

A national network inspiring excellence in maths education

Maths Hubs Programme
Annual Report 2022/23

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Useful links



Want to know more about the work of the Maths Hubs?

About Maths Hubs

explains what a Maths Hub is, the areas covered by each hub, and the history of the programme

Three types of professional development

explains the different formats of Maths Hubs CPD: Work Groups, programmes and communities

What Maths Hubs are doing

has details of over 30 fully-funded professional development projects available through Maths Hubs and the NCETM

Curious about teaching for mastery?

Mastery Explained

gathers evidence, exemplification and research about the approach

Mastery Materials

features a wealth of resources to help teachers develop mastery in their schools and classrooms

Mastery Magnified

brings together case studies and interviews from schools that have embraced mastery

Looking for professional development resources?

Curriculum prioritisation

materials provide a term-by-term framework to support planning and teaching primary maths

Checkpoints

are hundreds of diagnostic activities to help assess KS3 students' prior learning

The NCETM Maths Podcast

offers discussions about maths teaching in all phases

Keen to explore further?

NCETM

is the home of the National Centre for Excellence in the Teaching of Mathematics

AMSP

is the Advanced Mathematics Support Programme, supporting teachers of post-16 maths

NCETM on LinkedIn

is a great way to stay up-to-date with what's new from the NCETM for maths teachers

* The data within this report have not been analytically assured or certified by the Department for Education. All case studies have been written with direct input from the schools and individuals interviewed, and all quotes have been used with their permission.

Welcome

56%

Schools in England engaged with their Maths Hub in 2022/23

Welcome to the second Maths Hubs Programme Annual Report, looking back on the work that took place in 2022/23.

Maths Hubs support all state-funded schools in England, and this report focuses on examples of that work throughout the length and breadth of the country. As the effects of the pandemic begin to recede, schools are looking ahead to develop mathematics curricula which develop pupils as confident mathematicians, and to enhance their teachers' subject knowledge and classroom pedagogy. Maths Hubs remain instrumental in working with teachers of maths in all phases to equip them with the knowledge required to teach maths, and to inspire a love of the subject in their pupils. We are delighted that over half of all schools in England are now working with their local Maths Hub, and thousands are already signed up to take part in professional development in 2023/24.

Like schools, the Maths Hubs Programme has not stood still. Mastering Number in primary schools is about to begin its third year, with existing participants working in professional learning communities to embed practices that instil good number sense for their pupils. Leadership development programmes for secondary heads of department and maths MAT leads, as well as those who lead CPD in schools beyond their own, continue to support system leaders to deliver high-quality maths professional development locally. Specialist Knowledge for Teaching Mathematics (SKTM) Programmes remain popular with teachers from Early Years to post-16. And this year, the impact of Research and Innovation Work Groups was shared and celebrated at a new Influence Event. To underpin all this work, the NCETM's new Essence of Mathematics Teaching for Mastery document has consolidated the elements of effective teaching for mastery.

Partnership remains at the heart of all Maths Hubs' work. Once again, working closely with the NCETM, Maths Hubs have demonstrated system leadership that puts school leaders and teachers at its core. We remain grateful to the Department for Education, for their continued sponsorship and investment which makes the entire programme possible.

We thank all the schools, leaders and teachers who have both led and engaged with the work of Maths Hubs. Through their partnership and dedication to the Maths Hubs Network, system-led improvement in maths education in England is happening every day, and Ofsted's recent maths report suggests it's making a positive impact.

Once again, thank you to all of our partners.



Kathryn Greenhalgh
Maths Hub Lead and Chair of the Maths Hubs Council



Charlie Stripp
National Director, NCETM

Primary

Teaching for Mastery Work Groups, led locally by Mastery Specialists, attracted participation from 6,868 schools this year. These schools encompass a range of developmental stages, from 'Mastery Readiness' to the 'Sustaining' phase.

Typically, two lead participants from each school collaborate with colleagues from other schools within the Work Group across the year. Participants then work alongside their colleagues and their school's leadership team to enhance maths in their schools. Often, they receive additional support through visits from their Mastery Specialist. The expectation is for all schools to sustain their work with the Maths Hub to ensure continuous improvement.

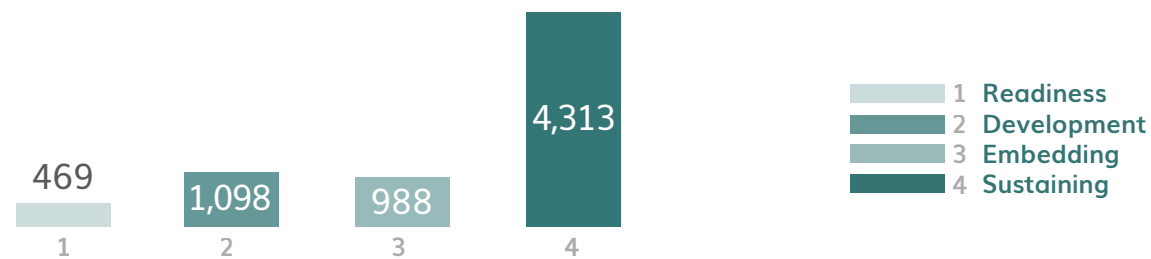
Recognising the critical role of early mathematical development in Reception and Key Stage 1, the Mastering Number Programme was introduced in 2021/22. This initiative aimed to provide support

to leaders and teachers in strengthening pupils' fluency with numbers and prepare them with the confidence and flexibility with numbers to tackle maths in Key Stage 2.

c. 7,000

Schools engaged in the Mastering Number Programme

Around 7,000 schools are now engaged with the programme, with those in their second year and beyond forming communities to embed and refine the programme's principles.



Number of primary schools engaged in the stages of the Teaching for Mastery Programme



Mastering Number

Q&A with Nathan Pow, Year 2 teacher and maths lead, working with North North West Maths Hub



What is the profile of your school?

Newlaithes is a two-form entry infant school in Carlisle with 15% Pupil Premium and very low EAL. We use Mastering Number as our Reception number curriculum and in Years 1 and 2 we use it in addition to daily maths lessons.

What impact have you seen from using the Mastering Number Programme?

It develops precise mathematical language. Our children arrive with weaker language skills, so the way the programme uses stem sentences is great. The vocabulary used in the sessions is transferable into maths lessons.

