

NRICH Annual Report for the year ending 31st August 2015

NRICH aims to:

- Enrich the experience of the mathematics curriculum for all learners
- Offer challenging and engaging activities
- Work in partnership with teachers, schools and other educational settings
- Develop mathematical thinking and problem-solving skills
- Show rich mathematics in meaningful contexts

NRICH annual report 2015

Ems Lord



nrich.maths.org

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Executive Summary

This report provides a summary of the activities of the NRICH team from September 2014 to the end of August 2015. In that period, the team continued to create high quality mathematical enrichment activities for the NRICH website and further develop its sister website Wild Maths wild.maths.org ; lead teacher professional development at home and abroad; contribute to national debates on mathematical education and publish articles in both academic and teacher journals.

NRICH's outstanding achievements in 2014/15 include:

- Attracting 7.9 million visits to our NRICH website (26% increase from 2013/14, source: Google Analytics)
- Attracting 35 million page views (19% increase from 2013/14, source: Google Analytics)
- Recruiting 20 400 NRICH Twitter followers (40% increase from 2013/14)
- Achieving NRICH Facebook 6 650 'likes' (33% increase from 2013/14)
- Supporting 6 000 class teachers at our NRICH professional development sessions
- Working face-to-face with around 2 000 students on NRICH resources
- Leading 70 NRICH Roadshows across the UK and overseas
- Hosting an NRICH Teacher Inspiration Day for newly qualified teachers (NQTs)
- Successfully building our new Wild Maths website, developed by the NRICH team

The NRICH team has welcomed three new members, including myself as its new Director, and is looking ahead to build on its achievements in 2015 and beyond.

Ems Lord
NRICH Director

The NRICH Team (from October 1st 2015)

Ems Lord	NRICH Director
Liz Woodham (PT)	Primary Coordinator
Fran Watson (PT)	Primary PD Lead
Bernard Bagnall (PT)	Primary Teacher Associate
Charlie Gilderdale	Secondary Coordinator
Alison Kiddle	Secondary Teacher Associate
Jacqui Watson (PT)	Stimulus Coordinator
Becky Warren	NRICH Roadshow Schools Liaison Officer

Technical Support:

Mike Pearson
Owen Smith

Administration and Events Support:

Alison Boyle
Margaret Bull
Kerstin Enright

Our technical and administration team members are employed by the Millennium Mathematics Project (MMP) and have duties across all the projects. The technical support team members have also been seconded to Cambridge Mathematics Education Project (CMEP) development work, the mathematics faculty websites, and to David Spiegelhalter.

People

We welcomed three new team members taking up their duties in September 2015. Ems Lord joined the team as our new NRICH Director. Ems previously led one of the largest Mathematics Specialist Teacher programmes in the country. She has taught across all key stages and at both undergraduate and postgraduate levels. Ems took over the reins from her predecessor Lynne McClure. The NRICH team would like to express its sincere thanks to Lynne for her inspirational leadership during her time at NRICH, and wish her well in her new venture as Director of the Cambridge Mathematics initiative.

Becky Warren is our new NRICH Roadshow Schools Liaison Officer. Before joining NRICH, Becky was Head of Department in a London secondary school and has also taught in an international school in Vienna. Becky takes over Roadshow duties from Fran Watson, to whom we are very grateful for doing such a wonderful job over the past two years. We are delighted that Fran continues to work with the team as our new primary coordinator responsible for CPD, taking over from Jennie Pennant who retires at the end of September 2015. Jennie's extensive experience and abundant enthusiasm will be sorely missed but we wish her well. NRICH also supports the STIMULUS local community service programme, which places University of Cambridge student volunteers in nearby schools to support maths, science and computing classes and after-school clubs. In September, Jacqui Watson took over the STIMULUS coordinator duties from her predecessor, Rob Percival. We are extremely grateful to Rob for his dedication and hard work over the past four years – a period which has seen remarkable growth in numbers of students volunteering for the programme.

We are delighted that Dr Sue Gifford is now coordinating our Early Years resources.

Unfortunately, due to ill health, we also said goodbye to Steve Hewson who coordinated NRICH's post-16 activities. Steve's extensive subject knowledge, impressive efficiency and thoughtful approach are truly missed.

