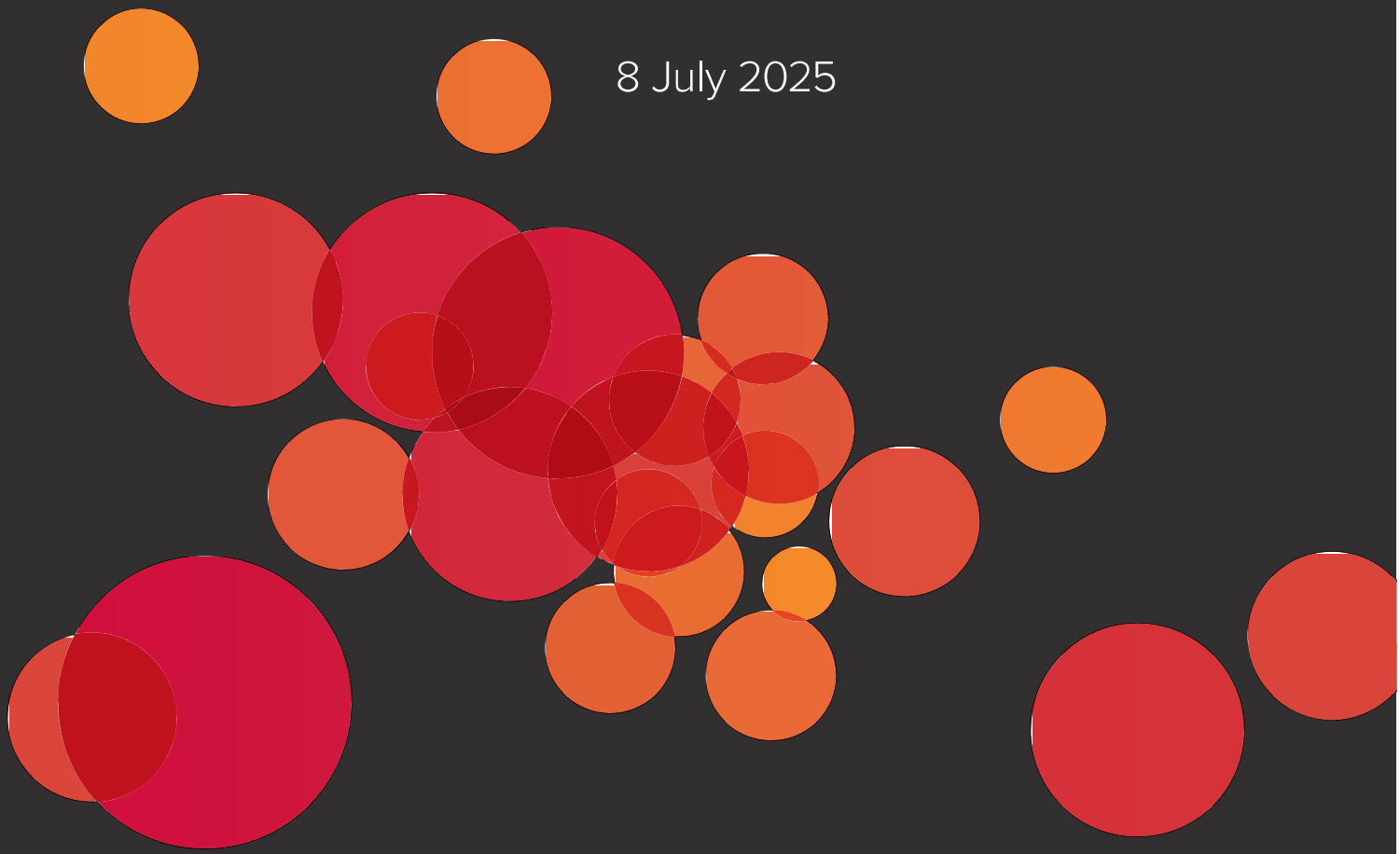
A new approach to mathematical and data education: an agenda for change

Conference booklet

8 July 2025



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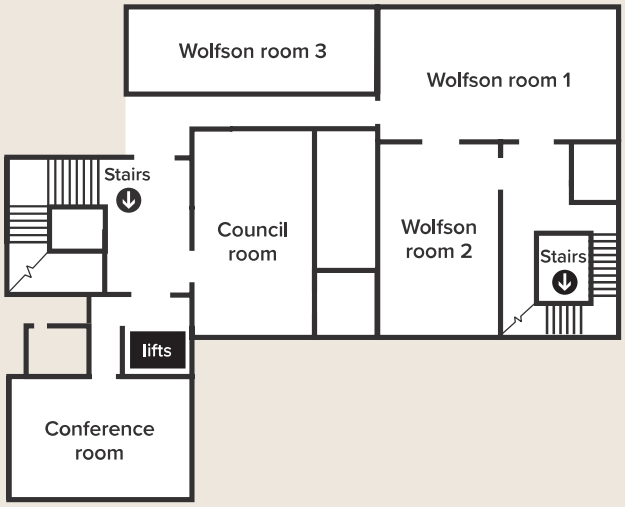
First floor



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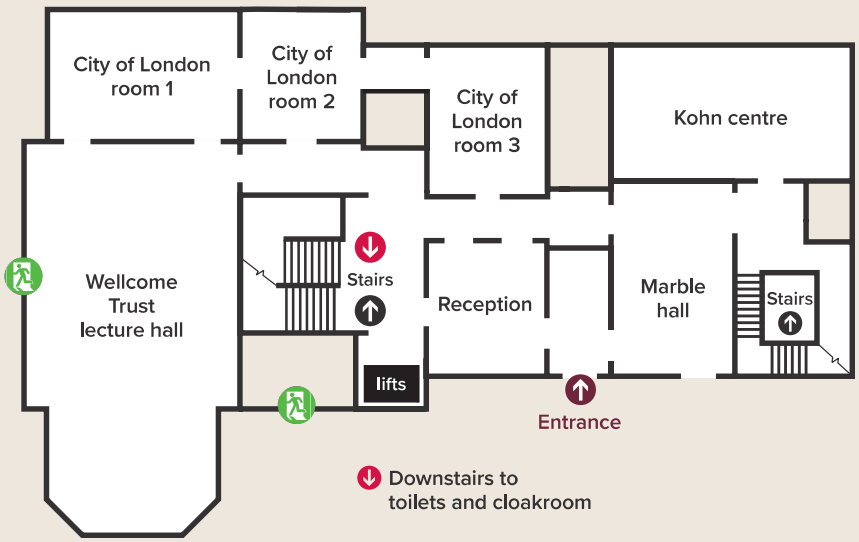

