematics degrees. In contrast, most teachers reported that 40% or more of their students were capable of studying for a mathematics degree, suggesting there is potential to grow participation in mathematics degrees post-18.

The Observatory's *Transition to university mathematics* report (ibid.) considered the experiences of 723 students who transitioned from A level to university mathematics in the autumn of 2024. The report showed that first year undergraduates experienced a dramatic drop in mathematical confidence during the first semester. This drop in confidence is experienced by a higher proportion of female students compared to male students, with female students also more likely to report that the pace of learning was too fast. The 2024 intake also reported a dramatic increase in their use of artificial intelligence during the first semester. Confidence in computer programming prior to starting their degree was correlated with anticipated grade for their first year. The Observatory is now working with the Academy for Mathematical Sciences to produce guidelines for A level teachers and university mathematics departments on how to prepare and support students for the transition to mathematics degrees.

6.7 Summary and next steps

The findings outlined in this Section give an indication of the attitudes and experiences of A level Mathematics students in England. However, the Observatory's data is much richer than presented here. Further analysis will link responses by class and institution linking students' responses to those of their teachers. Early indications show that some pedagogical practices (e.g. *textbook use* or *working in pairs or small groups*) do not vary as much within an institution as others that seem to vary between classes.

As well as the student and teacher level data presented here, the Observatory has surveyed parents and Heads of Mathematics to measure familial and institution influences. In a smaller number of institutions Observatory researchers have conducted lesson observations and interviews with staff. Further analysis will combine these quantitative and qualitative data to give unprecedented insights into A level Mathematics teaching and learning.

In 2025-26 the Observatory will survey the same students and their Year 13 A level Mathematics teachers to analyse any change in their attitudes or experiences. Later, the Year 12 and Year 13 data will be linked to the National Pupil Database to investigate associations between current attitudes and experiences and subsequent A level outcomes and careers. The intention is to track as many of these students as possible through mathematical degrees to monitor their experiences of the Higher Education sector in a broad cross-section of universities. This will confirm whether or not the variability between course descriptions observed in the Observatory's report on the landscape of mathematical science degrees[111] is reflected in student experiences and related to progression and outcomes.

Section 7
Appendices

Evidence
Excellence
Equity

7. Appendices

7.1 Attitude scales

Primary - Reception

Confidence

How good are you at....

- easy maths?
- hard maths?
- writing numbers?
- working out maths in your head?
- answering maths questions quickly?
- understanding your teacher when they talk about maths?

Response categories: *good/okay/bad*

Enjoyment

How much do you like:

- doing easy maths?
- doing hard maths?
- writing numbers?
- working out maths in your head?
- answering maths questions quickly?
- listening to your teacher talk about maths?

Response categories: *like/okay/don't like*

Secondary – Year 7

Confidence

How much do you agree that...?

- I feel okay about trying new maths problems
- I am sure that I could do the hardest year 7 maths
- I am sure that I can learn maths
- I think I could handle more difficult maths
- I can get good grades in maths
- I am confident in maths
- I am no good at maths
- I don't think I could do the hardest year 7 maths
- I'm not the type to do well in maths
- I find maths difficult, even when I work hard
- I do better in other subjects than in maths
- Maths is my worst subject

Response categories: *agree a lot, agree a little, neither, disagree a little, disagree a lot*

Enjoyment

How much do you agree that...?

- I feel satisfied when I solve a maths problem
- I enjoy maths
- I would rather do maths than write a story
- I am happier in maths than in other lessons
- Maths is a very interesting subject
- I feel comfortable sharing my ideas in maths
- I feel comfortable answering teacher questions in maths

Response categories: a*gree a lot, agree a little, neither, disagree a little, disagree a lot*

Mathematics anxiety

How much do you agree that...?

- I often worry that it will be difficult for me in maths
- I get very tense when I have to do maths homework
- I get very nervous doing maths problems
- I feel helpless when doing a maths problem
- I worry that I will get poor marks in maths
- I feel anxious about failing in maths

Response categories: *agree a lot, agree a little, neither, disagree a little, disagree a lot*

Value

How much do you agree that...?