I've been into other classes to deliver Mastering Number, and the consistency is clear. Children have come up to me from Year 1 understanding the language and gestures, because they are used throughout the programme. It's also developed our staff. The subject knowledge CPD that is part of Mastering Number is brilliant.

How has it benefitted your pupils?

I am confident that I am now sending children up to junior school as mathematicians. They don't just know how to answer a question.

A child in Year 2 was working below expectations in all areas, but Mastering Number has given him confidence. Because sessions focus on verbalising the maths, he is practising mathematical language and developing his ideas through peer discussions.

What would you say to people who are not yet involved in Mastering Number?

How often do we get free CPD in schools? The content is research-based and the small steps are planned for you, but it's not just 'pick up and go'. The programme lays the firm foundations for maths.

01 One primary school's long-term success with mastery

SCHOOL

St Margaret's C of E Primary, Durham

SIZE

Two-form entry

DISADVANTAGE

7% Pupil Premium

YEAR ENGAGING WITH MATHS HUBS

3

LOCAL MATHS HUB

Archimedes

Working with Archimedes NE Maths Hub has transformed the way maths is taught at St Margaret's C of E Primary School on the outskirts of Durham city. The main motivation for engaging with the hub was to address the gender disparity in achievement at greater depth in Key Stage 2. Despite the school historically achieving good results in KS2 assessments, many girls lacked confidence and did not always display positive attitudes towards maths.

The school has been collaborating with Archimedes NE since 2017, and has embedded a mastery approach to teaching maths, which has seen sustained improvement in teaching practices, pupil engagement and end of key stage results. Pupil voice surveys reveal increased confidence and enjoyment, particularly with fractions and times tables. Data show a significant rise in the percentage of KS2 pupils achieving greater depth, from 31% before mastery, to 60% in 2022. These results remained consistent despite the challenges of Covid.

We are now seeing the children who have had a mastery approach pretty much all the way through their school journey and the impact that's having.

Emily Pringle, maths lead at St Margaret's, and Mastery Specialist with Archimedes NE

The school introduced the Mastering Number Programme last year and is already reaping the benefits of children's fluency with number facts within 10. The programme also serves as high-quality CPD for staff in Reception and Key Stage 1, and the school is looking forward to the positive impact this may show in future years.

02 How a mastery approach supports EAL learners

SCHOOL

Goldfinch Primary, Streatham, London

SIZE

One-form entry

DISADVANTAGE

40% Pupil Premium

YEAR ENGAGING WITH MATHS HUBS

5

LOCAL MATHS HUB

London South-West

Goldfinch Primary serves a diverse pupil population, with around two thirds of pupils having English as an Additional Language (EAL). The school introduced a teaching for mastery approach both to support their EAL learners and improve the maths learning experience for all children. Over the course of five years, their Maths Hub involvement has had remarkable impact, particularly for EAL pupils. Key to their success has been the use of teaching for mastery.

Precise mathematical language

EAL learners develop a solid understanding of mathematical concepts as teachers promote the use of accurate vocabulary. To ensure effective language acquisition, staff use strategies such as 'I say, you say' and gestures. Pupils engage in discussions using sentence starters such as 'I notice that...!', which helps structure their thoughts.

Representations

Teachers carefully select representations to expose mathematical structures. This makes the maths accessible to all, including EAL pupils. It develops a deep understanding of concepts, and bridges from the concrete to the abstract.

It frees up the children to access the learning – to explain. When they explain, you can see the confidence!

Emilie Haston, headteacher at Goldfinch Primary, Streatham, London

Small steps and fluency

Complex concepts are broken into manageable, incremental steps, whilst methodical planning ensures pupils understand each concept before moving on. The deliberate sequencing of lessons prevents pupils from feeling overwhelmed. Mastery is achieved through regular and targeted practice, allowing pupils to embed their understanding and develop fluency in mathematical skills.

CPD

Staff feel confident using mastery-based teaching methods because they have the right support and resources. Many teachers attend Specialist Knowledge for Teaching Mathematics (SKTM) Work Groups and the NCETM Curriculum Prioritisation materials are used to support staff, alongside triad groups where staff can collaborate. It has become normal for teachers to regularly observe each other and then have reflective discussions on how they can further improve their teaching.

Secondary

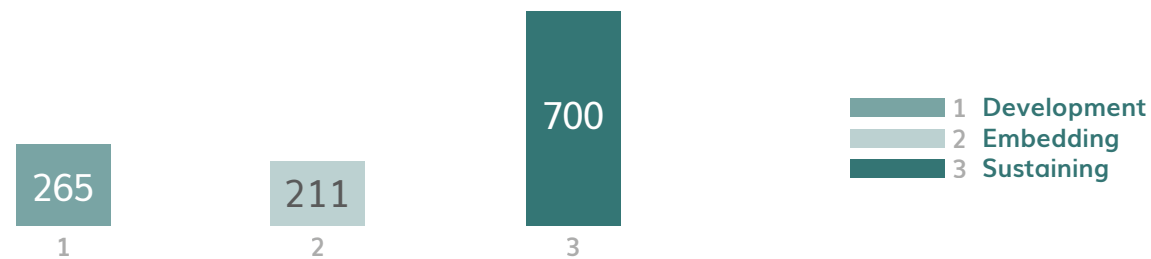
The number of secondary schools participating in Work Groups and programmes with their local Maths Hub continues to grow, with 1,959 schools actively engaged in 2022/23.

Of the secondary schools engaged with teaching for mastery, 265 were working at the Development stage and 700 were sustaining a mastery approach within their departments during the academic year. Schools in Sustaining continued in a Work Group, so that they could make ongoing improvements and further refine their teaching of maths.

Secondary schools were also able to take part in Work Groups which support the main Teaching for Mastery Programme, and enable departments to identify and address a particular need. These Work Groups align an area of focus with mastery, and offer schools the opportunity to work together

in local clusters to focus on topics such as ensuring coherence from Year 7 to Year 11, or working with primary schools to build continuity from Year 5 to Year 8. The Secondary Maths MAT Leads project and the Secondary Maths Subject Leaders project both also continued in 2022/23, with highly positive feedback.

Work Groups and participants in programmes were able to use the NCETM's expanding range of professional development resources, such as Checkpoints and Secondary Mastery Professional Development materials, to shape and support teaching.