The Websites

NRICH

The NRICH website now adapts to mobile use, and a growing number of new animations are tablet- and mobile-friendly.

The primary team has continued to update its curriculum mapping document which allows teachers to identify the most suitable NRICH resources to support their ongoing classroom mathematics topics.

The secondary team has also continued to add to the Curriculum Mapping Document and the [Stage 3 and 4](#) and [Stage 5](#) Curriculum pages on the site. They have begun to work closely with Don Steward to adapt some of his resources for NRICH, and these will be appearing on the Mapping Document in the next few months.

In addition, the secondary team has published new features on NRICH and has also developed some special collections for teachers:

Enriching the Secondary Curriculum <http://nrich.maths.org/enriching>
What we think and why we think it <http://nrich.maths.org/8068>
Developing Mathematical Habits of Mind <http://nrich.maths.org/habits>
Short Problems for Starters, Homework and Assessment
<http://nrich.maths.org/11652>

For students, the secondary team has published

Short Problems for Practice and Revision <http://nrich.maths.org/11993> and
Thinking Mathematically <http://nrich.maths.org/mathematically>.

We have collaborated with CMEP to publish some of its new resources on our Upper Secondary Student site. This has been a fruitful partnership as it has allowed CMEP to disseminate its resources more widely while offering NRICH users a chance to work on the new resources as they are developed, and submit solutions.

Alison has also been working on the STEP Prep features <http://nrich.maths.org/step> and there are now 24 modules that this year's STEP students will be able to work through independently.

To cater for the other end of the age range, Sue Gifford is now coordinating our EY resources. Three new Early Years activities and three Early Years articles have been published.

Features by Age and Title

	For teachers	For students
Early years	<p>Mathematical Problem Solving in the Early Years https://nrich.maths.org/11113</p> <p>Early Years Mathematics: How to Create a Nation of Mathematics Lovers? https://nrich.maths.org/11441</p> <p>Developing Number Through Tidying Up https://nrich.maths.org/11528</p> <p>The Value of Two https://nrich.maths.org/11527</p> <p>Maths Hub page https://nrich.maths.org/9829</p>	<p>Socks</p> <p>Position with Wellies</p> <p>Using Books</p>
Primary Features	<p>Problem Solving Feature https://nrich.maths.org/10334</p> <p>Reasoning Feature https://nrich.maths.org/11018</p> <p>Maths Hub page https://nrich.maths.org/9829</p>	<p>For Lower Primary Students:</p> <p>Trial and Improvement https://nrich.maths.org/11179</p> <p>Reasoning https://nrich.maths.org/11021</p> <p>The Young Mathematicians' Award https://nrich.maths.org/11588</p> <p>NRICH Advent Calendar https://nrich.maths.org/11078</p>
		<p>For Upper Primary Students:</p> <p>Trial and Improvement https://nrich.maths.org/11079</p> <p>Reasoning https://nrich.maths.org/11024</p> <p>The Young Mathematicians' Award https://nrich.maths.org/11576</p> <p>NRICH Advent Calendar https://nrich.maths.org/11078</p>

<p>Secondary Features</p>	<p>Enriching the Secondary Curriculum http://nrich.maths.org/enriching</p> <p>Introducing CMEP http://nrich.maths.org/11442</p> <p>Teaching Geometrical Reasoning http://nrich.maths.org/9189</p> <p>Starting Term the NRICH way http://nrich.maths.org/12068</p>	<p>For Lower Secondary Students:</p> <p>Addicted to Addition http://nrich.maths.org/11276</p> <p>Surprised by Shapes http://nrich.maths.org/11399</p> <p>All about Averages http://nrich.maths.org/11493</p> <p>Sequence Surprises http://nrich.maths.org/11602</p> <p>Playing with Polygons http://nrich.maths.org/11775</p> <p>Number Teasers http://nrich.maths.org/12100</p>
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		<p>For Upper Secondary Students:</p> <p>Making Decisions http://nrich.maths.org/11259</p> <p>Digging Deeper Into Quadratics http://nrich.maths.org/11270</p> <p>Thinking Functionally http://nrich.maths.org/11295</p> <p>Curves, Tangents and Asymptotes http://nrich.maths.org/11326</p> <p>Logs by the Fire http://nrich.maths.org/11327</p> <p>Circular Arguments http://nrich.maths.org/11474</p> <p>Tricky Trigonometry http://nrich.maths.org/11514</p> <p>Time to Be Irrational http://nrich.maths.org/11583</p> <p>Transforming Ideas http://nrich.maths.org/11616</p> <p>Curvy Calculus http://nrich.maths.org/11733</p> <p>Graphs and Networks http://nrich.maths.org/11822</p>
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CPD Content