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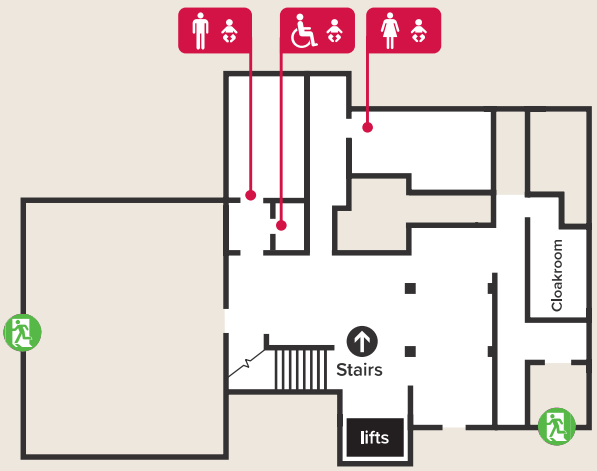

Key information

The conference will take place in the Kohn Centre and the adjoining Marble Hall on the ground floor. A cloakroom facility is located in City of London room 3, adjacent to the Kohn Centre.

Royal Society staff will be present throughout the meeting and are identifiable by red lanyards or gold name badges should you have any questions or need to seek any additional information or support. The conference registration desk will also be staffed.

Accessibility

The Royal Society is committed to continued improvement of accessibility at our events.

- A visual map of the building is included in this booklet which includes the location of the entrance, fire exits and toilets.
- Regular breaks have been incorporated into the conference agenda.
- A quiet room is available for use throughout the day.
- The seating area at the base of the Marble Hall staircase is available for use throughout the day.
- Accessible toilet facilities are located in a non-public area on the ground floor.

If you require assistance, please ask a member of staff, who will be identifiable by red lanyards or gold name badges.

Catering

Lunch will be served in the Marble Hall (adjacent to the Kohn Centre) at 13:00 and refreshments will be served throughout the day. Any dietary requirements noted in advance of the event have been catered for.

Cloakroom

There is a cloakroom available for your use in City of London room 3. Please note this will not be staffed, so belongings are left at your own risk.

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If a continuous fire alarm sounds, it is not a test. Please vacate the building via the nearest marked fire exit.

- **Do not stop to collect your belongings**
- **Do not use the lifts**
- **Do not re-enter the building until authorised**

Please assemble at the emergency point (located at the top of the Duke of York steps to the right of the Royal Society as you exit). Fire Wardens will lead the group to the assembly point and report to the roll-call officer.

First Aid

A first aider can be called by contacting the main building reception, or by asking a member of the Royal Society team for assistance.

Photographer

A photographer will be present during the event, and photographs taken may be used in reports, on our website, and in social media posts. If you would prefer not to be photographed, please take a sticker from the conference reception desk and wear it prominently.

Quiet Room

A designated quiet room is located in the corner of the Marble Hall, directly beneath the staircase.

Recording

This conference proceedings will be recorded to aid in the production of a post-conference write-up and will be deleted when no longer required.

Safeguarding

Please contact a member of staff if you have a safeguarding concern.

Smoking

Smoking and vaping are not permitted in any part of the Royal Society (including the terrace, forecourt or balconies).

Social Media

We encourage participants to post on social media, using the hashtag #MathematicalFutures.

Toilets

Toilets are located on the lower ground floor, which can be reached via the main staircase beyond the reception area, or by using the lifts.

There is an accessible toilet on the ground floor which is located in a non-public area. Please ask a member of staff who will assist.

Share your views

We're keen to ensure we capture your views on today's discussions. If you don't get an opportunity to offer them during the day, or would like to add more detail, please do so using this link:

The form will be live until 21:00 on 14 July 2025.

Welcome

Welcome to the re-launch of our annual conference.

It should be self-evident that it is our duty, as a society, to offer an education to our children which prepares them for the world they will face as adults. This means that we must offer an education that gives our young people the tools they will need to succeed in their rapidly changing world; an education that prepares them for the world of work; an education that gives them the confidence to contribute to building a world that is healthier, more stable, and a prosperous place where all can thrive.

Thus, living in an ever-more complex data-driven digital environment, with relentless advances in technology, it is vital that our young people are offered a Mathematical and Data Education fit for the 21st century. That they should all leave school with the competence and confidence to navigate this world increasingly dominated by mathematics and data.

In 2024 the Royal Society published the report **"A New Approach to Mathematical and Data Education"** which sets out an ambitious and exciting vision for the future.

In this conference, we hope to explore many aspects of this vision. We ask fundamental questions: **WHY** do we maintain that an effective mathematical and data education is *fundamental* to personal, societal and planetary well-being? **WHAT** should we be teaching - what *is* a mathematical and data education that is fit for the future? **HOW** can this be delivered? What role will new technologies play in our schools? **WHO** will deliver this education? Can we build a coalition of specialist teachers, teachers in other disciplines, and those who use maths in their everyday world, including employers? **HOW** can we build a pathway through mathematics education that allows children to develop key competencies and confidence in their ability to manage mathematical concepts and tools and understand data?

The aims of this conference are two-fold:

Firstly, it is to share and discuss the recommendations for the future of mathematical and data education and, more importantly, in the light of the Government's Curriculum and Assessment Review, to start to build a coalition of the willing (and the well-positioned) to deliver on the aims.

Secondly, it is imperative that we hear the views of you, the delegates, as we consider what our priorities should be as we move forward to ensure that our young people, the citizens of the future, will be offered the mathematical and data education they deserve.

I thank you for your participation and look forward to working with you all in the future.

Professor Jane Clarke FMedSci FRS
Chair of the Royal Society Advisory Committee on Mathematical Education

Royal Society Advisory Committee on Mathematics Education (RS ACME)

RS ACME provides authoritative and considered advice on high-level, cross-cutting issues in mathematical and data education and beyond. Importantly, as a committee of the Royal Society, we explicitly consider mathematics and data in a broad context, contributing to the Royal Society's mission: *"to recognise, promote and support excellence in science and to encourage the development and use of science for the benefit of humanity."* As part of the Society's broader work advocating education reform, RS ACME is working towards a world-leading education system in England where all young people develop high levels of mathematical and data competence and confidence.
RS ACME is made up of high-level experts with an interest in mathematical and quantitative education from the Fellowship, classroom, research and industry.

It currently has eight members:
Jane Clarke, Chair
Jon Coles
Noel-Ann Bradshaw (ex-officio, JMC)
Helen Drury
Lynne McClure (ex-officio, Academy for Mathematical Sciences)
Andy Noyes
Simon Peyton Jones
Anthony Tomei

The committee works closely with the Joint Mathematical Council (JMC), the Academy of Mathematical sciences (AMS), the Institute of Mathematics and its Applications (IMA), the London Mathematical Society (LMS) and the Royal Statistical Society (RSS). RS ACME also draws on the experience of its Expert Panels, spanning different phases of education, whose chairs represent panel members at committee meetings.