Number of secondary schools involved in the Teaching for Mastery Programme

01 How mastery in KS3 has transformed maths in KS4

SCHOOL

The Whitstable School, Kent

SIZE

An 11-18 school with 1,035 students

DISADVANTAGE

23% Pupil Premium

LOCAL MATHS HUB

Kent and Medway

Gavin Yates is Director of Maths at The Whitstable School and a Head of Department Advocate for Kent and Medway Maths Hub. Having seen the impact that teaching for mastery has had in his department, Gavin is keen to visit other heads of maths, and invite them into his own school, to share his expertise and experience.

Gavin's initial motivation for engaging with his local hub was a focus on Years 7 and 8 and a desire to reduce the drop in attainment often seen as children move up from primary school. A visit to feeder primary schools revealed that teachers were taking a mastery approach to maths, prompting Gavin to ask himself whether taking a similar approach to maths in KS3 would ease the transition for students and support them to hit the ground running.

Whitstable School is now in its third year of teaching for mastery and Gavin reports a marked improvement in progression at KS3, with students settling in quickly because the approach to maths is familiar to them. But perhaps the most surprising impact, and one that Gavin had not anticipated, are the noticeable improvements in mathematical thinking and problem solving observed in KS4. The benefits have impacted teachers as well as students. Gavin's team, particularly ECTs, have benefitted from the collaborative planning and consistency of approach which are key features of teaching for mastery, with considerable reductions in teacher workload.

Staff really appreciate the consistency and collaborative planning. There's a better understanding of what good quality maths lessons look like. Having those underlying mastery principles, and talking about that in meetings, is really helpful. Everybody's reflected on what they do in KS4 from the perspective of what we've built in KS3; they are using a mastery approach in KS4 because they've tapped into what we've built lower down the school, and our end of Year 9 results are up on previous years, which is exciting.

Gavin Yates, Director for Maths at The Whitstable School, Kent



02 Supporting maths leadership through the Secondary Maths MAT Leads Programme



Andrea Wickham

Mastery Specialist at Bucks, Berks and Oxon (BBO) Maths Hub

Alongside her role as head of maths at Didcot Girls' School, Andrea Wickham is a Mastery Specialist for BBO Maths Hub and a Mastery Maths Lead across the Ridgeway Education Trust (RET) in Oxfordshire. She participated in the Secondary Maths MAT Leads Programme in 2022/23. Her role is to support and develop the implementation of maths teaching for mastery in the schools in her rapidly expanding trust.

The ability to network with maths leads in larger trusts across the region has been a key benefit for Andrea. She recognises that systems will need to be put in place to manage RET's growth, and the Secondary Maths MAT Lead Programme enables her to focus on the bigger picture and access invaluable support and advice from colleagues at other MATs who have been through the same process.

Being part of the programme improved the quality of the CPD sessions and the collaborative planning that I lead. It's given me a bigger picture and, as my trust is growing, it's been really helpful to talk to people who work in much bigger trusts, to see how they organise things when they've got a lot more schools. What are the systems that you put in place to manage that and how can you use technology to bring people together?

Andrea Wickham, Mastery Maths Lead at Ridgeway Education Trust, Oxfordshire and Mastery Specialist

As well as her own personal development, Andrea has seen benefits for the trust's students. With RET's feeder primary and secondary schools engaged in Sustaining Work Groups, there have been significant improvements in progression. Andrea notes that collaborative planning has had a real impact on teacher workload, as well as ensuring a consistent approach. In her role as MAT maths lead, Andrea is excited about the new career opportunities opening up for teachers within the trust as RET expands, which she is able to support with professional development that focuses on leading teaching and learning.

03 Sustaining: transforming student engagement and motivation through mastery

Rae Potter

Headteacher at Sarah Bonnell School in Stratford, London

Sarah Bonnell School is a high-achieving girls' comprehensive in Stratford, London with significant levels of disadvantage; 40% of students are eligible for free school meals. 2022/23 saw its third year of engagement in the Teaching for Mastery Programme. The school's headteacher, Rae Potter, initially engaged with London North East Maths Hub in 2020, with the overarching vision of enabling her maths department to support their students to 'think, read, speak and write like a mathematician'.

Rae credits the bespoke CPD teachers in her maths department have received as a significant factor in helping them to achieve that aim. The department has developed a teaching approach which aligns with mastery principles, and has adapted its curriculum to support students to develop deeper conceptual understanding. In terms of impact, teaching staff report that they have a greater understanding of how to utilise representations to expose the structure of the maths, and now place a greater emphasis on developing connections and building on students' prior learning. This has contributed to substantial improvements in teaching and attainment, as well as students' motivation and engagement in maths lessons.

Our maths department has been able to shape the design and delivery of the maths curriculum in a way that has created a real enthusiasm for maths lessons amongst our students, and we've seen their confidence and enjoyment of maths grow. In all year groups, students are more resilient and engaged, particularly when it comes to reasoning and problem solving.

Rae Potter, Headteacher at Sarah Bonnell School in Stratford, London

Local Leaders of Mathematics Education (LLMEs)

Local leaders of mathematics education (LLMEs) are the teachers and education professionals who lead the work of the Maths Hubs at a local level. Most are current classroom practitioners who spend some of their time leading the activity of their local Maths Hub.

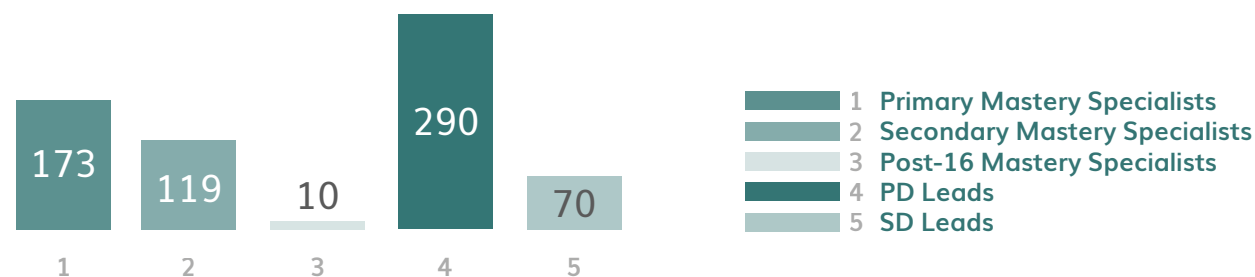
LLMEs work together as a community with their Maths Hub's Leadership and Management Team, supporting schools and colleges in the hub area, as well as further developing their own expertise.