The primary team has worked hard to create features on NRICH which build on the popular Mathematics Specialist Teacher (MaST) days. This approach is strengthening the links between our professional development work with teachers and the development of our website resources.

At NRICH, we are continuing to support the work of the growing number of Maths Hubs across the country. We are currently liaising with regional Hub leaders to develop a programme of support for problem-solving. Furthermore, we are strategic partners for our local Maths Hub. NRICH has added a dedicated Maths Hub <http://nrich.maths.org/9829>

Metrics

We now have over 10,000 tasks, articles and games on the NRICH site, for all ages, stages and capabilities. Our statistics indicate that the number of visits and pageviews for the NRICH site continues to increase, a growth of 26% in visits and 19% in pageviews compared to the previous year (Source: Google Analytics).

	Visits 2013/14	Visits 2014/15
Sep	564,058	739, 472
Oct	610,143	752, 667
Nov	611,052	803, 346
Dec	416, 352	498, 255
Jan	599,070	785, 121
Feb	559,467	710, 421
Mar	683,333	775, 467
Apr	458,968	625, 587
May	578,773	727, 136
Jun	577,479	739, 881
Jul	365,035	440, 761
Aug	300,030	384, 376

At NRICH, we continue to engage with our audience by a variety of means. Our teacher newsletter, NRICHSUPPORT has 13, 867 subscribers. Our pupil newsletter, NRICHTALK has 1 511 subscribers. Although both figures represent a slight decrease in subscribers compared to the previous year, we believe that a substantial number of subscribers have switched their preferences to our Facebook and Twitter; our Facebook page facebook.com/nrichmaths has 6650 likes, and our Twitter account twitter.com/nrichmaths has over 20,000 followers. We use both of those channels to keep our NRICH users up-to-date on a more frequent basis than our monthly newsletters allow, sharing new resources or professional development opportunities as soon as they emerge. It also gives teachers an opportunity to give us immediate feedback and share pictures from their classrooms and blogs about how they are using our resources. Subscriptions for our dedicated monthly update for MaST teachers has increased by 26% compared to last year, and its corresponding MAST tutor list also increased over the last 12 months.

Wild Maths

This year we launched our new website wild.maths.org for the Developing Mathematical Creativity project funded by the Templeton World Charity Foundation. The site complements the provision currently provided by NRICH by targeting parents working with their children. The new site comprises pathways of rich tasks, designed to develop mathematical creativity. Wild Maths is an ongoing project which is still in its developmental phase.

As of August 2015 the published pathways are:

- Open Spaces
- Freedom and Constraints
- Dotty Grids
- Number Pathways and Infinity
- Special Numbers
- Mathematical Stories

We continue to work on developing new pathways on strategy games, cutting and folding paper, number theory and visual proofs.

Other Development Projects

CMEP <http://www.maths.cam.ac.uk/cmep/> is a collaborative project between the Mathematics Faculty and NRICH. It is planning to go live in the new year. Although NRICH and CMEP are separate in fact there is a lot of overlap, especially at KS5. The rate of writing tasks for publication on the CMEP site has increased rapidly now that the planning phase is over, and the site is already available to our partner and affiliate schools. The CMEP team, supported by the NRICH team, has also led three CMEP residential workshops involving over 100 A level teachers this year.

