MATHS HORIZONS

Maths Horizons Project

Interim Report

February 2025

Contents

Executive Summary

The Maths Horizons Project is an independent, rapid review of maths curriculum and assessment in England. It has been initiated in response to the Department for Education's own curriculum and assessment review.

The project was started to help ensure that all children and young people:

- **develop excellent mathematical knowledge;**
- **appreciate the value of maths;** and
- **enjoy engaging learning experiences in maths.**

Our work combines expertise with widespread consultation. To date, we have collected **over 40,000 insights** from stakeholders, including students, parents, teachers, and employers. We have then discussed and debated these with experts.

This breadth and depth of research has given us a unique view of systemic challenges and opportunities. We will use this to produce recommendations for systemic improvement that can respond to the demands of a rapidly changing economy and AI-led innovation.

The Executive Group brings together representation from across education and industry, including primary and secondary schools, colleges, universities and leading businesses. The full Terms of Reference of the Project, and the membership of the Executive Group, are published on the Maths Horizons website.

At the end of the first phase of the rapid review, five main findings have emerged:

1. **Despite negative press, maths is seen by most students and parents as enjoyable, as well as valuable**
2. **Over half of all teachers may be underestimating what their students could achieve in GCSE maths**
3. **Teachers report that the stated curriculum aims for maths education are not consistently achieved**
4. **The competencies most valued by employers are also the ones in which students are most confident**
5. **Employer demand for maths competencies is mostly being met, but frontier tech companies are more likely to project demand in the future**

In the second phase of the rapid review, we will investigate how to better align national aims and expectations with classroom realities, and how to enhance the connection between maths education and workplace demands. We will also explore strategies to strengthen and sustain engagement with maths, to support progression to advanced study, and to ensure that all students have the opportunity to succeed.

The Maths Horizons Project is chaired by Professor Lord Tarassenko CBE, President of Reuben College, Oxford and formerly Dean of Engineering at the University of Oxford. The project's Executive Group is co-led by:

- Dr Helen Drury, Dean of Maths Excellence at Purposeful Ventures, and Founder and formerly Executive Director of Mathematics Mastery and a secondary maths teacher, and
- David Monis-Weston, AI Lead at Purposeful Ventures, and Founder and formerly CEO of the Teacher Development Trust and a secondary maths and physics teacher.

Section 1: A maths curriculum and assessment system for the age of AI

Maths is a universal way of understanding the world. It is relevant and essential for everyone. It is a fundamental language to understand all aspects of science and technology, and it will therefore always be important for children to learn maths, whatever new technologies arise. It is also an increasingly important way of navigating the modern world; one in which data use is increasing exponentially, and where ever more people need the fluency to be able to understand and navigate maths in work and daily life.

Maths is the key to understanding some of the most significant changes currently impacting the global community: climate change, cybersecurity, ageing populations, and notably, the explosive rise of Artificial Intelligence (AI). Indeed, even since the Maths Horizons Project began in September 2024, the progress made by "AI for maths" models has been incredible. Models such as DeepSeek's R1, OpenAI's o3, and Qwen's QwQ are rapidly accelerating their capacity to solve complex mathematical problems.

Children and young people going through education now will have their lives shaped by AI in ways that were hard to imagine even a few years ago. However, this is not to say that they will not need to understand fundamental mathematical concepts. In fact, the ability to reason, solve problems and use maths alongside AI may become ever more important, and those with the greatest mathematical capability are likely to derive the most value from such tools. There are significant implications for both curriculum and assessment systems in a world of increasingly competent and reliable AI.

We believe that maths is a crucial foundation of daily life, and that it is something that can and must be accessed by all. Indeed, ensuring that there is deep and equitable understanding of maths is key to the success of the UK's economy, industry, and society. We want to support all children and young people to develop excellent mathematical knowledge, to understand the role and value of maths, and to have positive and enjoyable experiences learning the subject. By doing so, we build resilience to even the fastest technological change, and create stronger foundations for our nation's future.

Our goal must be a maths education system, and a curriculum and assessment model, that delivers on several key principles:

a. Children and young people, regardless of their background, should attain a common core of knowledge in maths, and also have the opportunity to learn more maths beyond the common core.

b. Children and young people should have engaging and fulfilling experiences learning maths, including engaging in maths for pleasure.

c. The curriculum should focus on the universal nature of maths, and it should not dilute or restrict access, based on socio-cultural considerations, to different types of maths.

d. Children and young people should be prepared for further study, including in maths and other quantitative disciplines, but also in any other subject that uses maths.

e. That children and young people should be prepared for using maths in everyday life, including:

i. That they are prepared for using maths in the labour market, with a concern for the likely affects AI will have; and

ii. That their maths knowledge is on a par with that of their peers in any of the highest performing education systems in the world, at the age when compulsory education ends.