With support from a consortium of industry partners, and its academic partners, RS ACME has overseen the work of the Mathematical Futures Programme, which resulted in the publication of the report: "A New Approach to Mathematical and Data Education". In recent years, the committee has addressed a number of other important issues in mathematics education, including developing a Qualifications Assessment Framework for GCSE resits (2021) and developing a rationale for General Mathematical Competences for T levels.

RS ACME has long supported Core Maths qualifications which are designed for post-16 students with a grade 4 or above in GCSE mathematics. 'Core Maths' encompasses several qualifications which develop understanding of mathematics and data in their broadest sense. They help to equip students with the mathematical, statistical and data skills needed for their post-16 studies in most subjects, for personal development, financial awareness, and employment. Core Maths qualifications are designed to meet the substantial unmet demand from UK employers for quantitatively skilled people – including in arts, humanities, sciences and social sciences. The Society has published statements in collaboration with the British Academy calling for wider uptake of these valuable qualifications which 'A new approach to mathematical and data education' advocates as one step towards achieving the report's vision.

Further information can be found on the Royal Society website.

Programme

10am **Registration and refreshments**

10.30am **Opening remarks by conference chair**
Professor Jane Clarke FMedSci FRS, Chair, RS ACME

10.40am **Keynote address**
The case for change: why mathematical and data education matters for everyone
Sir Adrian Smith, President, The Royal Society

11am **Panel discussion 1**
Why we need to change the conversation around mathematical education

A Mathematical and Data Education (MDE) underpins wellbeing and social justice, as well as developing a talent pipeline for the future.

The government is committed to ensuring everyone has access, skills, support, and confidence to engage in our modern digital society and economy. A world-class mathematical and data education, designed to meet the needs of our young people, should be a foundational element of everyone's education, regardless of future aspirations. Ensuring an excellent MDE is a social equity solution that offers the government a key to unlocking increased growth and productivity by producing a talent pipeline for the future, whilst also increasing the life chances of all young people.

Chair: Lord Jim Knight, Chair, STEM Learning
Sir Leszek Borysiewicz GBE FMedSci FRS, Vice-Chancellor Emeritus, University of Cambridge
Sam Sims, Chief Executive, National Numeracy
Rachel Sylvester, Political Editor, The Observer; former Chair of the Times Education Commission

11.50am **Refreshment break**

12.10pm **Panel discussion 2**
Mathematical education in the digital age: integrating computational tools and technology

Maths education has changed very little for decades. While the underlying ideas remain, the tools available to interrogate and interpret the mass of data now available are powerful and many. Young people will need to understand how to use the power of computing in all dimensions of their lives, and technology used in school and college should more closely reflect what is widely available in most workplaces.

Chair: Sir Kevan Collins, Non-Executive Board Director, DfE (and Chair, Digital, AI and Technology Task and Finish Group)
Tom Button, Maths Technology Specialist, MEI
Professor Alison Clark-Wilson, Professorial Research Fellow, IOE, UCL
Dr Matthew Forshaw, Senior Advisor for Skills, Alan Turing Institute

1pm **Lunch**

2pm **Introduction to the afternoon session by the conference chair**

2.10pm **Panel discussion 3**
Mathematical and data education beyond the 'maths classroom': implications of MDE across the curriculum (at all stages)

There are very few, if any, areas of learning that children and young people are likely to experience that don't include some kind of quantitative reasoning. Our vision for the future imagines that while mathematical principles and concepts may be first experienced in the 'maths lesson', these ideas will be taken further, explored and applied in many other areas of learning. So, all teachers, whatever their subject background or the age they teach, will make explicit the links to general quantitative literacy, or domain-specific competences that learners need to understand the world and communicate information. This has implications throughout the curriculum and its assessment.

Chair: Dame Alison Peacock, Chief Executive, Chartered College of Teaching
Steve Brace, Chief Executive, Geographical Association
Lynne McClure, Chair of the Education Workstream, Academy for the Mathematical Sciences
Liz Moorse, Chief Executive, Association for Citizenship Teaching

3pm **Refreshment break**

3.20pm **Panel discussion 4**
Maths pathways, assessment and qualifications

Qualifications and tests currently shape much of what takes place in classrooms because of their role in 'holding schools to account'. How can we ensure our assessment system values what students can do with their mathematical and data education? And how can we free up more teaching time for exploration and understanding?
Our assessment and qualifications system must adapt to provide appropriate pathways for all young people, regardless of their future aspirations. Can we create flexibility in our system that encourages future mathematical scientists and offers mathematical and data skills for specific technical pathways, whilst also providing all young people with a firm understanding of the mathematical and data skills needed in everyday life?

Chair: Charles Clarke
Professor Noel-Ann Bradshaw, Deputy Dean, Faculty of Engineering and Science, University of Greenwich
Hannah Kitchen, Project Lead, Transitions in Upper Secondary Education, Directorate for Education and Skills, OECD
Professor Andy Noyes, Director, Observatory for Mathematical Education

4.10pm **Closing remarks by the conference chair**

4.30pm **Close**
Refreshments available until 5pm

Biographies

Sir Adrian Smith, President, The Royal Society

Adrian Smith became President of the Royal Society on 30 November 2020. He is a mathematician with expertise in Bayesian statistics. This branch of mathematics represents uncertainties in the form of probabilities, which are then modified through the mechanism of Bayes theorem as new information becomes available. Adrian's comprehensive publications on diverse areas of Bayesian statistics have had a major impact on statistical practice in a wide range of disciplines and application areas.

Between 2008 – 2012, he was Director General, Knowledge and Innovation in BIS (subsequently BEIS) and has previously worked with the UK Higher Education Funding and Research Councils. Between 2018 – 2023 he was Institute Director and Chief Executive of The Alan Turing Institute. Adrian was Chair of the Board of the Diamond Light Source between 2014 – 2024.

In 2017, he carried out a review of the maths curriculum for 16–18-year-olds for the Treasury and Department for Education. In the 2011 New Year Honours list, he was awarded the title of Knight Bachelor.

Conference Chair

Professor Jane Clarke FMedSci FRS, Chair, RS ACME

Jane Clarke is Emeritus Professor of Molecular Biophysics in the Yusuf Hamied Department of Chemistry at the University of Cambridge and former President of Wolfson College.

Jane's career is somewhat unusual. After several years teaching secondary school science in comprehensive schools, she started a PhD at the age of 40 with Professor Sir Alan Fersht in Cambridge. Following a postdoctoral fellowship in protein NMR spectroscopy at the MRC Centre for Protein Engineering in Cambridge, she won a Wellcome Trust Career Development Fellowship and joined the Chemistry Department in Cambridge University in 1997.