- Maths is a very useful subject
- I want to improve my maths skills
- Maths helps to develop thinking skills
- Maths is one of the most important subjects
- I can think of ways to use maths outside of school
- Maths helps with learning other subjects
- Being good at maths will help me in my future job

Response categories: *agree a lot, agree a little, neither, disagree a little, disagree a lot*

Secondary – Year 12

Confidence

How much do you agree that...?

- I feel okay about trying new maths
- I am sure I could do university level maths
- I think I can handle more difficult maths
- I expect to get a high grade in A level Maths
- I am confident in maths
- I don't think I could do university level maths
- I'm not the type to do well in maths
- I find maths difficult, even when I work hard
- I do better in my other subjects than in maths
- Maths is my worst subject
- Maths was one of my best GCSE grades
- I am confident in coding/computer programming

Response categories: *agree a lot, agree a little, neither, disagree a little, disagree a lot*

Enjoyment

How much do you agree that...?

- I get a great deal of satisfaction out of solving maths problems
- I have usually enjoyed studying maths
- I would rather solve a maths problem than write an essay
- I would prefer to do maths than write an essay
- I am happier in maths than in other lessons
- Maths is a very interesting subject
- I am comfortable expressing my own ideas on how to approach a difficult maths problem
- I like to solve new problems in maths
- Maths is dull and boring
- I really like maths

Response categories: *agree a lot, agree a little, neither, disagree a little, disagree a lot*

7.2 Acknowledgements

This Review, and the 2024-25 programme of work that led to it, was achieved through the hard work and dedication of the following team members: Michael Adkins, Christopher Brignell, Bobo Kai Yin Chan, Catherine Gripton, Jeremy Hodgen, Dawn Holt, Marie Joubert, Kalyan Kameshwara, Balbir Kaur, Alistair Lane, Gabriel Lee, Stephen Lee, Jennifer Norris, Marc North, Andrew Noyes, Emma Owens, Jake Powell, Corrine Robinson, Katie Severn, David Sirl, Inga Steinberg, Ron Urbon, Geoffrey Wake, Thomas Wicks, Emily Williams.

We are grateful to the various advisory boards and expert panels for their continued support and challenge to the Observatory.

Finally, our thanks go to the thousands of teachers, leaders, learners and parents/guardians who have taken the time to engage with various aspects of the research programme.

7.3 Infographic data sources

The following relate to Figures 2.1 and 2.2:

A https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/estimatesofthepopulationforenglandandwales

B https://explore-education-statistics.service.gov.uk/data-tables/permalink/b80203a8-1d5c-4021-62d6-08ddf03ad3ce

C https://explore-education-statistics.service.gov.uk/data-tables/permalink/91742442-51d0-4e38-f8bf-08de0724494a

D https://explore-education-statistics.service.gov.uk/data-tables/permalink/c633d148-f78f-4c23-0b76-08de07233b94

E https://www.gov.uk/government/publications/open-academies-and-academy-projects-in-development

F https://explore-education-statistics.service.gov.uk/data-tables/permalink/e22e9bec-e6e0-4000-475d-08de00c019e8

G https://explore-education-statistics.service.gov.uk/find-statistics/multiplication-tables-check-attainment/2023-24

H https://explore-education-statistics.service.gov.uk/data-tables/permalink/178168a0-ae26-46ed-0b79-08de07233b94

J https://explore-education-statistics.service.gov.uk/data-tables/permalink/f41110ec-0eea-4c86-475f-08de00c019e8

K OME analysis of matched NPD pupil data for 2021 GCSE Year 11 maths cohort grade against A level Mathematics grade in state-funded institutions.