There has been steady improvement in maths education throughout the 21st century, starting with New Labour's focus on numeracy and standards, and continuing with the Conservative Government's focus on mastery teaching. We are optimistic about the potential to build on the best aspects of our current curriculum and assessment systems; any changes we suggest as part of the Maths Horizons Project must address its weaknesses, including access to, and achievement in, maths qualifications. A reformed curriculum and assessment framework should support an education system in which everyone can achieve, with pathways for maths excellence through to university and beyond. Critically, it must recognise that change should happen in a way that is manageable and practical for the maths education system in England.

Section 2: The approach of the Maths Horizons Project

The Maths Horizons Project builds upon recent major reviews of maths education including the *Smith Review of Post-16 Mathematics* and the Royal Society's *Mathematical Futures*. We intend that our findings will be relevant to government, schools and colleges, charities, philanthropists and other stakeholders. We hope they will also be useful to the Department for Education's curriculum and assessment review.

We have consulted widely to gather diverse insights and perspectives, including from students, parents, employers, employees, primary teachers, secondary maths teachers, and lecturers and staff at colleges and universities. This has included:

- dozens of individual and group meetings with key stakeholder groups;
- more than 1,000 consultation responses through the Maths Horizons website;
- more than 10,000 polled contributions from pupils, parents, employers, and employees via Public First[1]; and
- over 31,000 responses from teachers via Teacher Tapp.[2]

During this first phase of the project, we have also signed up nearly four hundred interested stakeholders and experts to follow our regular updates. This inclusive approach ensures that the experiences and perspectives of those directly involved in maths education are central to our analysis, while retaining a broad coalition of stakeholders to help shape this agenda going forward.

The Maths Horizons Project is focused on curriculum and assessment. Five specific priority areas were identified and examined in depth during the first phase of the project, in a series of rapid investigations which combined opinion testing, expert discussions, feedback and research from the Executive Group, and discussion among the Co-Leads and members of the Executive Group:

- Investigation 1: **What is the impact of our current maths curriculum and assessment on children and young people?** What do they enjoy? How well does the current system prepare them for life? In what ways is it serving some less well?
- Investigation 2: **How can we improve the sequencing and quality of the maths curriculum that all pupils follow to age 14?** What content should be added, removed or re-sequenced to improve maths learning for all? How are we ensuring the strongest and most enjoyable foundations in maths for all children?
- Investigation 3: **How do we better support students who do not currently achieve Level 2 by the age of 18?** Where are the major points of challenge in the system, including at primary level, and what are the consequences for students? How are we supporting children with special education needs and disabilities? How is the current structure of qualifications at Key Stage Four working for all students?
- Investigation 4: **How do we better support students to join and stay on the maths excellence pathway?** How do we inspire and enable more students to meet the needs of the most demanding study and careers in STEM?
- Investigation 5: **How do we ensure that the maths curriculum and assessment system is giving all students access to work and/or further study?** Does the maths curriculum meet the needs of higher education institutions and different categories of employers? What are the roles of these institutions in the education process?

The findings of these investigations were published on the Maths Horizons Project website and remain accessible for continued input and engagement.