Maths Hubs have the autonomy to identify, recruit and develop their own team of LLMEs, and, in doing so, create a vibrant professional learning community that reflects local need. Collaborative practice is at the heart of this. The LLMEs within a hub meet regularly to develop their expertise in leading maths curriculum and pedagogy, leading maths professional development, and leading maths school development.

Several national development programmes are available for LLMEs, including the School Development Lead Programme, Professional Development Lead Programmes for teachers in all phases, and Mastery Specialist Programmes for teachers in primary, secondary and, new for 2023, FE.

622
LLMEs starting development programmes in 2022/23

In 2022/23, there were over 1,500 active LLMEs leading Maths Hubs activity, including Work Groups, programmes and communities.



LLMEs starting development programmes in 2022/23

An LLME shares her experience Q&A with Sam Savory, a Year 6 teacher at Lavenham Primary



Sam Savory is a Year 6 teacher at Lavenham Primary in Suffolk. She has led Work Groups for Primary Mastery Development, Embedding and Sustaining for Angles Maths Hub. Sam trained as a Mastery Specialist in 2020, has completed the PD Lead Programme, and is beginning the School Development Lead Programme in 2023/24. Since becoming an LLME, Sam has worked with over 50 schools locally.

When did you first get involved with Angles Maths Hub and how?

My school took part in a Development Work Group in 2019. I'd already done some research into teaching for mastery, and I wanted to be able to work with other professionals to embed this into my own practice. I put the idea to my headteacher, who is now an Advocate for Angles Maths Hub, and the rest is history! After training as a Mastery Specialist, I started leading Work Groups for the hub in 2021.

What has your LLME activity involved in 2022/23?

It's my job to lead and inspire teachers to adapt and review their teaching approaches. I also teach live lessons, demonstrating mastery approaches for people to observe. I visit schools on the Teaching for Mastery Programme and give them bespoke support to implement mastery. Attending central and local training and meetings has also meant I've been able to work with other LLMEs, so we can share our expertise and offer a rich and varied package to schools.

What are the challenges of being an LLME?

Being a Work Group Lead and working as a full-time teacher, member of SLT and lead of other subjects needs good time management. You have to be strict with yourself on the time you give to each element of your role. But it is worth it! To be able to enhance not only the subject knowledge of those you seek to inspire but also your own practice is invaluable.

Becoming an LLME has enabled me to learn so much about myself as a teacher and how I can support the children I teach in a more effective way

What do you most enjoy about being an LLME?

That's easy – I love sharing my passion and enthusiasm for the teaching of maths with others. I enjoy delivering workshops and visiting schools to support the implementation of the vision for maths in their school. It's all about igniting that curiosity to know more, not only for our pupils but for the teachers inspiring our next generation.

I enjoy collaborating with colleagues to improve the teaching of maths in our primary schools and I learn so much from every school I work with. It's a pleasure to play an important part in the way maths is taught.

Sam Savory, Year 6 teacher at Lavenham Primary, Suffolk

What happens in an LLME Community? Q&A with Laura Tullock, Hub Lead at Great North Maths Hub



In every Maths Hub in 2022/23, an LLME Community has allowed the Maths Hub Leadership Team and other LLMEs including Work Group Leads and Cohort Leads to develop and reflect on their own practice. At Great North, Laura and her team have taken this a step further, enabling their LLMEs to develop and pursue their own bespoke research questions.

Who is in your LLME Community?

There are around 45 LLMEs, mainly teachers and some lecturers; more work in primary than secondary. The community was led by me, Lindsey Fagan (Deputy Maths Hub Lead), and Jo Morrison (Primary Assistant Maths Hub Lead).

What did you want to achieve?

There is a vision for the hub, but we have also developed one for the community: 'To collaborate as a dynamic community of LLMEs who work to enquire and develop together; all learning from and with each other'. We wanted the principle of collective, collaborative leadership to inform our activity, allowing the LLMEs to really focus on developing themselves. In previous years, the Hub Leadership and Management Team had determined the focus and designed the sessions. LLMEs had gained knowledge, but their beliefs hadn't been explored.

How did you plan and undertake your LLME Community activity?

We wanted everything to be evidence-informed. In our first meeting, we looked at teachers as researchers, and gave everyone autonomy to

choose what to explore. Everyone took away a piece of research to read, and the second meeting involved exploring this in smaller groups. Initially we asked, 'What makes a great research question?', and everyone developed and then refined their own. Questions included 'How does whole class adaptive teaching impact Pupil Premium children?' and 'Which games can teachers use to support maths teaching?'

Throughout the year, LLMEs worked on their own question, met in groups and subgroups, and brought their findings back to discuss. Everything was informed by each other's experiences: they thought about the impact they would want to show at the end of the year, heard from each other about what they had been reading and what it meant to them, and looked hard at their own vision and values. In the final meeting of the year, everyone came together, described their journey, and shared their next step.

It was successful because the LLMEs made it successful – their enthusiasm and commitment meant it had impact and tangible benefits.

01 Benefits of having LLMEs in the secondary maths department



Tony McGuinness

Headteacher at All Saints Catholic High School, Knowsley, Merseyside

Tony McGuinness is the headteacher at All Saints Catholic High School, a large 11-18 secondary school in Knowsley, Merseyside. In his maths department, he has a Cohort 5 Mastery Specialist, Danny Henderson, and the subject leader, Ian Brennan, is training to become a Mastery Specialist from September 2023. Initially, Tony was anxious about his most experienced maths teachers being out of school. So what changed?

When Tony took over as head in 2015, the school was in special measures. It's now judged Good in all areas, and its maths department works regularly with its local Maths Hub, North West Three. Tony attributes his fully staffed maths department to both the positive culture now embedded in the school, and the opportunities for professional development in the department.

When Danny first approached Tony about training as a Mastery Specialist, Tony had concerns about capacity. 'We need teachers in front of the students for them to be in with a chance', he explained. But Danny quickly demonstrated that he could apply his new learning department-wide and beyond his own classroom. Tony made sure the maths department had time to work together and explore teaching for mastery, and all now engage in CPD with the hub. Danny has become lead practitioner and KS4 coordinator, and continues to develop the department alongside his work with other local schools.

In September, Ian will begin the Mastery Specialist Programme, enhancing the department's capacity to embed mastery and support the professional development of staff. Does this mean more lessons without a maths teacher in front of students? Far from it – Tony has recruited maths teachers and planned the timetable in advance so that Ian and Danny can attend training without classes being disrupted. Danny uses his new knowledge to support and develop colleagues' pedagogy and the curriculum, and automaticity of facts is now foregrounded.