NRICH is also contributing towards the new Cambridge Mathematics initiative. Charlie represented NRICH at the launch of its [Cambridge Mathematics Framework](#) at a one-day conference in March 2015. NRICH is actively engaging with this new initiative and contributing towards its ongoing consultation process. The NRICH team is represented at the Cambridge Mathematics' Advisory Group and it is a member of its Governance Group.

Professional Development Activities

We enjoy working with teachers in a variety of settings. This year we have continued to rationalise our activities and have focussed on:

- 'advertising' – keynotes or other events where we know we will not change attitudes but will acquaint teachers with the full range of activities on our site;
- working with multipliers – consultants and coordinators whom we know will be able to share what we have developed with their colleagues
- longer term projects – working in depth with one school or group of schools in order to bring about sustained change.

Over the year we have worked with approximately 6000 teachers, 500 of them here at CMS and the remainder at various venues around the country or abroad. This year we have actively engaged with the new Maths Hubs programme, run by the NCETM, which brings together mathematics education professionals in a collaborative national network of 34 Hubs, each locally led by an outstanding school or college. We have been invited to be a national partner and have been working with Maths Leads at national level and we have also been working with individual hubs on problem solving projects, such as the Matrix and GLOW Hubs.

In the summer, the secondary team worked with Cambridge University Press to support teachers preparing for the new Key Stage 4 examinations (for further details see <http://nrich.maths.org/11553>).

Once again, we were invited to contribute to the UKMT Teacher Meetings at various locations around the country (see <http://nrich.maths.org/11599> for details).

Jennie coordinated an on-going series of one-day conferences, held at the London Mathematical Society (LMS), and designed to support primary Mathematics Specialist Teachers (MaST) and mathematics subject leaders. These have proved extremely popular and we now have a database of over 450 MaST colleagues with whom we regularly communicate. We are now welcoming delegates to our sessions from British schools overseas, including Germany and Spain, and also from the curriculum team in Ireland. Feedback from participants has been extremely positive, including 'Your online resources, especially articles and linked activities are fabulous!'

Bernard and Jennie together have continued to develop their fruitful relationship with Explore Learning, a private company that runs after-school clubs. As well as designing three rich tasks suitable for their national team challenge, Jennie and Bernard have worked with the coordinators to support them in understanding what rich tasks are and how best to communicate them to their students.

Charlie continues his consultancy to the Heymath project, which is based in India and Singapore, and has expanded into a number of other countries including South Africa and Brazil.

Liz and Michael Hall, an independent consultant, successfully completed their [London Schools' Excellence Fund](#) project with fifteen Haringey primary schools. Over five terms and ten face-to-face sessions, the project aimed to improve primary teachers' mathematical subject knowledge and pedagogic knowledge, thereby increasing pupil attainment. The project culminated in a well-attended conference which included workshops hosted by some of the participating schools. At one of the workshops, a school outlined how it had effectively deployed NRICH resources to engage its Pupil Premium Pupils and their parents. It reported an increase of 19% of pupils achieving Level 4 or higher in their end of Y6 SATs compared to the previous year. Michael and Liz are currently writing the project evaluation.

Please see Appendix A for examples of our professional development activities.

Teacher Inspiration Days

In July at CMS we hosted 127 Newly Qualified Teachers from primary and secondary schools at our Teacher Inspiration Day. This is the fifth year we have offered this free CPD event and it is always well received. Plans are already underway for the summer 2016 events.

We also hosted our highly successful Cambridge University Press (CUP) event 'Brighter Thinking: Enriching the Mathematics Curriculum at KS4.' Thanks to generous support from CUP we were able to offer free places for KS4 teachers of mathematics at any UK school. The event was designed to support teachers preparing for the new GCSE curriculum by focusing on key areas of problem-solving, reasoning and fluency. It was delivered across a pair of linked days, with participants required to attend both days. Feedback revealed that 100% of participants had shared, or planned to share, the ideas and resources from their training with their colleagues back in their own schools. Typical comments from participants included 'Brilliantly delivered and inspiring' and 'Amazing resources. Inspiring me to be more creative.'

Working with Students

This year we have worked with approximately 2000 students, in addition to those Fran has worked with as Roadshow participants.