Section 3: Main findings so far

A. Despite negative press, maths is seen by most students and parents as enjoyable, as well as valuable

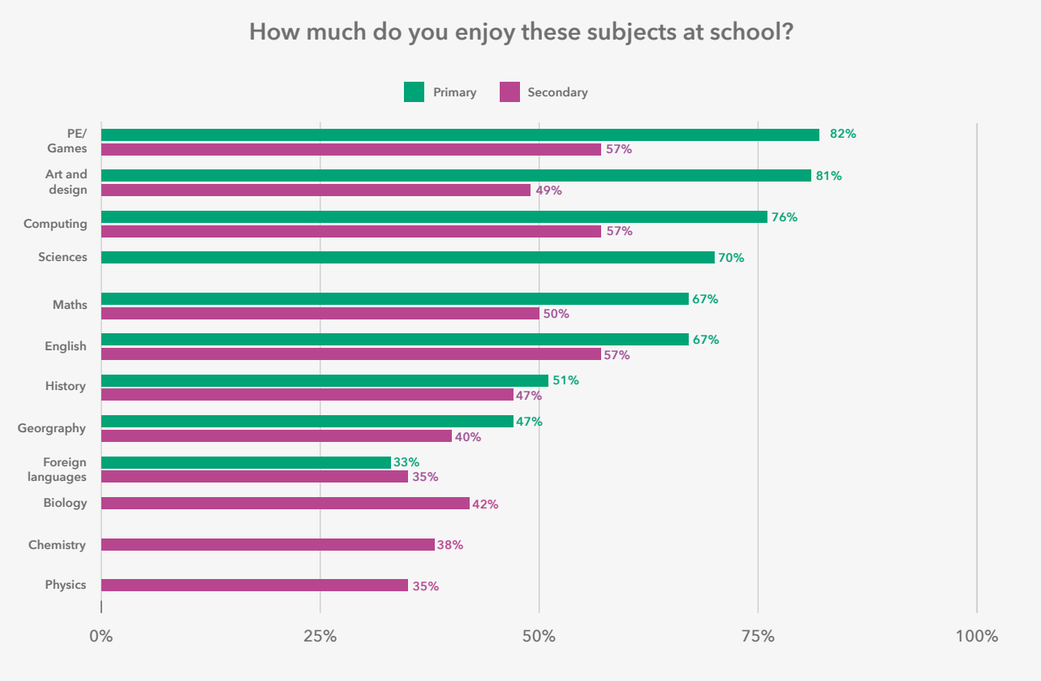
The National Curriculum, last updated in 2014, places a high value on learning maths. It says that maths is *'essential to everyday life, critical to science, technology and engineering, and necessary for financial literacy and most forms of employment.'*

Through our polling, most students, parents and employers agreed that learning maths is **important**:

- For students: **67%** **of students said that maths was the subject they expected to help them most when they are adults. This was followed by English, selected by 54% of primary children and 61% of secondary. This was then followed by computing** (**48%** primary, **41%** secondary) and sciences (**31%**, primary), both of which have strong links to maths.
- For parents: **98%** **of parents said maths was an important subject for their child to learn**. Additionally, when asked about the link between proficiency at maths and their child's future and career success, **93%** said that strong performance in GCSE Maths was important and **82%** said the same of A-level Maths.
- For employers: **over 75%** **of employers said that maths competencies are essential for most or all of the staff in their organisation to have** – and this increases for STEM-focussed organisations.

The National Curriculum also places a high value on enjoying learning maths. One of its defined purposes is for students to develop *'a sense of enjoyment and curiosity about the subject'*. While UK media habitually **paints maths as boring**, our polling of students in primary and secondary schools shows that **students and their teachers generally report a high level of enjoyment of maths** compared to other subjects.

- **At primary level, 67% of students said that they enjoy maths**. While enjoyment of maths for this group is below that of PE, art and design, and computing, it is similar to that of English and the sciences, and it is significantly higher than that of history, geography and foreign languages.
- **At secondary level, 50% of the students we polled said that they enjoy maths**. While this is a significant drop from the primary-level results, it is likely that this is due at least in part to external factors, as we see a drop replicated across all of the other subjects primary students enjoyed most (PE, art and design, and computing). However, the decrease in the enjoyment of English is lower, at only 10 percentage points, compared to 27 percentage points in maths. It is also worth noting that **international studies suggest that** secondary students in England enjoy maths, on average, about the same level as those in Singapore, arguably the highest-performing nation in maths education.
- **Encouragingly, these results tally closely to teacher perceptions**. Primary teachers' most common answer was that **61-80%** of their pupils find maths enjoyable, and secondary maths teachers' most common answer was that **41-60%** of their pupils enjoy the subject. This implies that teachers have a relatively good understanding of what their students enjoy, which helps them to think about how to maximise student enjoyment in their teaching.
- When breaking down the student polling results into smaller age ranges, we found that **enjoyment of maths drops relatively steadily over time**. There seems to be **a particular shift at the transition from Key Stages 1 to 2**, and at the transition to post-16 maths, which may well be driven by mandatory re-sits.



B. Over half of all teachers are underestimating how many of their students could pass GCSE maths

The 2014 curriculum reforms aimed to set England's national expectations on a par with those in some of the highest-performing education systems in the world. Internationally, England performs relatively well in maths, albeit just below the very highest-performing nations (using TIMSS and PISA data as a benchmark); it has improved over the last decade. But teacher expectations of students' performance by the end of Key Stage 4 – the point at which compulsory maths education stops in the UK – are very mixed.

When we asked secondary maths teachers how many of their students would not be able to achieve a grade 4 or above in GCSE Maths by the age of 19, regardless of what additional help they received:

- **50%** said that **11-30%** of all students would be unable to achieve this benchmark; and
- **8%** said that more than **30%** of all students would not be able to achieve this benchmark.