Collaborative planning is at the heart of CPD in the maths department, Tony explains: 'All staff can contribute, regardless of their career stage. When everyone is involved in planning, lessons are better'. Schemes of learning are based on the expertise Danny has acquired as a Mastery Specialist. The department comes together to discuss teaching and learning; teachers then review their curriculum in the light of informed practice and research.

Having seen the impact in his own school, Tony now advocates for involvement with the Maths Hub to other headteachers in the area. As part of the Priority Education Investment Areas initiative, he is able to explain the benefits of working with the Maths Hub, and of having local leaders of maths education in your school.

SKTM

Maths Hubs collaborate with a range of partners to provide effective training and professional development for teachers of maths in schools and FE colleges. The aim is to equip participants with the specialist knowledge they need for teaching maths (SKTM).

SKTM programmes are continuous professional development initiatives that involve sessions led by local leaders of mathematics education (LLMEs). Programmes combine these sessions with activities for participants to try in their own settings between sessions. There is then opportunity to reflect on and discuss how practice is developing.

5,134

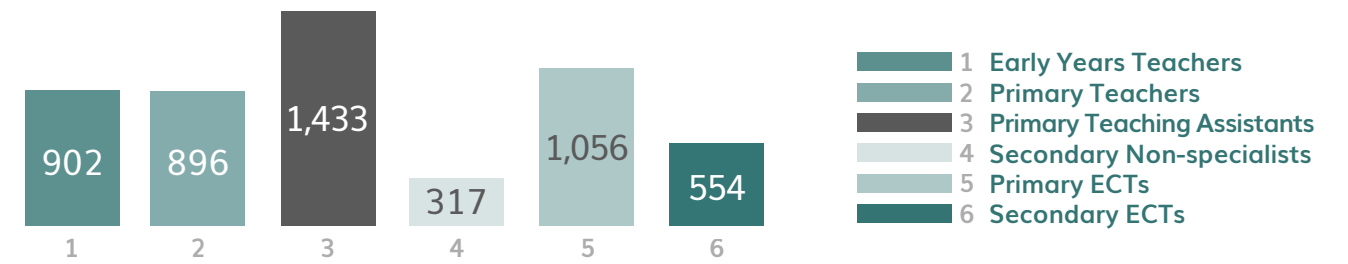
Participants engaged in SKTM programmes in 2022/23

Established programmes have already supported Early Years practitioners, primary and secondary teachers, and primary teaching assistants.

159

ITT providers involved in Maths Hubs Work Groups

Representatives from across the Initial Teacher Training (ITT) sector, including schools engaged in supporting ITT, come together in Work Groups to refine and enhance the mathematical aspects of their provision. The Strengthening Partnerships with ITT Providers Work Groups collaborate, sometimes across hub borders, to ensure that trainees in all phases have a deep understanding of teaching for mastery principles.



Number of participants in SKTM programmes in 2022/23

01 The impact of SKTM on a non-specialist maths teacher



NAME

Brian Witherspoon

SCHOOL

St Anselm's College, Merseyside

SKTM PROGRAMME

Secondary Non-specialist Teachers

MATHS HUB

Cheshire and Wirral

Brian began his career in 2005 as a design technology teacher, with a degree in Electrical and Electronic Engineering. However, a turning point came in 2018 when he was asked to teach Year 8 and 9 maths. Brian was keen to develop as a maths teacher, but felt both his pedagogy and curriculum knowledge for teaching maths still needed further development.

The SKTM Secondary Non-specialist Teachers Programme focuses on participants developing effective teaching methods and deeper subject knowledge to improve their teaching of maths. Sessions cover a wide range of topics and support planning for progression. Brian commented that learning about graphical representations is something he now uses when introducing new topics to his students.

A significant highlight of the SKTM programme for Brian was the collaborative element, as he was able to connect with both other non-specialist teachers and experienced maths educators. Within this supportive network, he felt able to share his own experiences and seek advice, which greatly contributed to his professional development.

Engaging in the programme has improved Brian's teaching practice in maths, which has also been noticed by his head of department. The knowledge and conceptual understanding he has developed have given him the confidence to implement successful strategies in the classroom to extend his students' understanding.

02 Primary Teachers SKTM – Spatial Reasoning Pathway



Vicki Giffard
Maths consultant and former maths lead, LLME for East Midlands South Maths Hub

The Primary Teachers SKTM Programme has two pathways – Number and Spatial Reasoning – and is designed for primary teachers who want to improve their subject and pedagogical knowledge. It provides professional learning in workshop sessions, alongside focused practice development in the classroom. This year, Vicki Giffard, maths consultant and former maths lead, led the Spatial Reasoning pathway for East Midlands South Maths Hub, after previously running a Research and Innovation Work Group (RIWG) on the topic.

Research is an important part of any SKTM programme, as it helps participants see the rationale behind the pedagogy. Vicki's passion for and experience in maths research enhanced her leadership of this programme, and enabled her to tailor the content for her group. A key focus for the Work Group soon became 'how precise language and gesture can be used to support spatial thinking and reasoning'.



The programme really opened my eyes to the importance of teaching shape and space to children, alongside the continued focus on number. It was wonderful to see one particular pupil grow in confidence and capability through working with her on her spatial reasoning and visualisation skills.

Kate Burrows, Year 4 teacher at Stafford Leys Primary School, Leicester

I feel more confident to focus on the children's needs, such as using manipulatives more suitable for the children, rather than having to use the one on the lesson plan.

Primary Early Career Teacher

Participants explored visualisation techniques and how early experiences, such as playing with construction toys and puzzles, are crucial for spatial reasoning development in young children. Activities including tangrams and block play, and reinforcing spatial language during PE sessions, were incorporated into the curriculum. Teachers reported improvements in their pupils' confidence and proficiency in reasoning skills, and this holistic approach supported their understanding of more difficult concepts.

Using NCETM centrally produced materials to support them, participants designed tasks to improve spatial reasoning, which helped them notice how spatial reasoning underpins other areas of maths, and the importance of developing this. Teachers found that paying greater attention to variation benefitted the children's mathematical language, and they were able to define shapes more precisely using accurate vocabulary.

Post-16

In 2022/23, 114 schools, colleges and other post-16 institutions took part in professional development with their local Maths Hubs to support students engaged in A level, Core Maths and GCSE resit.