Her research has always been multidisciplinary, combining single molecule and ensemble biophysical techniques with protein engineering and simulations to investigate protein folding, misfolding and assembly. Her small research team included chemists, biochemists, physicists, and computer scientists drawn from across the globe. She retired from active research in 2017, when she joined Wolfson College as its sixth (and first scientist and first female) President.

As a mother and grandmother, Jane knows that it is possible to combine family life with a successful career. She has long been actively involved in mentoring, career development and leadership training for scientists at all stages in their careers. She is particularly committed to supporting women and other under-represented groups to enter and then remain working in science. "I know from my earliest years, encouraged by my science-teacher mother to be curious and confident, that great teaching is fundamental to success. We cannot underestimate the power of education to change lives, and the world, for the better."

It is this experience and understanding that Jane brings to RS ACME. “Although I am not a mathematician, I have used mathematics and data science every day throughout my scientific career; I have seen how large data has transformed research in biomedicine and other areas of scientific endeavour. Unusually for a Fellow of the Royal Society, I also taught maths for a number of years in comprehensive schools (a very significant proportion of maths lessons are taught by non- specialists). Thus, I truly appreciate the importance of offering all our children a mathematical and data education that will prepare them for their futures.”

Panel Discussion 1

Lord Jim Knight of Weymouth, Chair, STEM Learning

Jim Knight works in education, digital technology and as a legislator.

Jim is the Non-Executive Chair of a number of education boards: E-Act Multi Academy Trust, Council of British International Schools, Century-Tech and STEM Learning Ltd. He also sits on the Pearson Qualifications Committee and provides advice to Nord Anglia Education, the Brookings Institute, GoodNotes, Edwin Group and Everfi.

As a government minister and MP, Jim’s portfolio included rural affairs, schools, digital and employment, He was a member of Gordon Brown’s Cabinet, before joining the Lords in 2010. He regularly speaks in the Lords on education and technology policy. He is a member of the Communications and Digital Committee of the Lords.

Sir Leszek Borysiewicz GBE FMedSci FRS, Vice-Chancellor Emeritus, University of Cambridge

Leszek Borysiewicz is an influential scientific administrator who has promoted biomedical education and clinical research through a number of senior positions in UK institutions. His own research career centred on the immune response to common viruses, and his work on a human papillomavirus (HPV) vaccine led to routine immunisation for girls against cervical cancer.

Leszek contributed to our understanding of how the immune system fights off viral infection, and why ‘harmless’ viruses can sometimes cause disease. The most common cause of cervical cancer is infection with HPV. Leszek led a team to develop a therapeutic vaccine against HPV infection and headed its first clinical trial in Europe.

He was knighted for his vaccine research in 2001, the same year he moved to Imperial College London where he became Deputy Rector. In 2007, he was recruited as Chief Executive of the Medical Research Council until, in 2010, Leszek became the 345th Vice-Chancellor of the University of Cambridge.

Sam Sims, Chief Executive, National Numeracy

Sam joined National Numeracy as Chief Executive in 2020.

He has a broad range of experience in helping to scale-up the reach and impact of charities and education organisations. He was the Chief Operating Officer at social work charity, Frontline, and previously served as Director of Development at Teach First and as an Assistant Director

of Research at the Yale University Office of Development.

Sam has held trustee positions at a number of youth development and humanitarian aid charities and has degrees from University College London and the University of Oxford.

Rachel Sylvester, Political Editor, The Observer

Rachel Sylvester is political editor of The Observer and before that she was a political columnist at The Times. She chaired the Times Education Commission, which reported in 2022.

Panel Discussion 2

Sir Kevan Collins, Non-Executive Board Director, DfE (and Chair, Digital, AI and Technology Task and Finish Group)

Kevan is a non-executive board member at the Department of Education and adviser on school standards to the Secretary of State. Starting as a primary school teacher Kevan has served in a range of school, local and national leadership roles. He was appointed as England's Education Recovery Commissioner. Kevan was the first Chief Executive Officer of the Education Endowment Foundation (EEF). Between 2005 and 2011 Kevan was Chief Executive and Director of Children's Services in the London Borough of Tower Hamlets.

Kevan serves on UK based and international boards for a range of organisations working in the youth, education, and early learning sectors. Kevan completed his doctorate at Leeds University in 2001 and is a visiting professor at the University College London Institute of Education and holds honorary degrees from Durham, Lancaster, and Derby Universities.

Tom Button, Mathematics Technology Specialist, MEI

Tom Button is the Mathematics Technology Specialist for MEI. He taught in sixth form colleges before joining MEI in 2005. He is leading on MEI's innovative work providing data science courses for students and supporting teachers understanding the maths underpinning machine learning and AI. He is also passionate about the potential of technology to deepen students' understanding of maths and has both designed resources and delivered many teacher courses on this.

Professor Alison Clark-Wilson, Professorial Research Fellow, UCL Knowledge Lab, IOE - Faculty of Education and Society, University College London

Alison is a Professorial Research Fellow at UCL Knowledge Lab. She trained to teach secondary mathematics in England during the 1990s, which coincided with the development of a range of digital technologies in mathematics education. She piloted many of these in her classroom (spreadsheets, graphing calculators/softwares, and dynamic geometry softwares) before moving into academia to lead a number of award-winning curriculum design projects (RM MathsAlive!, Intel's Mathematical Toolkit) and online teacher professional learning initiatives (EdUmatics). Alison's 2010 PhD study introduced the Hiccup Theory of teacher learning, offering insights into the processes that underpin teachers' classroom-based professional learning.

Alison is currently involved in projects that aim to bridge the many gaps between academic knowledge, technology developments and teachers' classroom practices in mathematics education with the aim to improve the quality, and equitable access to digitally-enhanced mathematics education for all learners.

Alison is the author of over 50 publications. Her current research is focused on the leading edge of technological development in mathematics education (extended realities, artificially intelligent systems and teacher dashboards), with a firm eye on the trailing edge - how to continually support all teachers to learn about, and to implement digital technologies in their professional practices in discerning ways.

Dr Matt Forshaw, Senior Advisor for Skills, The Alan Turing Institute

Dr Matthew Forshaw is Senior Advisor for Skills to The Alan Turing Institute, the UK's national institute for Data Science and Artificial Intelligence, and a Reader in Data Science at Newcastle University, UK. His work in data and AI skills includes working with the Government on the skills pillar of the UK's National Data Strategy and National AI Strategy, as College of Experts member to the UK Department for Science, Innovation and Technology (DSIT), and leading the development of AI Skills for Business competency framework with Innovate UK BridgeAI.