L https://explore-education-statistics.service.gov.uk/data-tables/permalink/bc559c0f-5cd2-45e4-5487-08ddf03e69a2

M https://analytics.ofqual.gov.uk/apps/GCSE/Outcomes/

N https://www.jcq.org.uk/examination-results/2025-level3-results/, https://www.jcq.org.uk/wp-content/uploads/2025/08/UK-JCQ-Press-notice-Level-3-2025.pdf

P https://www.hesa.ac.uk/news/20-03-2025/sb271-higher-education-student-statistics/subjects, https://www.hesa.ac.uk/data-and-analysis/staff/areas

7.4 Endnotes

[1] Observatory for Mathematical Education (2024). *Introductory report: Concepts and plans*. University of Nottingham. https://www.nottingham.ac.uk/observatory/documents/observatory-intro-report-021224.pdf

[2] Noyes, A., Brignell, C., Jacques, L., Adkins, M., & Powell, J. (2023). *The mathematics pipeline in England: Patterns, interventions and excellence*. University of Nottingham. https://www.nottingham.ac.uk/research/groups/crme/documents/maths-pipeline-report.pdf

[3] *Op. cit.,* note 2.

[4] The Royal Society & The British Academy (2018). *Harnessing educational research.* https://royalsociety.org/-/media/policy/projects/rs-ba-educational-research/educational-research-report.pdf The Royal Society & The British Academy.

[5] Observatory for Mathematical Education (2024). *UK Mathematics education organisations.* University of Nottingham. https://www.nottingham.ac.uk/observatory/documents/reports/maths-ed-organisations-uk-dec-24.pdf

[6] *Op. cit.,* note 1.

[7] Observatory for Mathematical Education (2025). *What we do.* University of Nottingham. https://www.nottingham.ac.uk/observatory/what-we-do.aspx

[8] Observatory for Mathematical Education (2025). *Public reports*. University of Nottingham. https://www.nottingham.ac.uk/observatory/publications/public-reports.aspx

[9] Brignell, C., Noyes, A., & Jacques, L. (2025). The mathematics pipeline in England: Inclusion and the excellence stream, *Teaching Mathematics and its Applications: An International Journal of the IMA*, 44(1), 28-46, https://doi.org/10.1093/teamat/hrae005

[10] Sirl, D. (2025). *Cohort study school sampling: Technical report.* University of Nottingham. https://www.nottingham.ac.uk/observatory/documents/reports/schoolsampling-technicalreport.pdf

[11] Phillipson, B. (2025, 04 July). We've laid the foundations. Now we build. *Schools Week.* https://schoolsweek.co.uk/weve-laid-the-foundations-now-we-build/

[12] Phillipson, B. (2024). *Fixing the foundations of opportunity: Education Secretary speech, 10 Sept 2024.* Carlton House Terrace, London. https://www.gov.uk/government/speeches/fixing-the-foundations-of-opportunity-education-secretary-speech

[13] £60m funding over two years according to: Lewis, J., & Maisuria, A. (2023). *'Maths to 18' in England* (House of Commons Library Research Briefing 9780). https://researchbriefings.files.parliament.uk/documents/CBP-9780/CBP-9780.pdf

[14] Pages 8 and 37 of: https://assets.publishing.service.gov.uk/media/651d3c116a6955000d78b292/A_world-class_education_system_-_The_Advanced_British_Standard__print_ready_.pdf

[15] NCETM funding increased 2024-25 (£7m due to ABS) and then 'reduced' for 2025-26. Chantler-Hicks, L. (2025, 09 May). Maths hubs funding drops (but DfE says it's not a cut). *Schools Week.* https://schoolsweek.co.uk/maths-hubs-funding-drops-but-dfe-says-its-not-a-cut/

[16] Phillipson, B., & Kyle, P. (2025, 06 May). *More girls to study maths under plans to improve pathway into AI careers.* [Press release]. https://www.gov.uk/government/news/more-girls-to-study-maths-under-plans-to-improve-pathway-into-ai-careers