Maths Hubs offer an expanding range of support for teachers in schools and colleges to improve their practice and help students to achieve beyond Year 11. In 2022/23, Work Groups enabled teachers to collaborate in a range of areas including GCSE resit, A level pedagogy and Core Maths.

In addition, a collaboration between the Maths Hubs Network and the Advanced Mathematics Support Programme (AMSP) saw the New to Core Maths

SKTM Programme launch last year. Available to those in the first two years of teaching Core Maths, it aims to support the development of specialist knowledge and increase participants' confidence.

With qualifications such as Core Maths likely to form part of post-16 institutions' efforts to deliver maths to 18, it is expected that participation in this programme will continue to grow.

NEW this year: Post-16 GCSE and FSQ Mastery Specialists

Part of a brand-new programme designed for teachers of compulsory maths in FE settings, the focus of the Post-16 GCSE and FSQ (Functional Skills Qualifications) Mastery Specialists Programme is to help teachers develop the mathematical skills and confidence of students aged 16-19 who study GCSE Resit or Functional Skills.

The initial pilot featured ten participants known as the Trailblazers. They were brought together from across the FE sector, bringing a wealth of FE-specific experience and knowledge to enhance this new programme. Trailblazers played a fundamental

role in the development of the programme, working together to trial and evaluate the materials and advocate for teaching for mastery in FE.

The first full cohort of 40 Post-16 Mastery Specialists will begin their journey in autumn 2023, following the lead of the Trailblazers. Applications for the programme far outnumbered the places available, and the intention is to have a new cohort every year to build a growing collaborative network of specialists who work with maths colleagues in their establishments.

Leading a Post-16 Work Group

Q&A with Mary Harris, Assistant Maths Hub Lead for Post-16 and Secondary Co-Lead at Matrix Herts Maths Hub



Mary Harris leads an A Level Pedagogy Work Group in her local area.

What does the project aim to do in schools and colleges?

The aim is to bring experienced teachers of A level Maths together to discuss teaching approaches which deepen students' conceptual understanding of the A level content, leading to an enhanced classroom experience and improved results. Through collaboration, both in the Work Group sessions and individual teacher experimentation in their own classrooms, successful approaches are embedded and shared with their departments. Collaboration is also part of the delivery format, as Maths Hubs work with the AMSP to deliver the project.

What was the focus of your Work Group?

We looked at ways to engage the student to be an active learner in the classroom, and encouraging mathematical discussion was one of many pedagogical approaches we took.

What is the format of the Work Group?

There were two full-day, in-person sessions and two twilight online sessions. I prepared each session ahead with tasks, discussion points, resources and reference to relevant research. Teachers were set tasks to complete in advance and then asked to update an online 'Gap Task Board' to capture evidence and observations about their school-based activities, which were shared within the Work Group.

What impact has the Work Group had?

Representatives from 13 schools, including KS5 coordinators and heads of department, attended sessions and participated in school-based tasks, and a good level of evidence was captured. Opportunities to discuss and collaborate have been rich and rewarding for the participants, and teachers have found that small changes to their practices are having a positive impact.

Developing students' success in mathematical argument and reasoning on paper continues to be an area of focus, particularly as more students are undertaking assessments using online tools. Participants were supported to explore a range of effective strategies to address this, and reported that they felt better equipped to deal with problem-solving style questions, encouraging students to devise their own strategies without being prescriptive in the solutions.

What is next for your Work Group?

I'll be trialling a new Work Group in the next academic year aimed specifically at participants from the 2022/23 Work Group. It will provide more time to embed the approaches explored, both into participants' practice and across their departments. More time will also be spent in each other's settings with a focus on observation, reflection, and discussion.

01 Two maths teachers share their experiences of the A Level Pedagogy Work Group



Alice Livingstone-Boomla
Head of department at Seven Kings School, Greater London

Alice Livingstone-Boomla is head of department at Seven Kings School in Greater London. Seven Kings is a larger than average 4-18 all-through school, with 15% Pupil Premium and 74% EAL students. Alice engaged with London North East Maths Hub to better support the 300 students studying A level Maths in Seven Kings' large Sixth Form.

One of the appealing features of the Work Group for Alice is that the focus is on how to deepen students' understanding of the subject matter, rather than just developing teachers' subject knowledge. She adds:

I really enjoyed meeting experienced KS5 teachers from other schools and it was quite a small group, so we all had a chance to come back to ideas and share them. I thought that the sessions were really well planned and delivered. Clearly a lot of thought had gone into what we should cover and what would be useful for us.

Alice Livingstone-Boomla, head of department at Seven Kings School, Greater London

Alice found the group's focus on problem solving, mathematical talk, generalisations and formulating plans incredibly useful. A key benefit for her was the opportunity to discuss departmental strategy with her peers:

We spent some time thinking what our capabilities were within in our departments to manage the change we'd like to see. It really encourages you to think about the kind of teacher you want to be and the kind of maths teaching you want to see in your department. Rather than seeing that as something very far away, you think about it as small concrete steps that you can regularly take in order to move you and your department closer to your goals.



Sav Rupra
KS5 maths teacher at Eastbury Community School, Barking

For Sav Rupra, a passionate KS5 maths teacher at Eastbury Community School in Barking, which has 32% Pupil Premium and 57% EAL students, the A Level Pedagogy Work Group, delivered in collaboration with the AMSP, provided a useful opportunity to learn from more experienced KS5 teachers.

This is my second year of being in a Work Group and I will do it again. It's not a big group and I like that. I liked the attention to detail, so that subject or topic requests are always acted on. I asked if we could look at certain topics and the Work Group made me feel more comfortable to discuss various ideas, rather than a course, where you're given a series of sessions and you get a certificate from it. This is very intimate; it's a small working group and whenever the next one is I'm going to sign up for it.

Sav Rupra, a KS5 maths teacher at Eastbury Community School, Barking



Research and Innovation Work Groups (RIWGs)

Research and innovation takes place across all 40 Maths Hubs in the network. It involves Work Groups exploring and testing ideas that can help improve maths learning across all phases.

Research and Innovation Work Groups enable Maths Hubs to explore areas of local need, as well as tackling national issues. Topics range from oracy to problem-solving to SEND, and reflect these local and national dimensions. The outcomes of RIWGs influence work across the Maths Hubs Network, with evidence from them feeding into both classroom practice and professional and school development activity.