Faculty of Education and Faculty of Mathematics

The team continues to be involved with the Faculty of Education, attending meetings of the STEM academic group. We also contribute to both Secondary and Primary PGCE courses by presenting sessions about NRICH to the trainees. This year we have developed our involvement by also contributing to the Primary NQT day run by the Faculty in March. We anticipate this becoming an annual event.

NRICH supported a number of the widening participation activities organised by Cambridge Admissions Office in collaboration with the Faculty of Mathematics. Alison Kiddle contributed to the Sutton Trust summer school, led by Professor Nigel Peake on behalf of the Mathematics Faculty. The summer school offered a challenging academic programme and gave highly achieving students from less advantaged backgrounds an opportunity to experience life in Cambridge and learn more about STEP. Alison also taught on the STEP Easter School, providing support for 100 Year 13 students holding conditional offers to study mathematics at Cambridge.

Wider Representation and Professional Activity

It is a sign of the increasingly wide reach of NRICH that we are invited to join various national groups and advisory bodies. Jennie is a member of ACME and team members attended the annual conference in July. NRICH is a participating society of

JMC, which in itself is an acknowledgement of a high profile in the Mathematics Education community. In addition team members sit on the DfE Expert Maths group, advisory boards for OCR, MEI, Critical Maths, Maths Mastery and the PRIMAS and MASCIL European projects. We continue to work in professional partnership with UKMT, NCETM and several different subject associations. We also ensure that we respond to government consultations, such as assessment in mathematics, as we know that we have a national overview to share that is important.

Research

One of the benefits of NRICH becoming increasingly well-known and regarded is that respected experts in the field of mathematics education are happy to work with us.

For the Early Years section of the site we continue to work with Dr Sue Gifford who has helped us to provide short accessible articles about supporting evidence.

Our MaST days have been heavily informed by our own reading of the literature and research into mathematical fluency and reasoning.

The TWCF grant has continued to provide an opportunity for us to delve into and synthesise the literature on mathematical creativity and on-line models to support students working independently.

Discussion Forums

We have launched a new forum as part of our offering for students preparing for STEP at <http://maths.org/step/forum>. As with AskNRICH, we have offered training to University of Cambridge maths students so that they can respond to students' queries about STEP in a supportive manner without giving answers. Early indicators show that the forum is reaching a wide audience with just under 7 000 site visits and over 27 000 page views.

STIMULUS

STIMULUS is a community service programme which gives Cambridge University students the opportunity to work with pupils in local schools, helping with mathematics, science, computing or technology lessons. STIMULUS students work as volunteers in the classroom, under the supervision of the class teacher.

In the 2014/15 academic year STIMULUS organised the highest annual total of volunteer placements in the programme's history. Each placement commits a volunteer to working in their allocated school alongside a specific teacher for one afternoon a week during the university term. In total, STIMULUS created 361 placements for Cambridge student volunteers in local schools during the 2014/15

school year. Volunteers work in classrooms of all ages - from 5 to 18 year olds - and take on a variety of supportive roles, from working with struggling learners to delivering challenge and extension activities for those who need it. This year has also seen the expansion of the STIMULUS programme through a collaboration with the national Code Club network. From October 2014, 30 of the STIMULUS student volunteers have been running weekly Code Clubs in 10 primary schools within the city of Cambridge, introducing primary school children to computer programming.

NRICH Roadshow

Fran Watson handed over the reins of Schools Liaison Officer to Becky Warren in September 2015. Over the last 12 months, Fran has delivered 68 UK-based NRICH Hands-On Roadshows. Audiences included primary, junior, infant, middle, prep, secondary and international schools in both the state and independent sectors. Feedback from participants continues to be very positive. Typical comments include 'Excellent ideas, open-ended tasks, ways to provoke thought and extend teaching.' Fran has also continued to take the roadshow overseas, leading 3 days of events in Stavanger in Norway and two sessions in Dublin.

In addition, the Mathematics of Paper Folding workshops are now a well-established part of our offer to schools (see <https://maths.org/paper-folding>). Paper folding activities will appear on the primary area of the NRICH site in autumn 2015, and will also be featured on the new Wild Maths website.