[17] Alongside introducing a new Core Maths Premium. Education and Skills Funding Agency & Department for Education (2025). *16 to 19 funding: Advanced maths premium*. https://www.gov.uk/guidance/16-to-19-funding-advanced-maths-premium, and Education and Skills Funding Agency & Department for Education (2025). *16 to 19 funding: Core maths premium*. https://www.gov.uk/government/publications/16-to-19-funding-core-maths-premium/16-to-19-funding-core-maths-premium

[18] Paragraph 66 of: https://assets.publishing.service.gov.uk/media/65e0a4cb2f2b3b00117cd7ae/Government_evidence_to_the_STRB.pdf

[19] Committee of Public Accounts (2025). *Increasing teacher numbers: Secondary and further education HC825*. House of Commons. https://publications.parliament.uk/pa/cm5901/cmselect/cmpubacc/825/report.html

[20] National Foundation for Educational Research (2025, 05 June). *NFER comment on latest DfE School Workforce in England data* [Press release]. https://www.nfer.ac.uk/press-releases/nfer-comment-on-latest-dfe-school-workforce-in-england-data/

[21] Department for Education (2024). *Offer a teacher degree apprenticeship*. https://www.gov.uk/guidance/offer-a-teacher-degree-apprenticeship

[22] Mellor, J. (2024, 29 Nov). Multiply subtracted: Sunak's flagship maths scheme to end. *FE Week.* https://feweek.co.uk/sunaks-multiply-to-be-subtracted-in-march/

[23] Golding, J., Richardson, M., Isaacs, T., Barnes, I., Wilkinson, D., Swensson, C., & Maris, R. (2024). *Trends in International Mathematics and Science Study (TIMSS) 2023: National report for England Volume*

1. Department for Education. TIMSS 2023 national report for England - volume 1 (12/24); Richardson, M., Golding, J., Isaacs, T., Barnes, I., Wilkinson, D., Swensson, C., & Maris, R. (2025). *Trends in International Mathematics and Science Study (TIMSS) 2023: National report for England Volume 2.* Department for Education. TIMSS 2023 national report for England - volume 2 (03/25)

[24] Wheater, R., Kuhn, L., Classick, R., del Pozo Segura, J.M., Guevara, M.J., Harland, J., Liht J., & Lopes, G.H. (2024). *Survey of adult skills 2023 (PIAAC): National report for England, December 2024.* Department for Education. https://www.nfer.ac.uk/publications/survey-of-adult-skills-2023-piaac-national-report-for-england/

[25] Department for Education (2024, 19 July). *Government launches Curriculum and Assessment Review* [Press release}. https://www.gov.uk/government/news/government-launches-curriculum-and-assessment-review

[26] Curriculum & Assessment Review (2025). *Curriculum and Assessment Review Interim Report.* https://www.gov.uk/government/publications/curriculum-and-assessment-review-interim-report

[27] The Royal Society (2024). *A new approach to mathematical and data education*. https://royalsociety.org/news-resources/projects/mathematical-futures/

[28] Maths Horizons (2025). *How England should reform maths education for the age of AI.* https://www.mathshorizons.uk/_files/ugd/d28465_07ab1d04a9d34036a5cd569767bd2f52.pdf

[29] Cambridge University Press & Assessment (2024). *Striking the balance: A review of 11–16 curriculum and assessment in England.* OCR. https://www.ocr.org.uk/Images/717919-striking-the-balance.pdf?hsCtaAttrib=177138440350

[30] OECD (2024). *An evolution of mathematics curriculum: Where it was, where it stands and where it is going.* OECD Publishing. https://www.oecd.org/content/dam/oecd/en/publications/reports/2024/12/an-evolution-of-mathematics-curriculum_af8ac3c3/0ffd89d0-en.pdf

[31] Department for education (2025). *Giving every child the best start in life.* https://www.gov.uk/government/publications/giving-every-child-the-best-start-in-life

[32] Ofsted (2024). *Strong foundations in the first years of school*. https://www.gov.uk/government/publications/strong-foundations-in-the-first-years-of-school/strong-foundations-in-the-first-years-of-school