His work on professionalisation of the data science occupation with the Alliance of Data Science Professionals is having a significant impact on public and professional policy and practice, setting professional values and ethical standards for the use of data science and AI for the UK's accreditation and certification processes across several major professional bodies. He is passionate about democratising access to, and widening participation into, data and AI skills training at all levels.

Panel Discussion 3

Dame Alison Peacock, Chief Executive, Chartered College of Teaching

Dame Alison Peacock is Chief Executive of the Chartered College of Teaching, a charitable Professional Body that seeks to empower a knowledgeable and respected teaching profession through membership and accreditation.

Prior to joining the Chartered College, Dame Alison was Executive Headteacher of The Wroxham School in Hertfordshire. Her career to date has spanned primary, secondary and advisory roles. She is an Honorary Fellow of Queens' College Cambridge, Hughes Hall Cambridge and UCL, a Visiting Professor of Glyndŵr University and a trustee for Big Change, the Helen Hamlyn Trust and an adviser to the Institute for Educational & Social Equity. She is a Director of the Edge Foundation and has honorary degrees from the University of Brighton and University of Bath Spa. She is a Deputy Lieutenant for Hertfordshire.

Her research is published in a series of books about Learning without Limits offering an alternative approach to inclusive school improvement.

Steve Brace, Chief Executive, Geographical Association

Steve is the Chief Executive of the Geographical Association (GA). He started his career as a geography teacher. Before joining the Geographical Association, he led the educational work of the Royal Geographical Society, the Commonwealth Institute and ActionAid.

Steve has also worked closely with Government, the awarding organisations and other key stakeholders on reform of the geography curriculum, its GCSEs and A Levels.

Lynne McClure, Chair - Education Workstream, Academy for the Mathematical Sciences

Until her retirement, Lynne was the Head of Mathematics Solutions at Cambridge Partnership for Education at the University of Cambridge.

Previous project leadership roles include as Director of Cambridge Mathematics, Director of NRICH and PI on the Government funded A-level project Underground Mathematics. Lynne was President of the Mathematical Association in 2014/5 and Executive Chair of ISDDE in 2017-18.

Lynne is active in various mathematics education communities including as chair of governors of the Cambridge Maths School, and a trustee of National Numeracy and MathsWorldUK. She is a member of the DfE Digital AI and Technical task and finish group. Lynne was a member of ACME from 2009 to 2013, again from 2017 to 2020, and now is an ex officio member as chair of the Academy for the Mathematical Sciences Education workstream. She was a member of the Mathematical Futures Programme Board and writing group and previously also sat on the Royal Society Partnership Grants Panel.

In 2022 she was awarded an OBE for services to education.

Liz Moorse, Chief Executive, Association for Citizenship Teaching

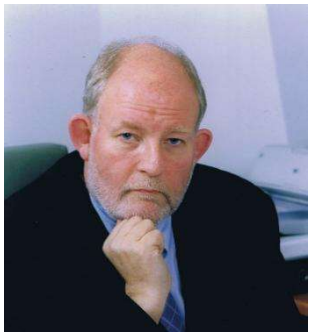
"Working with citizenship teachers is inspirational and shows the power and impact of high quality subject teaching for young people every day."

Liz leads the Association for Citizenship Teaching, a subject association, membership and education charity who are the voice for Citizenship education. Working with our Board of Trustees, Teacher Council and staff Liz oversees the implementation of our strategic plan including key programmes: the Active Citizenship in Schools Programme and the Five Nations Network in the UK and Ireland.

She has a MSc Politics and Public Policy from Birkbeck London and a BA Hons Geography with Archaeology from Manchester University.

Liz has worked in education for over twenty-five years and led the development of Citizenship as a new curriculum subject in previous roles for central government. She has expertise in national curriculum reviews, curriculum design and national policy. Liz is a Director of the Council for Subject Associations. She is also the Department for Education's UK representative to the Council of Europe Education Policy Network on Democratic Citizenship and Human Rights and a member of the Advisory Board on Sustainable Development. Liz is a regular speaker at conferences and has written extensively on Citizenship education in the curriculum.

Panel Discussion 4



Charles Clarke

Charles Clarke read mathematics and economics at Kings College Cambridge. He is now Visiting Professor in Politics at the University of East Anglia.

He was President of the National Union of Students and then a Labour councillor in Hackney before working for Neil Kinnock, the Leader of the Labour Party, as his Chief of Staff.

He was elected Labour MP for Norwich South from 1997 to 2010. In 1998 he joined the government, first as a junior Minister and then joining the Cabinet in 2001 as Labour Party Chair, then Secretary of State for Education and Skills and finally Home Secretary until 2006.

www.charlesclarke.org

Professor Noel-Ann Bradshaw, Deputy Dean of Engineering and Science, University of Greenwich

Noel-Ann Bradshaw is Professor of Operational Research and Mathematics Education, and Deputy Dean of Engineering and Science at the University of Greenwich. She is Chair of the Joint Mathematical Council of the UK (JMC) and a member of the Education workstream for the Academy of Mathematical Sciences. She is also Chair of the Higher Education Committee for the Institute of Mathematics and its Applications (IMA) and a past IMA Vice President Communications.

Noel-Ann came into academia after completing her BSc Mathematics degree as a mature student in 2007. She obtained her Doctorate from

Middlesex University in 2019 on Innovations in Mathematics Education in HE. Prior to that, whilst bringing up a young family, she worked as a numeracy specialist in a pre-school and also taught numeracy to adult learners. As well as working in academia, she has also spent time in industry as a Senior Data Scientist working on problems related to optimising the supply chain.

Hannah Kitchen, Project Lead, Transitions in Upper Secondary Education and Career Readiness, Directorate for Education and Skills, OECD

Hannah Kitchen is a Senior Policy Analyst in the OECD Directorate for Education and Skills, where she currently leads the Transitions in Upper Secondary and Career Readiness projects. She leads work on assessment and certification, upper secondary pathways and teenage career activities and guidance.

Hannah has contributed to, and overseen, a wide range of OECD publications about upper secondary education, notably on its design, student transitions, assessing social and emotional skills and mathematics provision, as well as tailored policy reviews for England, Lithuania and Wales. In the past, Hannah has led and contributed to OECD Reviews on Evaluation and Assessment in Turkey, Romania, North Macedonia, Serbia and Morocco. Prior to this, Hannah worked in the OECD's Directorate for Public Governance and Territorial Development providing advice to governments to improve public service delivery.

Hannah started her career in the UK Treasury working on public sector reform. Hannah studied modern history and politics at the University of Oxford and international economics at Sciences Po, Paris.