Publications

McClure, L. (2014) *Developing Number Fluency - What, Why and How*. Primary Mathematics Vol 18 Issue 3 Leicester: Mathematical Association

Pennant J (2015) *Exploring visual proof in the Primary school* Teach Primary Autumn 2015

Pennant, J. (2015) *Problem Solving with NRICH and the 2014 National Curriculum* in Primary Mathematics Vol 19 Issue 2 Leicester: Mathematical Association

Pennant, J. (2015) *Reasoning: novice, proficient or expert?* Teach Primary Spring 2015

Pennant, J. (2015) *Supporting learners to articulate their reasoning* Teach Primary Summer 2015

Pennant, J. (2015) *Structuring the problem-solving process for young learners* May 2015 MT Journal number 246: Association of teachers of Mathematics

Pennant, J. and Woodham, L. (2015) *Mathematical Reasoning - Moving Beyond 'Because ...'* Primary Mathematics Vol 19 Issue 1 Leicester: Mathematical Association

Marketing and Publicity

In addition to our online NRICH resources, the NRICH team also produces rich mathematical postcards and posters which have proved very popular with schools.

Into the Future

The NRICH project is widely known and respected. Through our 'low threshold high ceiling' activities we offer support and challenge on topics both within and outside the usual mathematics curriculum, together with extensive teacher support material. There are already over 10,000 tasks on the site for students from 3 to 18+ and catering for nearly all students, the exception being those at the very lower end of the attainment spectrum who find mathematics very challenging. NRICH continues to reach an enormous audience through our website. Our task in the future then is to build on NRICH's strong foundations so that it continues to be seen as the essential source of high quality resources for teachers. We are currently actively seeking funding to secure both the continuation and future growth of NRICH once our current grant funding ends in 2015/16, and we are keen to secure further support to enable us to enlarge our team.

This is my first report as NRICH Director as I joined the team in September 2015. I would like to thank my predecessor Lynne McClure whose leadership ensured that NRICH continues to maintain a high profile in mathematics education. I would also like to express my sincere thanks to Charlie Gilderdale for his commitment to the role of Acting NRICH Director prior to my appointment, and his support following my appointment. I look forward to working with the NRICH team to further develop our

resources, professional development work and involvement in national debates relating to mathematics education so that NRICH continues to build on those strong foundations.

Ems Lord

NRICH Director, September 2015

Appendix NRICH Out and About

PRIMARY

Sustained programmes:

EXPLORE
MaST Leading Learning days (4)
Haringey two-year project (Second year)
Camden four-day programme with Eleanor Palmer teaching school

INSET:

Sussex Teaching Alliance
Central South Consortium, Wales (2 days)
Faculty of Education PGCE students
Faculty of Education NQT conference
Durham LA
Roadshow Problem Solving conference at CMS
NQT day at CMS

Keynotes:

Derbyshire LA conference
IAPS conference, Beaconsfield
Brent LA conference

Workshops:

MA CPD event (High Wycombe).
ATM April conference
Visiting Canadian teachers (Ontario)

Hubs:

Matrix Hub (Essex and Herts) led by The Hertfordshire and Essex High School and Science College, Bishops Stortford
GLOW Hub (Gloucestershire, Oxfordshire, Worcestershire) led by The Balcarras school Cheltenham

SECONDARY

Contribution at teacher events:

CUP/NRICH Brighter Thinking Workshops
Bromley Schools Collegiate Training Day
ATM and MA Easter Conferences
MA Stirling Conference
Hampshire Maths Teachers Conference
UKMT teacher meetings Oxford, Aberdeen, Coventry, York, Cambridge and

Greenwich
PGCE students Faculty of Education, Cambridge
Prince's Teaching Institute, London and Cambridge
Cambridge International Examinations Seminars in Madrid, Colombia and
Argentina
Cambridge International Examinations Conferences in Cambridge and Sri
Lanka
London FMSP Key Stage 4 Enrichment days
FMSP Manchester Conference

Contribution at student events:

Cambridge Science Festival
Year 9 enrichment work in Enfield
Gibraltar Maths Week
FMSP Year 10 and 12 enrichment days
STEP Easter School
Sutton Trust Summer School