Teacher expectations varied significantly between schools with different deprivation levels. Among teachers in the most affluent schools, expectations were high, with just **4%** believing that more than **30%** of students would be unable to achieve a grade 4 by age 19. However, among teachers in the least affluent schools, this figure rose to **13%**.

According to our polling, students are more confident than their teachers about their ability to achieve this benchmark: **78%** of year 10 and 11s polled anticipated that they would achieve a grade 4 or above.

As part of our wider work, experts have estimated that only around **3%-6%** of young people have cognitive challenges which mean they are categorically unable to achieve this standard in maths, regardless of additional help they received.[3]

Together with the polling data above, this suggests a **significant disparity between what is possible according to cognitive science, and what teachers believe to be possible**, even with additional support for students. Given the evidence[4] that teacher expectations can have significant impact on student performance, this is a cause for concern.

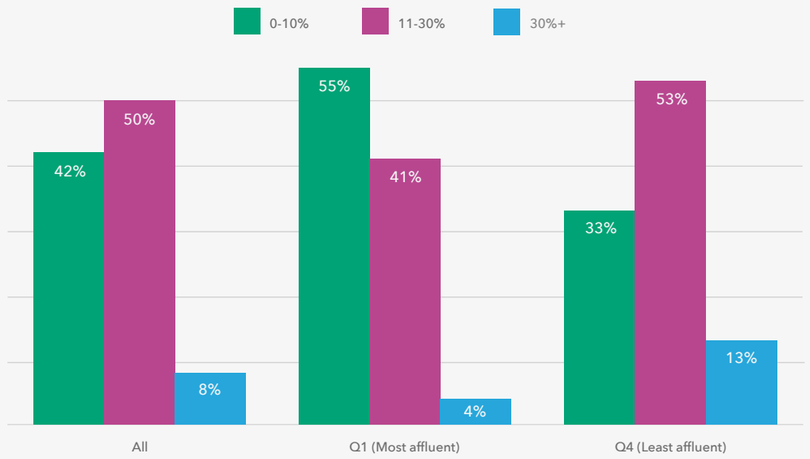
Many teachers show a similar lack of confidence when considering the potential of young people to progress to maths undergraduate study and beyond. Even though maths is the most chosen A-Level subject, our polling found that:

> Most secondary maths teachers believe that less than **20%** of students in their school demonstrate the potential to pursue university courses in maths or related fields (which may include engineering, computer science, physics or chemistry). Only **6%** of teachers indicated that more than **50%** of students in their school possess such potential.

> Again, significant differences emerged based on school demographics. Nearly **50%** of secondary maths teachers in the least affluent schools stated that less than **10%** of their students showed potential for university-level maths courses. This contrasts with less than **25%** of teachers in the most affluent schools.

What proportion of young people will not be able to achieve GCSE grade 4 by age 19, regardless of additional support?

Excluding "I don't know", and "not relevant/cannot answer"



C. Teachers report that the stated curriculum aims for maths education are not consistently achieved

There are significant gaps between the stated aims of the National Curriculum for maths and what teachers report their students achieve. The National Curriculum defines the purpose of studying maths as *"A high-quality mathematics education … provides a foundation for understanding the world, the ability to reason mathematically, an appreciation of the beauty and power of mathematics, and a sense of enjoyment and curiosity about the subject."*

We asked primary teachers and secondary maths teachers whether 80% or more of their students achieve each of the following aims to a reasonable standard for their age:

> Have a sense of enjoyment and curiosity about maths

> Are able to reason mathematically

> Can think, reason and apply their knowledge to solve problems

> Persevere in seeking solutions; and

> Appreciate the beauty and power of maths.

In each case, less than half of teachers reported that they did.

> **Respondents reported that there is insufficient time to master content, particularly at the primary phase, because of the volume of material in the National Curriculum.** In particular, they reported that pupils do not have sufficient time to build the fluency that builds strong foundations for confident progression to more complex maths. The volume of content to cover also leads to insufficient time to explore the *"beauty and power"* of maths, or to cultivate *"a sense of enjoyment and curiosity"*. As a result, some contributors to our first investigation described their child's or student's experiences of maths as stressful and anxiety-inducing.

"Stress, anxiety, too much in the primary curriculum" – A teacher in a SEND school.