Professor Andy Noyes, Director, Observatory for Mathematical Education

Andy is a Professor of Education at the University of Nottingham and the founding Director of the Observatory for Mathematical Education. He joined the University in 2001, after teaching mathematics in a Nottinghamshire secondary school. He led the PGCE and Professional Doctorate programmes before becoming Head of the School of Education (2014-18) and Associate Pro Vice Chancellor for Research and Knowledge Exchange from 2018-20.

Andy's research in mathematics education stretches from primary schools to further and higher education. He was Chair of the Joint Mathematical Council of the UK from 2018-24 and advises a range of projects and organisations

Message from Professor Becky Francis CBE on behalf of the Curriculum and Assessment Review Panel

Over the course of the review, it has become clear that there is much to celebrate within maths education in England. The current curriculum is rigorous and ambitious and sets up many high attainers for success in further study or to progress into the world of work. It is important that these strengths are retained and built on to ensure the continued popularity of the A level Mathematics and the continued strong performance of pupils in England relative to other high-performing nations.

There are, however, too many pupils for whom the current system is not working well. Many low attainers are being left behind, which is evidenced by the number of pupils not achieving their grade 4 at level 2 at age 16, and again by the very small proportion of these pupils who go on to secure grade 4 by 19 after resits. Many of these pupils are often unable to demonstrate basic competencies, a situation which we must not allow to continue. Pupil experience of GSCE Mathematics, both pre-16 and post-16, is something we are continuing to look at very carefully.

The challenges are not just confined to KS4. We have been made aware of difficulties with transitions between key stages – particularly between KS2 and KS3. This is often attributed to a lack of continuity caused by the range of learning experiences of incoming students. This reportedly leads to teachers revisiting KS2 material in Year 7 so that learning gaps can be identified, often holding back those pupils who have a secure grasp of the KS2 concepts.

To address this, we are assessing the content at each key stage and see an opportunity to better distribute the points at which new concepts are introduced, delaying more complex topics to later key stages. Specifically, we believe there is scope to shift some content from KS1 to KS2, and from KS2 to KS3 and streamline topics currently covered in both KS2 and KS3, ensuring certain material is introduced for the first time in KS3. This approach will help pupils develop fluency, build mastery, and apply their knowledge across different contexts, without compromising the breadth or depth of learning.

The review is also looking at the wider qualification and assessment framework, including how this is working for individual subjects. In the interim report, we signalled a number of strengths in the current assessment system at primary school. Assessments rightly focus on the core skills of reading, writing and maths, which are essential to equip pupils with the knowledge and skills they need to succeed as they transition to secondary school and throughout their lives. As such, there are no plans for any significant change in this area for maths.

The Review will publish its final report in autumn 2025. The report will set out recommendations for government across the keys areas of focus identified in the interim report, which are those areas where the expert panel sees the greatest opportunities and need for improvement. We expect to recommend a phased programme of work in different subjects and areas to allow reforms to be made incrementally in a way that does not destabilise the system. The panel are mindful of capacity issues and the need to retain and build on those aspects of the system that are working well.

The Government will publish a response to the final report which will include next steps to deliver the accepted recommendations. The Government has been clear that it will ensure that schools, colleges and teachers have sufficient time to plan and prepare for changes. Once the Government is clear about the level of change required, it will determine how best to support teachers and leaders to implement these reforms. The Government will work closely with the sector during the next phase of work.

Key questions from the Curriculum and Assessment Review team for conference delegates:

- Does the 'integration of computational tools and technology' into maths necessitate addition of content on such things – or would these simply be aids to teaching?

- What is your view on the existing content relating to 'data' in the maths curriculum? Does it go far enough? If not, in which key stages would you like to see more, and how do you reconcile this with suggestions that there is already too much content in the maths curriculum?

- Do you feel that providing pupils with a good financial education is the responsibility of maths or should this sit elsewhere in the curriculum? Is there any content missing from the current maths curriculum that would support a pupil's financial literacy?

- What changes, if any, to a) curriculum and b) assessment would you consider to be beneficial **pre-16** to support pupils not achieving grade 4 by 16?

A new approach to mathematical and data education

An agenda for change

In the 21st century, the scope and application of mathematics have undergone a remarkable expansion, partly driven by an unprecedented surge in data availability, computing capabilities, and statistical methodologies. Data now plays a pivotal role in both employment and everyday life.

With increased demand for communication, collaboration and problem-solving skills, there is greater need for mathematically- and data-educated people. Mathematical and data literacy has become fundamental for daily life, but too many citizens have poor numeracy and too few are trained to the high levels of mathematical and data competence that will be needed in the future. This has serious implications for the future health of the UK economy. The rise of big data, machine learning and AI demands a shift towards statistics, data science and computing.

The scope of mathematical education needs to change from 'mathematics' to what we have called mathematical and data education (MDE); a combination of mathematics, statistics and data science, underpinned by computational tools.

MDE has three interconnected elements which, taken together, provide the skills and competences that individuals and society need to thrive:

• Foundational and advanced mathematics
An evolution of the maths currently taught in school, with greater emphasis on data, technology and computing. It will continue to reflect the subject as a canon of knowledge that can be studied to the highest level.

• General quantitative literacy
Addressing the need for all students to confidently apply their mathematical and data skills to common, real-world, quantitative problems in a range of educational, employment and everyday contexts.

• Domain-specific competences
Recognition that mathematical and data skills are increasingly used within the classroom and beyond, in job or domain-specific contexts.

Mathematical and data education – where are we now?

Across the UK, mathematics education has made progress over the past twenty years. It serves some students well, but lets too many down. There are wide gaps between the lowest and highest achievers, with a long tail of underachievement, linked to economic disadvantage.

Children's progress in mathematics slows as they transition from primary to secondary school, and their attitudes towards mathematics decline. Gaps between high and low achievers widen in key stage 3 (ages 11–14). This particularly impacts pupils from disadvantaged backgrounds.

In England, the qualifications and assessment system means that around a third of students leave compulsory education without a GCSE pass in maths and with an enduring sense of failure, while for many who do achieve a higher GCSE grade there are few appropriate opportunities to continue their mathematical education.

Modern data and computational concepts and tools are largely absent from mathematical education as it is currently practised, while problem solving and application of mathematical learning in meaningful contexts are not given high priority.

There is a long-standing shortage of qualified mathematics teachers, which is most evident in lower secondary years (ages 11 – 14).

The future: mathematical and data education (MDE)

Mathematics is at the heart of mathematical and data education and its importance as a discipline cannot be overstated. Future citizens in all walks of life will need generic, transferrable mathematical competence to underpin their occupation-specific techniques and skills, and to support daily life.