[33] National Children's Bureau (2025). *Early Years Stronger Practice Hubs*. Department for Education. https://www.strongerpracticehubs.org.uk/

[34] Geraniou, E., Marks, R., Hodgen, J., Bretscher, N. & Jacques, L. (2025). *Effective approaches to teaching mathematics in key stages 3 and 4.* Education Endowment Foundation. https://educationendowmentfoundation.org.uk/education-evidence/evidence-reviews/mathematics-in-key-stages-3-and-4

[35] Purposeful Ventures (2025). *Maths excellence fund*. https://www.mathsexcellencefund.org/

[36] Dickens, J. (2022, 30 Nov). Oak National Academy quango judicial review launched. *Schools Week.* https://schoolsweek.co.uk/oak-national-academy-quango-judicial-review-launched/

[37] Department for Education (2025). *Oak National Academy independent review.* https://www.gov.uk/government/publications/oak-national-academy-independent-review-and-market-impact-assessment

[38] Hodgen, J., Pepper, D., Sturman, L, & Ruddock, G. (2010). *Is the UK an outlier? An international comparison of upper secondary mathematics education.* Nuffield Foundation. https://www.nuffieldfoundation.org/wp-content/uploads/2019/12/Is-the-UK-an-Outlier_Nuffield-Foundation_v_FINAL.pdf

[39] Organisation for Economic Co-operation and Development (2024), *Mathematics for life and work: A comparative perspective on mathematics to inform upper secondary reform in England*, OECD Publishing. https://doi.org/10.1787/26f18d39-en.

[40] The Advanced Maths Support Programme (AMSP) was established in 2018, building on earlier initiatives led by MEI. It evolved from the Further Mathematics Support Programme (FMSP), which ran from 2009 to 2018 and itself grew from a pilot project in the early 2000s that was initially funded by the Gatsby Charitable Foundation

[41] *Op. cit.,* note 15.

[42] Wakeling, P. (2024). *Mathematics in UK higher education: A brief overview.* University of York. https://21ee65c1-6f70-4267-8143-cf318b1a3814.usrfiles.com/ugd/21ee65_7c9930582c15417ebbd6acc94479bd97.pdf

[43] Campaign for Mathematics Sciences (2025). *Maths degrees for the future*. https://www.campaignmathsci.uk/maths-degrees-for-the-future

[44] Institute of Mathematics and its Applications (2025). *Statement on methods of assessment in the mathematical sciences.* https://ima.org.uk/26817/statement-on-methods-of-assessment-in-the-mathematical-sciences-3/

[45] Monk, F.T. (2025, 12 Mar). It's time for a resits rethink. *FE Week.* https://feweek.co.uk/its-time-for-a-resits-rethink/

[46] Education and Skills Funding Agency & Department for Education (2025). *2024 to 2025 academic year: 16 to 19 funding: maths and English condition of funding*. https://www.gov.uk/government/publications/16-to-19-funding-maths-and-english-condition-of-funding/2024-to-2025-academic-year-16-to-19-funding-maths-and-english-condition-of-funding

[47] Camden, B. (2024, 28 Nov). GCSE resits: November 2024 entries rise by 21%. *FE Week.* https://feweek.co.uk/gcse-resits-november-2024-entries-rise-by-21/

[48] Maris, R. & Robinson, D. (2025). *English and maths resits: Drivers of success.* Pearson & Education Policy Institute. https://www.pearson.com/content/dam/global-store/en-gb/english-and-maths-resits-epi-report.pdf

[49] Department for Education (2025, 11 Feb). *10,000 more apprentices as government slashes red tape to boost growth* [Press release]. https://www.gov.uk/government/news/10000-more-apprentices-as-government-slashes-red-tape-to-boost-growth

[50] House of Lords Science and Technology Committee (2025, 20 May). *Letter to the Rt Hon Bridget Phillipson MP, Secretary of State for Education*. https://committees.parliament.uk/publications/48032/documents/251204/default/

[51] *Op. cit.,* note 18.