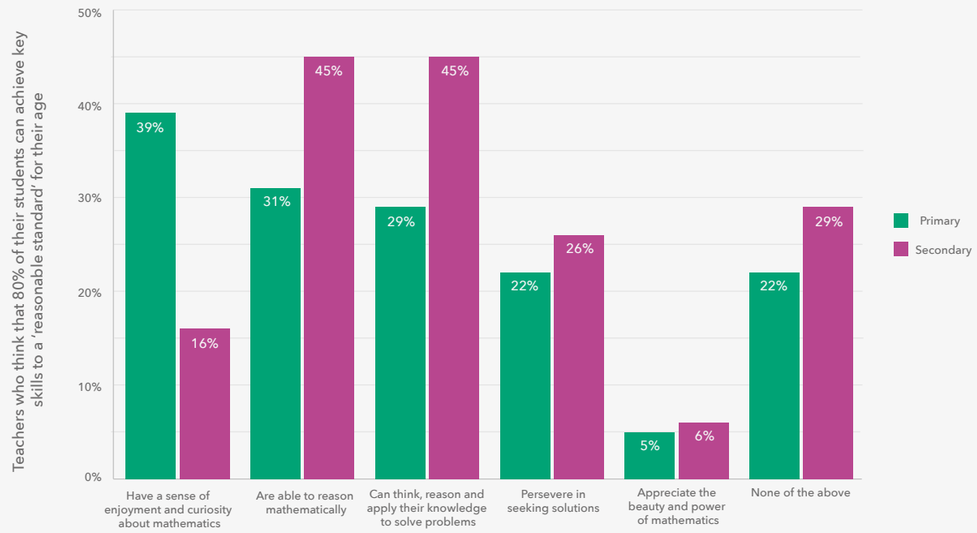
"Too much content taught too quickly" Student 1, now in higher education.

> **Respondents reported that accountability drivers, particularly at key stages 2 and 4, incentivise maths teachers to focus on test and exam practice, rather than building strong foundations.** Students, parents and teachers reported high stress as a result of what one described as a *"one assessment style fits all"* approach.

"The current approach to teaching, assessing, and examining maths in schools can cause stress, limit creativity, […] focus too heavily on rote memorisation, and discourage students who struggle with traditional methods." – An employer who contributed to Investigation 1.

"Only focusing on what you need to know to pass exams" – Student 2, now in higher education.

Children's attitudes and attainment in maths



> **Poor experience of transition between primary and secondary school.** Respondents said that secondary schools are often sceptical about incoming pupil data and subject knowledge, and that this often leads to the re-teaching of content. Respondents also said that the assessment system and workforce shortages lead to a prioritising the allocation of subject specialists to Key Stage 4 teaching, resulting in weaker content knowledge among some Key Stage 3 teachers. Students and parents report that this transition has a lack of continuity and of logical, achievable steps that help to build knowledge and confidence. Some feel – contrary to school performance data – that primary maths is lower performing than secondary maths, or that the teaching of it in primary is not trusted, leading to some repetition in Key Stage 3.

"The standards are low in primary school and going very high in high school." – An employer in Yorkshire and the Humber.

"A lot of content taught in primary is taught in secondary which feels like a waste of time"- Student 3, now in higher education.

These perceptions are not necessarily ones that the Maths Horizons Project endorses, but are shown to be representative of the views we heard.

D. The competencies most valued by employers are also the ones in which students are most confident

The topics that employers need most are also the topics that students feel most confident with, and that students say they have spent most time learning about.

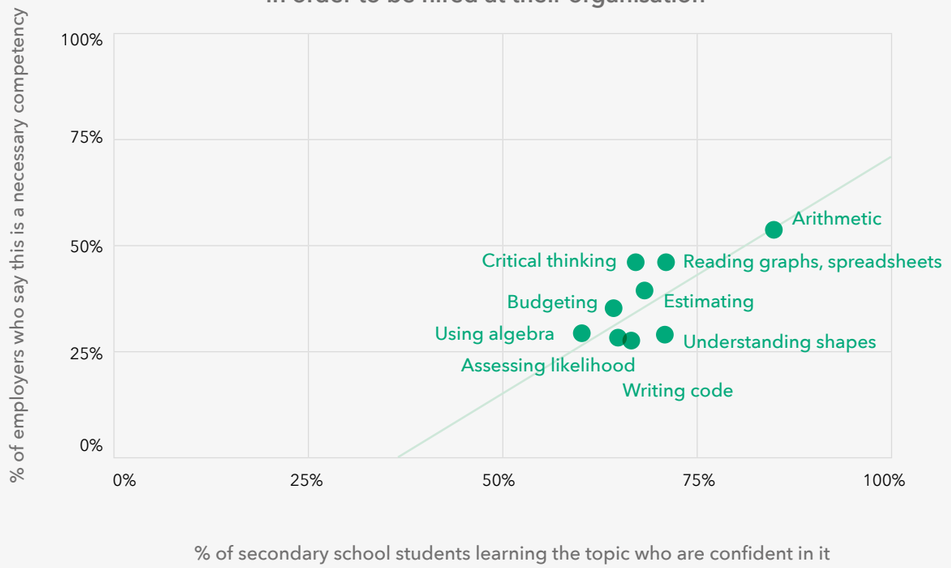
We asked employers to think about a typical role in their organisation and comment on how often employees in that role use a range of maths competencies. **The results showed that the competencies used most often were general arithmetic, use of data, critical thinking, and estimation of values**.