Whole-school approaches to mathematical and data education

MDE is embedded in many school subjects, and as students progress, they increasingly need domain-specific competences. These are needed to support different subjects, but also to help understand important, substantive issues such as climate change and sustainability. Consistency of terminology and approach is needed to benefit students, teachers and curriculum planners. Model whole-school MDE policies to underpin consistency and coherence between subjects and phases should be developed. Developing and implementing these policies will involve staff from a variety of relevant subjects, supported by mathematics staff.

Computational concepts, technology and tools

There is a striking difference between mathematics as done in school, and the way it is done beyond school. In employment, higher and further education, and adult life, computation is largely undertaken using digital technology, not by hand. This discrepancy has an effect on the real and perceived relevance of school mathematics. It needs to be addressed both by educational technology that offers tailored tutoring and immediate feedback, and by using computational tools routinely for learning, doing and exploring mathematics.

The interdependencies between computing and mathematics are rich and complex, and they apply in the school context. Mathematics and computing are nonetheless separate subjects, in life and in school, and we expect this to continue. We acknowledge the differences and expect the interdependencies will be fruitfully explored in the future design of MDE.

Teachers

The long-term plans for MDE require investment – financially, politically and culturally – in teacher professionalism. They will depend heavily on a positively disposed teaching workforce across all stages and subjects and must offer teachers sufficient agency to embrace the undoubted challenges that reform will bring.

A new approach to mathematical and data education will require a steadily evolving cadre of teachers who embrace change, not as passive recipients, but as co-creators of a shared, more relevant, ambitious and exciting array of learning experiences, for both students and their teachers.

Next steps

The reforms outlined in the Royal Society report cannot be developed by limited short-term measures; they will take 10 – 15 years to implement fully and will need planned and coordinated progress on four fronts: curriculum, qualifications, resources and professional development. They will need serious investment and careful planning, design, implementation, and evaluation. They will require collaboration between the stakeholders involved, cross-party support and determination to stay the course.

At the same time, the direction and shape of the long-term changes that are needed are already clear. There are significant risks in delay, and the process should begin as soon as possible.

A new approach to mathematical and data education

Our recommendations for change

Implementation

• The government should sponsor an independent task force to plan for long-term system changes and implement the recommendations from this report. This task force should include relevant government departments such as Department for Education, Department for Science, Innovation and Technology, Department for Business and Trade, and the Treasury. It should also involve senior figures from key stakeholder bodies and should consult with devolved nations. A sufficient budget should be provided to commission exploratory and developmental projects.

Curriculum

• Design and implement a curriculum that integrates appropriate data, statistics, and computational tools coherently with mathematics.

• Review the early years and primary curriculum to provide strong foundations, strengthening key areas such as spatial reasoning.

Qualifications and Assessment

• Develop a single MDE 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 development of the existing Core Maths qualifications.

• Develop a low-stakes competency assessment, to be taken by all students around the end of key stage 3 (age 14), to enable individual learners to demonstrate mastery of the foundational MDE concepts and skills necessary for confident and engaged citizenship.

• Develop assessment methods that identify and communicate what students know and can do.

• Develop new methods of assessment for general quantitative literacy that reflect how it is used in practice, including the use of digital technologies to analyse data sets.

• Standardise MDE terminology and level of detail expected in all school and college courses and require awarding organisations to be consistent in how they describe MDE competences in their programmes of study and assessment criteria. Begin this process by carrying out a study into how MDE competences are currently described and used in existing high-stakes qualifications in non-maths subjects.

• Develop online assessment methods that can grow as needed, enabling the use of MDE-specific digital tools and benefitting from lower costs and improved operations.

Computational tools and technology

• Computational tools and technologies, such as spreadsheets, apps and programming platforms, should be well-embedded at suitable stages within MDE learning. Curriculum designers should ensure these technologies are incorporated to meet the new MDE objectives.

• The Department for Education should carry out a dedicated research programme on the potential impact of AI on MDE learning, identifying new approaches for students at all stages of their education.

• Strengthen the links between MDE and computing by including problems in MDE that draw on pupils' computing knowledge and skills, including programming, and providing rich, motivating MDE contexts for programming and other skills in computing lessons.

• Ensure advanced MDE students (post-16) develop programming skills and learn the use of computational tools common in mathematically demanding undergraduate programmes.

Teachers

• The government should prioritise funding over several years to support a major programme of professional development, including initial teacher training, early career training and continuous professional development to support the implementation of MDE. This should be designed into the implementation plan from the outset and sustained over time.

• Develop professional development programmes, with supporting classroom resources, to enable current teachers to become expert teachers of MDE at key stage 3, and to encourage new routes into teaching.

• Develop ways for mathematics and subject departments in schools and colleges to work with each other to support consistency and coherence between subjects and phases in the teaching of MDE across all subjects; for example, by developing whole-school MDE curriculum guidance documents.

The full report, including references, can be found on the Royal Society website.

Royal Society Education and Skills Policy

The Society's activity in mathematical and data education sits within a policy team whose work is concerned with education as a whole, and STEM in particular. We have called for a major review, taking into account the school and college education system in its entirety, rather than piecemeal adjustments. Our aim is to promote education as a priority for all political parties, moving towards a system which provides excellent education for science, pathways for all and the foundations for scientific literacy so that future citizens can engage confidently and critically with science.

Two key themes (Computing education and AI) in our education and skills policy work are highlighted below. They are particularly closely linked to mathematical and data education. However, our call for a broad, balanced and connected education recognises that MDE underpins many disciplines – not only those leading to further study or work in the mathematical sciences.

The policy positions that follow illustrate the breadth of our activity and are the product of much research and consultation.

If you would like to find out more about any areas of our education policy work, please contact education.policy@royalsociety.org.

Computing Education

Digital literacy is essential for school, work, and life in the 21st century, and computing education at school plays a large part in helping young people to develop foundational skills in this area. The UK's digital skills gap is estimated to cost the UK economy £63bn per year and, without remedial action, is expected to widen in the future. With rapid and large-scale advancements in AI, large language models, and other technologies in recent years, it is crucial that young people across the country are able to experience computing and digital education taught by specialised teachers, in order to best prepare them for the future.

However, computing education faces a number of challenges and continues to suffer from relatively low take up at GCSE and A level compared to other subjects. Computing continues to be one of the subjects most affected by low numbers of teachers recruited into the subject – in 2024/25, only 37% of the government's target figure for computing teacher recruits was met. Teacher shortages in computing disproportionately affect pupils in the most disadvantaged areas, with research suggesting that 31% of schools in poorer areas did not offer computer science A level, compared to 11% of schools in more affluent areas.