[52] McLean, D. & Worth, J. (2025). *Teacher labour market in England: Annual report 2025. NFER.* https://www.nfer.ac.uk/publications/teacher-labour-market-in-england-annual-report-2025/

[53] Department for Education (2025). *Postgraduate initial teacher training targets* [Data set]. https://explore-education-statistics.service.gov.uk/find-statistics/postgraduate-initial-teacher-training-targets/2025-26

[54] Department for Education (2025). *Targeted retention incentive payments for school teachers*. https://www.gov.uk/guidance/targeted-retention-incentive-payments-for-school-teachers

[55] Department for Education (2025). *Targeted retention incentive payments for FE teachers.* https://www.gov.uk/guidance/targeted-retention-incentive-payments-for-fe-teachers

[56] Department for Education (2024). *Offer a teacher degree apprenticeship*. https://www.gov.uk/guidance/offer-a-teacher-degree-apprenticeship

[57] Education Endowment Foundation (2025). *Mastering Number at Reception and KS1 – trial.* https://educationendowmentfoundation.org.uk/projects-and-evaluation/projects/mastering-number-trial

[58] Education Endowment Foundation (2025). *Maths Champions – scale up.* https://educationendowmentfoundation.org.uk/projects-and-evaluation/projects/maths-champions-subsidised-programme

[59] CooperGibson Research (2025). *Evaluation of the Early Years Professional Development Programme (Phase 3) Research report.* Department for Education. https://assets.publishing.service.gov.uk/media/686bda4c2557debd867cbd83/EYPDP3_evaluation_report-03.07.25.pdf

[60] Department for Education (2025). *Early years child development training*. https://child-development-training.education.gov.uk/

[61] Glenn, S., Mulkearn, K., & Woolacott, Z. (2025). *A comparison of earnings for teachers with those for other graduate professions A report for NASUWT*. Incomes Data Research. https://www.nasuwt.org.uk/static/63dac553-8d84-4e48-86158359034f75d8/IDR-Research-The-Pay-of-Teachers-and-Comparable-Graduate-Professions-England.pdf

[62] National Education Union (2025, 14 April). *State of education: teacher stress and wellbeing* [Press release]. https://neu.org.uk/press-releases/state-education-teacher-stress-and-wellbeing

[63] National Centre for Excellence in the Teaching of Mathematics (2025). *Maths Hubs*. https://www.ncetm.org.uk/maths-hubs/

[64] Department for Education (2024). *Engagement with the Maths Hubs Programme.* https://www.gov.uk/government/publications/engagement-with-the-maths-hubs-programme

[65] Department for Education (2025). *Regional improvement for standards and excellence (RISE)* [Policy paper]. https://www.gov.uk/government/publications/regional-improvement-for-standards-and-excellence-rise/regional-improvement-for-standards-and-excellence-rise

[66] Greany, T., Noyes, A., Gripton, C., Cowhitt, T., & Hudson, G. (2023). *Local learning landscapes: exploring coherence, equity and quality in teacher professional development in England.* University of Nottingham. https://www.nottingham.ac.uk/research/groups/crelm/documents/equalls-report.pdf

[67] Association for Mathematics in Education (2025). *AiME.* https://amie.org.uk/

[68] Publication withdrawn 26 Sept, 2024: Department for Education (2024). *National academy focused on mathematical sciences (closed to applications)*. https://www.gov.uk/government/publications/national-academy-focused-on-mathematical-sciences

[69] Hansard HC Deb vol 755 (2024, 22 Oct). https://hansard.parliament.uk/commons/2024-10-22/debates/24102240000014/MainstreamFreeSchoolsReview

[70] Observatory for Mathematical Education (2025). *Evaluation of pupil attainment and progression in Maths Schools.* University of Nottingham. https://www.nottingham.ac.uk/observatory/documents/reports/pupil-attainment-progression-mathsschools.pdf