RIWGs are characterised by three types of professional culture:

Research culture

Teacher research is at the heart of every RIWG. The work is also often informed by existing research and published papers.

Innovation culture

The emphasis is on trying out new pedagogical approaches and ways of working, or finding new ways of using existing ideas.

Collaborative culture

Working together and learning from each other's experiences are promoted at each stage of the RIWG.

1,069

Schools participating in RIWGs

121

Research and Innovation Work Groups



NEW: RIWG Influence Events

For the first time in 2022/23, the end of a successful year of RIWGs was marked by three 'Influence Events'. These half-day online gatherings brought together Research and Innovation Work Group Leads (leaders of the work at a local level), Research and Innovation Leads (those coordinating an overall project theme), and a range of other NCETM and Maths Hubs stakeholders.

Each Influence Event had its own focus:

- Developing pupils' understanding of mathematics
- Working with school leaders and communities
- Meeting the needs of all learners

Emphasis was very much on exploring influence. A combination of expert input and open forum discussions allowed all participants to learn how this year's RIWGs had embodied a culture of research, innovation and collaboration in order to explore a series of themes across the whole Maths Hubs Network. Themes explored in 2022/23 included oracy, primary subject leadership, GCSE to Level 3 transition, teaching for mastery in the context of special schools, and problem solving. Each RIWG Lead had prepared a one-page 'poster' of their key findings, and lively Q&A sessions took place in breakout rooms where all attendees were able to come and learn more about their peers' work.

At each event:

- Research and Innovation Leads (RILs) provided an overview of the work that had taken place within the overall event theme
- There was an opportunity for participants to visit breakout rooms and talk with RIWG Leads about their work
- It concluded with a reflection on the event, and the sharing of any existing or potential outputs or opportunities to influence, and the next steps for each area of work.

Abby Cotton (Maths Hub Lead at Boolean Maths Hub) is the Research and Innovation Lead for primary subject leadership, and leads an RIWG looking at the impact of student dialogue on mathematical understanding. After the first event, she commented, 'Can I shout really loudly about how brilliant the RIWG Influence Events were today? I feel so inspired!'

Work in RIWGs in 2022/23 has once again influenced the suite of Network Collaborative Projects on offer in 2023/24, including informing a new SKTM programme for secondary teaching assistants. Looking ahead, many RIWG theme-level research questions have been refined for 2023/24, and for the first time some RIWGs will be 'situated' within Primary and Secondary Sustaining Work Groups.

Research and Innovation in the Maths Hubs Network



The RIWG is helping us shape future work and explore wider questions about teacher professional development. We want the project to be a longitudinal one so we can really engage with the findings over time.

Nicki Ashton and Kate Mole, RIWG Leads

01 Primary

THEME

Primary – new

LOCAL RESEARCH QUESTION POSED

Does the Primary Teaching for Mastery Programme have an impact on Year 1 pupils' mathematical reasoning?

MATHS HUB

London South West

The Work Group set out to explore how Primary Mastery Specialists disseminated information about mastery to their colleagues, how it led to changes in teachers' practice, and whether any change in practice led to better mathematical reasoning. Nicki Ashton and Kate Mole, RIWG Leads, created a teacher framework (a questionnaire based on the NCETM's Essence of Mathematics Teaching for Mastery) and a learning framework (an observation proforma based on Robin Alexander's dialogic teaching repertoires). These were used to explore examples of teaching for mastery happening in the classroom, and to determine the views of teachers in the Mastery Specialists' schools. In lessons they visited, Nicki and Kate noticed that responses to particular questions could highlight either pupils' understanding or lack of knowledge, and that examples of different types of learning talk were also helpful.

The RIWG identified that fidelity to teaching for mastery to provide the best possible conditions for pupils to learn is important, but also ambitious. They noted that the learning framework should be used as an ongoing tool to assess the quality of pupils' reasoning.

Several questions still remain. How can greater use be made of the NCETM's Essence of Mathematics Teaching for Mastery document in the exploration of the research question? How can the study become a longitudinal piece of work? Work will continue in 2023/24 to explore these questions in more detail, and to learn more about mathematical reasoning in other year groups.

02 Oracy

THEME

Oracy

LOCAL RESEARCH QUESTION POSED

What is the impact of structured oracy templates on higher-attaining pupils' ability to explain their reasoning?

MATHS HUB

Origin

Teachers identified that pupils from Early Years to Year 5 with higher prior attainment were not reasoning at the depth that would be expected. A reasoning scale was developed, so teachers could identify where pupils were and their next steps. Rapid progress in oral reasoning was made when structured oracy templates, such as sentence stems and concept cartoons, were used. Focusing on developing oracy skills in pupils with higher prior attainment changed the classroom culture for all pupils.

Participants were surprised that before using the templates their focus children were not justifying, convincing, or proving. Trisha Henley and Jo Makin-Isherwood, RIWG Leads for the project, believe this observation could be more widely true, and that the findings of this RIWG could have benefits in other maths classrooms. Focus pupils improved within just a few months when teachers used the oracy templates. This, in turn, raised the status of reasoning within the classroom.

Participants hope to continue into a second year, and the work of the group will be shared with Origin's wider LLME community. In the future, the RIWG hopes to explore what 'proof' looks like in a primary classroom and how to nurture this, and whether teacher expectation influences the changes observed. The project challenged teachers' perceptions of how well pupils should be able to articulate their thinking, and raised their expectations for the whole class.

The opportunity to engage with research is missing from most teachers' experience of professional development. We often try out ideas and may even have a hunch that what we find out is more widely true – but we are rarely able to test our theories in a rigorous and systematic manner. This Work Group has given participants the chance to do exactly that.

Trisha Henley, RIWG Lead

One of the most significant milestones was the realisation, through collaborative research, that participants' focus pupils, despite achieving well in assessments, were not providing the quality of response that teachers had previously thought. During the RIWG, teachers evolved their understanding of what high-level reasoning, justifying, and proving might look like in their classrooms.

Jo Makin-Isherwood, RIWG Lead

03 GCSE to Level 3 Transition

THEME

GCSE to Level 3 Transition

LOCAL RESEARCH QUESTION POSED

How can we strengthen the common structures and pedagogical approaches to make the transition between GCSE and A level engaging, deepen understanding and not leave any students behind?