Computing faces huge issues in encouraging more equal gender participation. In 2024, 82% of those taking Computing A level were boys. Research to be published in autumn 2025 by the Royal Society suggests that girls enjoy computing significantly less than boys do, and may feel less confident in their ability when it comes to computing, even if they are able across other subject areas. Girls reported favouring the creative and humanistic areas of computing such as experimenting with digital media, graphic design, animation: areas which are less well covered by current GCSE specifications. A broadening of the topics covered in GCSE computing could encourage wider take up of these qualifications.

The Royal Society recommends that Government and the devolved administrations should ensure the profile and status of computing education is elevated to reflect its importance as part of a broad, balanced and connected education, as well as its important links with mathematics and data, science and creative subjects.

Education in the age of AI: developing AI-literate citizens

Artificial Intelligence (AI) is rapidly reshaping science, society and the economy. From decision-making in public services to the everyday tools young people use to communicate, learn and create, AI is becoming embedded in many aspects of life and work. For the UK to thrive in this changing context, all young people must be equipped to engage critically and confidently with AI.

AI literacy sits at the intersection of scientific, information and data literacy. It involves understanding the technical principles behind AI systems, such as algorithms, machine learning and data processing, while also developing the judgement to interpret their outputs, identify bias, and evaluate their broader social and ethical implications. It is not just about technical skill, but about fostering agency, resilience and responsibility in the digital age.

However, significant challenges remain. The pace of technological advancement has outstripped the development of clear educational guidance, creating a 'literacy vacuum'. The computing curriculum, while foundational, does not yet provide all learners with the broad, transferable skills needed to engage meaningfully with AI. There are persistent shortages of computing teachers, and the subject remains the least popular STEM option among girls.

The Royal Society has worked with educators, researchers and policy experts to define the knowledge and capabilities young people will need to develop strong AI literacy. These include:

Technical knowledge

Foundational computing knowledge
Probability
Processing data
Critical information literacy

Critical social and human skills

Communication
Bias awareness
Judgement and evaluation
Self-direction
Ethical reasoning
Systems thinking
Digital agency

The Society is calling for a cross-curricular strategy to AI literacy, supported by inclusive curriculum design, modernised assessment models, and targeted professional development. AI has applications across all subjects, offering rich opportunities for interdisciplinary learning.

Equity is essential. Many schools still face significant barriers in accessing devices, connectivity and specialist expertise. National investment in infrastructure, research, and teacher training will be crucial to ensure that all young people can critically engage in a world entangled with AI.

Summary of policy positions relating to our wider work

The documents listed in the policy positions below are all accessible via the Royal Society website.

Future of Education

The current secondary education system in England is extremely narrow, restricting young people's future opportunities in life and work and limiting wider social and economic progress.

The Royal Society advocates for a fundamental review and reform of the education system, ultimately resulting in a system with greater breadth and choice for young people and a renewed approach to assessment, teaching, pathways and progression.

Recent work in this area includes:

- The Royal Society's Response to the Curriculum and Assessment Review Call for Evidence (November 2024)
- A manifesto for science: building a more resilient and prosperous future (December 2023)

Science, Mathematics, and Computing Teacher Workforce

There are persistent shortages of specialist STEM teachers, particularly in chemistry, maths, computing, and physics, presenting substantial hurdles to improving education in STEM subjects.

The Royal Society advocates for recognition of teachers' value and agency through restoration of the professional autonomy and responsibility they appear to have lost, and support to deliver high-quality, inclusive STEM education.

The Royal Society recommends: guaranteed 35 hours of subject related professional development annually for all teachers; reduction of administrative tasks and marking to reduce teacher workload; learning from initiatives to boost teacher recruitment and retention; ensuring every primary school has access to at least one subject specialist teacher in both science and mathematics, and that all post-primary STEM lessons are taught by suitably qualified subject specialists; the establishment of an independent expert body to oversee science education teacher CPD; and investment in the recruitment and retention of science technicians.

Recent work in this area includes:

- Why reforming education should start with boosting the status of teachers (January 2024)
- A manifesto for science: building a more resilient and prosperous future (December 2023)

Educational Research

The potential benefits of more research into improving education are huge, yet investment is often short-term and fragmented. The Royal Society has partnered with the British Academy to understand the current ecosystem of educational research and how it can be improved.

The Royal Society's recommendations are that funding for education research should be increased, should include more long-term funding opportunities, and should include support for under-represented themes.

Recent work in this area includes:

- Investing in a 21st-century Educational Research System (May 2024)
- The Landscape of Education Research in the UK. Report to the Royal Society and British Academy Joint Enquiry on Educational Research (January 2021)

Practical Work in Science

Practical work is intrinsic to science and should be a core component of science education. But evidence from the Science Education Tracker has shown that time spent on hands-on practical work in schools in England has decreased substantially during the past decade.

- Research suggests that, if taught well, regular opportunities to engage in hands-on practical science activities can motivate students to learn science, develop their conceptual understanding, and help them develop technical skills and valuable transferable skills.
- Hands-on practical work should be at the heart of the science curriculum, with all students having frequent opportunities to participate in this throughout primary and secondary science education.
- Research shows that engaging in 'open ended' hands-on practical inquiry can be most rewarding with such investigations providing a more authentic experience of how scientific research is conducted.
- Teachers should be supported to develop their skills in teaching practical science through dedicated subject-specific professional development.
- There is a severe shortage of science technicians; and the professional status of technicians needs raising.

Recent work in this area includes:

- Practical inquiry in secondary science education: An evidence synthesis (April 2024)
- Science Education Tracker 2023 (April 2024)
- Teaching resources: Brian Cox school experiments (January 2024)

Technical and Further Education

Technical education is not currently valued at the same level as academic education, despite around half of those studying at Level 3 taking a technical or vocational qualification.

The Royal Society believes that the government should look at technical education as part of a review of the secondary education system, seeking to ensure all pupils have access to high-quality technical and vocational educational pathways.

The Royal Society wants to understand the landscape of technical and further education, including developing a set of principles that should underpin any future technical and vocational education system and providing support to experts in the sector who are advocating for changes to the current system.

Recent work in this area includes:

- Establishing a working group on Technical and Further Education
- A series of case studies from across England to exemplify different approaches to the provision of technical and vocational education (May 2025)

Climate Change, Biodiversity, and Sustainability Education

Young people are not being adequately prepared to live, work, and thrive in a world shaped by the impacts of climate change and biodiversity loss.

The Royal Society believes that the interdisciplinarity of climate change, biodiversity, and sustainability should be recognised, along with its links to social justice, data literacy, and technical skills, and that environmental topics should therefore be woven into the fabric of the curriculum.

The Royal Society is seeking to determine the barriers to teaching climate change, biodiversity, and sustainability in schools, and develop recommendations around how the education sector can best respond to environmental climate-related risks.

Recent work in this area includes:

- “The Royal Society’s Response to the Curriculum and Assessment Review Call for Evidence (November 2024)