We also asked current students to tell us how confident they felt about the same list of competencies. The results showed that confidence with general arithmetic was highest (with **83%** saying they felt confident or very confident), followed by use of data (**71%**). Confidence in critical thinking was a little lower, at **69%**. Nonetheless, **there was generally a correlation between the maths competencies needed by employers and the maths competencies students felt most confident in**.

Interestingly, student confidence largely aligned with how much time they said that they spend learning each competency. Arithmetic, for example, was the area students felt most confident in and also the area that students spent most time learning about. However, there were some areas, such as algebra, where students lacked confidence despite relatively high amounts of time spent learning it.

Overall, the polling suggests an alignment between the content of the maths curriculum that is required from adults in the labour force, the prominence of these topics in the curriculum, and the confidence children feel having been taught those topics.

Confidence levels of secondary school students who are learning about each of the maths competencies plotted against employers who say this is a necessary competency in order to be hired at their organisation



E. Employer demand for maths competencies is mostly being met, but frontier tech companies are most likely to project demand in the future

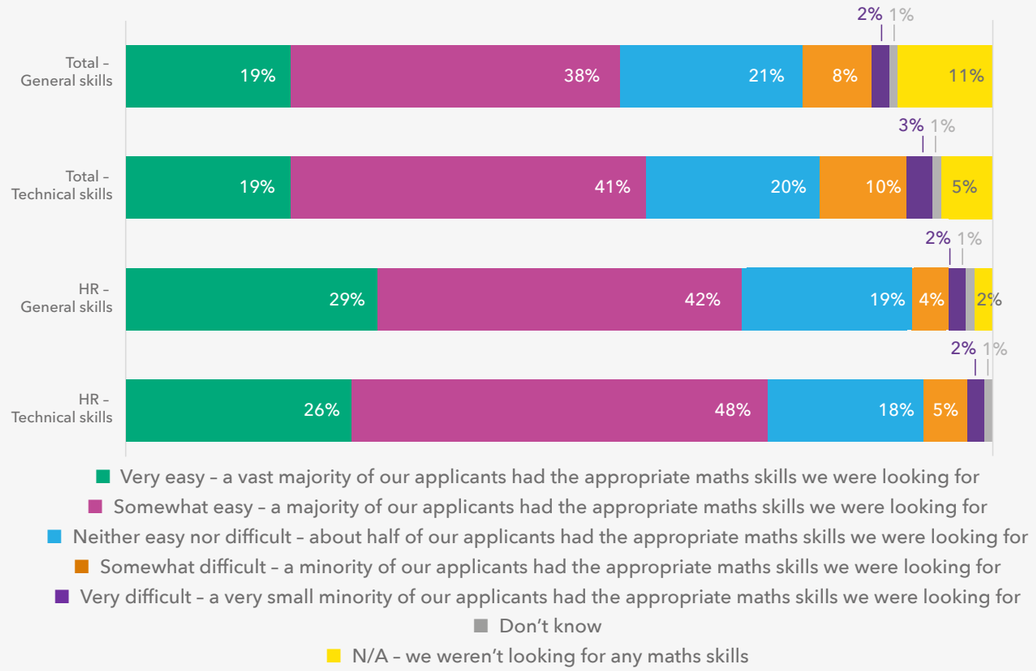
Although often cited as a significant barrier to economic growth and innovation, our polling did **not find that the typical employer[5] reported difficulty in recruiting staff with the maths competencies they require.**