MATHS HUB

Yorkshire and the Humber

In participants' schools, where teaching for mastery was already embedded, students moving from GCSE to A level Maths completed a 48-page transition booklet over the summer and a diagnostic test in the first two weeks of Year 12. On investigation, the transition questions were procedural, they did not embrace the overarching themes of use of technology or problem solving, and students commented that they were dull. Led by Christine Robinson, the RIWG developed a series of new transition activities.

Participants questioned what they were doing, and how and why it benefitted either the students, the teachers or both. As a consequence of this, teachers began to change their practice. One teacher commented, 'It has made me focus on the gaps in learning and look at how we should use the transition materials as teachers, to really support students', with another observing, 'By attempting to create an excellent bridging booklet, I'm exploring activities and approaches to learning that I should be using in my practice'. Another participant said, 'I never gave any consideration to student engagement or student anxiety. I was more concerned with their knowledge of the basic skills and making sure that they understood that A level is hard'.

The bridging booklet will be used in all 11-18 academies who participated in the RIWG across the Outwood Grange Academies Trust. Participants intend to review the impact of the changes, and capture students' views on whether the problem-solving approach to transition supports and inspires them as they start A level Maths. Teachers will review the pedagogical changes to the curriculum delivered in the first half term.

This RIWG enabled us to re-focus on our core values as teachers of A level Maths. It gave us permission to be innovative and to put the students back at the centre of their transition experience.

RIWG participant

Maths Hub Leadership

Maths Hubs Leadership and Management Teams are made up of both strategic and operational team members. They range from Senior Leadership Links – members of a Lead School's senior leadership team – to project managers and finance administrators – people with the skills to manage and coordinate hub activity.

Alongside the leadership team, a Strategic Board serves a similar purpose to a governing body, supporting and challenging the hub's work. Strategic Boards are made up of individuals from the hub area who may be experts in maths education, or understand the needs of local schools. Their combined knowledge and experience helps steer and develop the hub.

A Lead School may be a school, college or trust. These lead institutions help fulfil the complex system leadership remit of the hub, and are instrumental in ensuring a hub has the expertise and commitment to deliver high quality school and professional development across its whole region.

Local leaders of mathematics education (LLME) are the many maths professionals – usually practising teachers – who lead the work of the hub at a local level. The LLMEs in a hub area may change from one year to the next, but each LLME has expertise in both maths education and maths professional development.

483

National and regional Maths Hubs Network events in 2022/23

01 Senior Leadership Links



Steve Wilkinson

Outgoing Senior Leadership Link for North North West Maths Hub

Senior Leadership Links (SLLs) are senior education leaders with experience of system leadership and partnership building. They are sometimes headteachers or principals, or they may work on a school's senior leadership team, with a responsibility for different kinds of partnership work.

Given that each Maths Hub is a large partnership of schools and other organisations working together to support maths education, the Senior Leadership Links have a key role in establishing and sustaining these collaborations. It is vital to the ongoing success of Maths Hubs that leadership capacity is both sustained and developed. 2022/23 saw the departure of two long-serving SLLs, Steve Wilkinson (North North West) and David Baldwin (Great North), both of whom had played significant roles in enabling their Maths Hubs to flourish.

They offered the following reflections on the kind of leadership and collaboration that is needed for Maths Hubs to be effective:



David Baldwin

Outgoing Senior Leadership Link for Great North Maths Hub

Having been involved in many system leadership initiatives, and having been on the early Shanghai visit organised through the extraordinary National College for School Leadership as a National Leader in Education, I can confidently say that the Maths Hubs initiative has an exemplary pedigree that has impacted on all aspects of maths education in England. I am proud to have been involved, and to continue to be involved as the Chair of the NNW Maths Hub Strategic Board.

Steve Wilkinson, Outgoing Senior Leadership Link for North North West Maths Hub

Connectivity is at the heart of good leadership across the Maths Hubs Programme. Leaders communicate well, searching out the people and the organisations listening to their needs and matching the right support. We are servant leaders and evangelists at the same time.

David Baldwin, Outgoing Senior Leadership Link for Great North Maths Hub

02 Evaluators in Residence

In 2022/23, seven Maths Hubs were involved in the new Evaluators in Residence initiative. The cross-section of hubs – Angles, Central, BBO, Kent and Medway, London South East Plus, GLOW and North West One – all worked closely with an evaluator, exploring a particular strategic goal. At the start of the work, each hub came up with an overarching research question, then worked with their evaluator to refine and develop the question to make it bespoke to that hub's context. Hubs explored questions ranging from the impact of multiple teaching assistants in a school taking part in the same SKTM programme, to how Primary Sustaining Work Groups support lasting change in schools.

Across the academic year, Evaluators in Residence worked with their hub, staying in touch online and making face-to-face field visits to the hub, and to schools in its area. The aim was both to generate a report which the hub could use to develop strategic plans for the future, and to build an evaluation community.

In the summer, each Evaluator in Residence produced a detailed report, which focused on a case study of a school that the hub had worked with, but also looked at the wider context of the hub's work, and suggested a range of themes for future exploration. Those involved in the initiative are keen to continue the work next year. In 2023/24, two additional hubs will join the initiative, and look at how the development themes identified in the reports can inform the wider national picture of professional development offered by the Maths Hubs.

Being a project manager

Q&A with Parul Burman,
project manager at
Cambridge Maths Hub



In 2022/23, many Maths Hubs started developing new and existing members of their operational management teams into the role of project manager. The role involves overseeing all hub activity, including planning, recruitment, finance, communications and more.

How long have you been at the hub?

I joined in November 2022, so nearly a year.

What are the main elements of your role?

I oversee the day-to-day management of the hub, which requires clear and effective processes. I also line manage the operations team; we support the hub leadership group, local leaders of maths education, and hub activity participants.

The role is very outward facing, so I have to communicate well with all stakeholders.

My role is also analytical and strategic. I produce data on the hub's reach and engagement, and process this to form strategies for growth. I coordinate the plans, reports and data collection required for the CPD programmes, and review timelines to ensure deadlines are met.

What do you enjoy most about your role?

I enjoy the challenges that this role brings, and I'm energised by them. Being able to put processes in place and find solutions is like working on a maths problem by applying reasoning. (Yes, I like maths!) Above all I love the work environment; I have amazing people around me. It's also great being part of the wider network of Maths Hubs operational management teams. We can share our knowledge and learn from each other. I really enjoy being part of a team dedicated to promoting quality maths education in England.

The Maths Hubs Network