[71] Purposeful Ventures (2025). *Our vision.* https://purposefulventures.org/

[72] Sunak, R. (2025, 01 March). *Rishi and Akshata unveil the Richmond project to tackle numeracy problems.* https://www.rishisunak.com/news/rishi-and-akshata-unveil-richmond-project-tackle-numeracy-problems

[73] Ofqual (2023, 20 March). *Letter to Robin Walker MP, Chair Education Select Committee.* https://committees.parliament.uk/publications/39051/documents/191996/default/

[74] Burge, B. and Benson, L. (2025). *National Reference Test Results Digest 2025.* NFER https://www.nfer.ac.uk/publications/national-reference-test-results-digest-2025/

[75] Office for Students (2022). *Analysis of degree classifications over time: Changes in graduate attainment from 2010-11 to 2020-21.* https://www.officeforstudents.org.uk/media/7054/ofs-202222.pdf

[76] For a recent overview of the issue, see Golding, J. (2022). *UK mathematics 14-19: the gender jigsaw.* Joint Mathematical Council of the United Kingdom. https://www.jmc.org.uk/wordpress-cms/wp-content/uploads/2022/03/UK-mathematics-14-19-gender-jigsaw-Report-Jan-22-final.pdf

[77] *Op. cit.,* note 2.

[78] Machin, S., McNally, S., & Wyness, G. (2013). Educational attainment across the UK nations: performance, inequality and evidence. *Educational Research,* 55(2), 139-164. https://doi.org/10.1080/00131881.2013.801242

[79] *Op. cit.,* note 2.

[80] *Op. cit.,* note 22. In TIMSS (2023) Volume 2, Year 5 pupil scores across different mathematical domains were broadly similar from 2019 to 2023 with data the strongest domain and measurement & geometry the weakest.

[81] *Op. cit.,* note 22. In TIMSS (2023) Volume 1, the average score in mathematics for year 5 boys was significantly above that for year 5 girls and this difference is greater than in 2019 where the average score for boys was higher but not statistically significant.

[82] *Op. cit.,* note 10.

[83] Campbell, T. (2022). Relative age and the Early Years Foundation Stage Profile: How do birth month and peer group age composition determine attribution of a 'Good Level of Development'—and what does this tell us about how 'good' the Early Years Foundation Stage Profile is? *British Education Research Journal*, 48, 371-401. https://doi.org/10.1002/berj.3771

[84] *Op. cit.,* note 52.

[85] Observatory for Mathematical Education (2025). *Key Stage 3 teachers of mathematics.* University of Nottingham. https://www.nottingham.ac.uk/observatory/documents/reports/ks3-teachers-of-mathematics-tr-2501.pdf

[86] 18% difference in FSM/non-FSM pupils reaching expected level in mathematics at the end of EYFS. Department for Education (2024). *Early years foundation stage profile results* [Data set]. https://explore-education-statistics.service.gov.uk/find-statistics/early-years-foundation-stage-profile-results/2023-24

[87] 19% difference in FSM/non-FSM pupils reaching expected level in mathematics at the end of Key Stage 2. Department for Education (2025). *Key stage 2 attainment* [Data set]. https://explore-education-statistics.service.gov.uk/find-statistics/key-stage-2-attainment/2024-25

[88] *Op. cit.,* note 2.

[89] *Op. cit.,* note 22 TIMSS (2023) Volume 1.

[90] Organisation for Economic Co-operation and Development (2023). *PISA 2022 Results (Volume I and II) - Country Notes: United Kingdom.* OECD. https://www.oecd.org/en/publications/2023/11/pisa-2022-results-volume-i-and-ii-country-notes_2fca04b9/united-kingdom_b5071eb8.html#section-d1e17

[91] *Op. cit.,* note 22. TIMSS (2023) Volume 2.