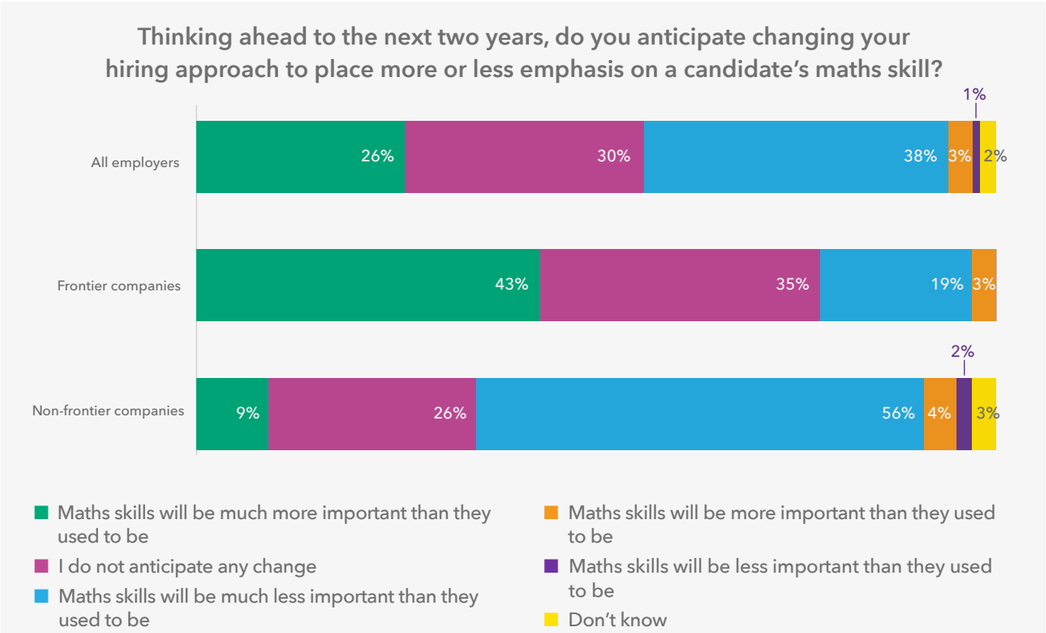
79% of employers in our polling said that maths was essential for most or all of their staff, with slightly higher levels of agreement from respondents in STEM-focussed companies and from respondents who worked in HR functions, and therefore had a broader perspective on recruitment.

Third-party assessments often conclude[6] that skills shortages are a major barrier to further economic growth, or innovation in the labour market, especially in STEM careers. But, contrary to frequent discussion on these skills shortages, **when we explored employers' current and forecast demand for maths competencies, 57% of respondents said that filling vacancies with appropriately maths-skilled candidates 'very easy' or 'somewhat easy'**. A further **21%** said filling vacancies with appropriately maths-skilled candidates was 'neither easy nor difficult'.

Even for what we defined as technical roles in these companies – those requiring a higher standard of maths – few employers or HR representatives reported difficulties in recruiting. **60% of employers recruiting for technical roles said it was 'easy' or 'very easy' to find candidates with the necessary maths competencies, with a further 20% saying it was 'neither easy nor difficult'.** Only **3%** of this group reported it to be 'very difficult'.

Ease of hiring in the necessary maths competencies for the general and technical roles at firms, by all employers and those in HR roles





While this finding goes against the 'maths skills shortage' narrative, it may be because our analysis suggests that, in non-technical companies, the most mathematically technical roles tend to be finance roles, for which the maths competencies themselves are relatively accessible and widely held.

We also looked at frontier tech companies, those saying that most or all of their roles require advanced mathematical competencies: these companies were just as likely as non-technical companies to report relative ease in hiring for both general and technical roles at the current time.

We also polled employers to understand their projected recruitment needs in the future. Here, we found a much greater difference between frontier tech companies and typical companies:

- **78%** of the frontier tech companies we polled reported that they expect maths competencies to become more important in the next two years, compared with **35%** of the typical companies (i.e. not frontier tech companies).
- For typical companies, the competencies that they reported needing most were arithmetical and financial, rather than competencies in things like coding, use of large language models (LLMs) or calculus.

In general, our polling shows that the likely forthcoming adoption of AI into the labour market is still anticipated less by most employers than by some of the AI experts that we consulted. However, most employers think that maths competencies will become more important over time. When asked to think about the hiring decisions they will be making in two years' time, **56%** of all employers reported that they expected maths competencies will be more important than they are now. This rises to **75%** for people working in HR roles, who we might expect to have a greater involvement in workforce planning decisions than line managers.

We also conducted some polling that asked what respondents thought would be the impact of AI on employment. The nationally representative sample of the general public we surveyed was broadly unsure what advances in AI mean for learning maths, whereas **35%** of all employers said that advances in AI mean it is more important now to learn competencies in maths. By contrast, a quarter (**25%**) of secondary school students said that advances in AI makes learning maths competencies more important.