[92] For example, see Evans, D., & Field, A.P. (2020). Predictors of mathematical attainment trajectories across the primary-to-secondary education transition: parental factors and the home environment. *Royal Society Open Science*, *7*(7), 200422. https://doi.org/doi:10.1098/rsos.200422; Hodgen, J., Coe, R., Brown, M., & Küchemann, D. (2024). Educational Performance over Time: Changes in Mathematical Attainment between 1976 and 2009 in England. *Implementation and Replication Studies in Mathematics Education*, *4*(1), 83-124. https://doi.org/10.1163/26670127-bja10018

[93] Allen, R., & Sims, S. (2018). *How do shortages of maths teachers affect the within-school allocation of maths teachers to pupils?* Nuffield Foundation. https://www.nuffieldfoundation.org/publications/shortages-maths-teachers-affect-within-school-allocation-teachers-to-pupils

[94] Lee, G.C-Y. (2025). *Validation of secondary pupil attitudes survey.* Observatory for Mathematical Education. https://www.nottingham.ac.uk/observatory/documents/reports/202503-validation-of-secondary-pupil-attitudes-survey.pdf

[95] Lou, N.T.T., Ansari, D., Sokolowski, H.M. (2024). Unraveling the interplay between math anxiety and math achievement. *Trends in Cognitive Science,* 28(10), 937-947.

[96] Swan, M. (2006). *Collaborative Learning in Mathematics: A Challenge to our Beliefs and Practices.* National Institute for Advanced and Continuing Education (NIACE).

[97] Ibid.

[98] National Centre for Excellence in the Teaching of Mathematics (2025). *Oracy in mathematics framework.* https://www.ncetm.org.uk/teaching-for-mastery/mastery-explained/oracy/oracy-in-mathematics-framework/

[99] Ernest, P. (1989). The impact of beliefs on the teaching of mathematics. In: P. Ernest (Ed.), *Mathematics teaching: The state of the art*. The Falmer Press.

[100] Jerrim, J., & Sims, S. (2019). *The Teaching and Learning International Survey (TALIS) 2018.* Department for Education. https://assets.publishing.service.gov.uk/media/5f6484c2e90e075a01d2f4ce/TALIS_2018_research.pdf

[101] National Centre for Excellence in the Teaching of Mathematics (2025). *Using mathematical representations at KS3.* https://www.ncetm.org.uk/classroom-resources/secmm-using-mathematical-representations-at-ks3/

[102] *Op. cit.,* note 85.

[103] Leckie, G., & Prior, L. (2022). A comparison of value-added models for school accountability. *School Effectiveness and School Improvement*, *33*(3), 431-455. https://doi.org/10.1080/09243453.2022.2032763

[104] Ofqual (2025). *Provisional entries for GCSE, AS and A level: summer 2025 exam series.* https://www.gov.uk/government/statistics/provisional-entries-for-gcse-as-and-a-level-summer-2025-exam-series/provisional-entries-for-gcse-as-and-a-level-summer-2025-exam-series#as-and-a-level-entries

[105] Joint Council for Qualifications (2025). *A and AS level trends*. https://www.jcq.org.uk/wp-content/uploads/2025/08/A-and-AS-level-trends-June-2025.pdf

[106] *Op. cit.,* note 27.

[107] Observatory for Mathematical Education. (2025). *The landscape of undergraduate mathematics degrees in England and Wales*. University of Nottingham. https://www.nottingham.ac.uk/observatory/documents/reports/landscapeofmathematicsdegrees-themedreport-202503.pdf

[108] *Op. cit.,* note 10.

[109] Observatory for Mathematical Education. (2025). *Motivations of Year 12 students for choosing A level Mathematics.* University of Nottingham. https://www.nottingham.ac.uk/observatory/documents/reports/y12choices-tr-202504.pdf

[110] Observatory for Mathematical Education. (2025). *Transition to university mathematics*. University of Nottingham. https://www.nottingham.ac.uk/observatory/documents/reports/transitionstouniversitymathematics-themedreport-202502.pdf

[111] *Op. cit.,* note 107.

November 2025

Observatory for Mathematical Education
University of Nottingham
Jubilee Campus
NG8 1BB

mathsobservatory@nottingham.ac.uk
www.nottingham.ac.uk/observatory
Follow us on LinkedIn

In partnership with