Section 4: Next Steps

Building on the findings we have set out above, the second phase of the Maths Horizons Project will delve more deeply into a number of key areas, with the goal of informing actionable recommendations for improving maths education in England.

Specifically, we aim to investigate the following:

1. Understanding and shaping teacher expectations in maths education

We will explore the factors contributing to teachers' perceptions of what students can achieve in GCSE maths and beyond, including professional development, systemic pressures, and classroom challenges. We aim to identify strategies to raise teacher expectations without overburdening teachers.

2. Aligning stated curriculum aims with classroom reality

Recognising that teachers report inconsistency between the National Curriculum aims for maths education and what is achieved in practice, we will analyse the barriers. This will include examining curriculum design, assessment frameworks, teacher support, and accountability structures.

3. Strengthening the link between maths education and workplace needs

While we have found that the competencies valued by employers align with students' confidence areas, we will explore how well maths education prepares students for current and future workforce demands. This includes investigating access to A-Level Further Maths and STEM pathways, particularly in underrepresented schools, and examining how maths education can better equip students for emerging roles in frontier tech sectors.

4. Promoting enjoyment and value in maths

Given that most students and parents see maths as both enjoyable and valuable, we will investigate how to sustain and enhance this positive perception. This will include analysing what drives enjoyment in the subject and how the curriculum, teaching strategies, and resources can better engage students across all phases of education, ensuring this perception translates into long-term mathematical achievement.

5. Maximising opportunity for all

We will assess the factors that impact students' access to high-quality maths education, teacher expectations, and progression to advanced study. This strand of the review will explore practical, scalable solutions ensure that all students have the opportunity to succeed in maths.

The second phase will combine further quantitative analysis with in-depth qualitative research, engaging a wide range of stakeholders, including teachers, school leaders, parents, employers, and policymakers. By the conclusion of the review in April 2025, we aim to provide clear, evidence-based recommendations to improve the quality and future focus of maths education in England.

In our Final Report we will:

- Put forward a detailed framework for conceptualising the different factors at play in curriculum and assessment reform, thus avoiding unhelpful conflation of aims and arguments and helping policymakers to visualise the trade-offs involved in pursuing different options.
- Identify improvements that will be designed to improve the maths curriculum and assessment regime in England and support the government's ongoing curriculum and assessment review.
- Determine a number of transformational changes that could be considered, laying out research, pilots or steps needed to establish the evidence and pathway to developing and implementing these.

References

[1] **Public First** is a research agency that conducts opinion polls using nationally representative samples, with results weighted by factors such as age, gender, region, and social grade to ensure balanced data.

[2] **Teacher Tapp** is a daily survey app where over 10,000 teachers in England answer questions about school life, with responses weighted to reflect national demographics, ensuring representative data.

[3] For example Morsanyi, K., van Bers, B. M. C. W., McCormack, T., & McGourty, J. (2018). The prevalence of specific learning disorder in mathematics and comorbidity with other developmental disorders in primary school age children. British Journal of Psychology, 109(4), 917-940 Available at https://doi.org/10.1111/bjop.12322 or Haberstroh, S., & Schulte-Körne, G. (2022). The Cognitive Profile of Math Difficulties: A Meta-Analysis Based on Clinical Criteria. Frontiers in psychology, 13, 842391. https://doi.org/10.3389/fpsyg.2022.842391 or as cited in National Numeracy, "What is dyscalculia and how can it be spotted and supported in children and adults?" https://www.nationalnumeracy.org.uk/news/what-dyscalculia-and-how-can-it-be-spotted-and-supported-children-and-adults

[4] Coe, R., Rauch, C. J., Kime, S., & Singleton, D. (2019). Great Teaching Toolkit: Evidence Review. p. 26. Evidence Based Education. [Online] Available at: https://assets.website-files.com/5ee28729f7b4a5fa99bef2b3/5ee9f507021911ae35ac6c4d_EBE_GTT_EVIDENCE%20REVIEW_DIGITAL.pdf 1 [Accessed 24 January 2025]

[5] That is, not one of the minority in our study who defined themselves as being in a STEM industry, or requiring the majority or all of their staff to have advanced mathematical skills

[6] https://reports.weforum.org/docs/WEF_Future_of_Jobs_Report_2025.pdf; https://www.nfer.ac.uk/publications/the-skills-imperative-2035-an-analysis-of-the-demand-for-skills-in-the-labour-market-in-2035/

MATHS
HORIZONS

mathshorizons.uk