National HE STEM Programme

Mathematical Sciences Strand

Overview Report 2009 - 2012

Contents.

This brochure has been created to give a broad overview of the work of the mathematics strand in the National HE STEM Programme.

A more indepth and detailed report and brochure showcasing the work of the six Spoke Universities and four professional bodies working within the National HE STEM Programme will be made available via the website www.hestem.ac.uk in January 2013.

This website is also the repository for all outputs created within the Programme.

Guide to acronyms

HEFCE -	Higher Education Funding Council for England
HEFCW -	Higher Education Funding Council for Wales
HEI -	Higher Education Institution
HoDoMS -	Heads of Departments of Mathematical Sciences
IMA -	Institute of Mathematics and its Applications
IOP -	Institute of Physics
LMS -	London Mathematical Society
MSOR Network -	Maths, Statistics and Operational Research Network of the Higher Education Academy
PGCE -	Post Graduate Certificate in Education
RAEng -	Royal Academy of Engineering
RSC -	Royal Society of Chemistry
RSS -	Royal Statistical Society
STEM -	Science, Technology, Engineering and Maths
WIMCS -	The Wales Institute of Mathematical and Computational Sciences
OFFA -	Office For Fair Access
QAA -	Quality Assurance Agency


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Background

In 2004, the Secretary of State sought advice from the Higher Education Funding Council for England on strategically important Higher Education subjects or courses. A review was undertaken to identify subjects in need of support to address an imbalance between supply and demand, and a range of disciplines were identified including Chemistry, Engineering, Mathematics and Physics.

The mathematics pilot project was called More Maths Grads and ran between 2007 and 2010 in three regions, being administered by a consortium of five mathematical organisations (IMA, LMS, HoDoMS, MSOR Network and RSS). More Maths Grads was judged overall to have been a tremendous success and in conjunction with a number of other factors, the HE mathematics landscape began to change, with many mathematics departments boasting healthy student numbers, where once they had been on the brink of closure.

It was in this landscape that the National HE STEM Programme began in August 2009 - no longer were maths departments struggling to increase student numbers, instead they were addressing a number of other concerns relating to a wide range of issues around curriculum development, student preparedness, graduate skills and employability.

Under the leadership of a hub team based at University of Birmingham, the National HE STEM Programme was set up to work within six regions in England and Wales, led by six regional HEI 'Spokes'; as well as across four subject disciplines of Mathematics, Physics, Chemistry and Engineering (led by the four professional bodies of IMA, IOP, RSC; and RAEng).

The National HE STEM Programme had three broad aims:

- Widening participation within the STEM disciplines at university level, by supporting HEIs to work with those currently within the school and FE sectors.
- Higher Education curriculum developments focusing upon course delivery and design and student support, to enhance student knowledge, progression and skills.
- Encouraging those currently within the workforce and society without a prior university-level qualification to engage with further study to develop enhanced knowledge and skills.

The mathematics strand was led by the IMA in consultation with other mathematical organisations (HoDoMS, LMS, RSS, MSOR). In order to address the aims of the National HE STEM Programme, the IMA recruited a project manager (Makhan Singh) and a project officer (Hazel Lewis). The IMA also established two major sub-contracts - one with the MSOR network which addressed curriculum development; and one with **sigma**, looking at student support and transition via maths support centres. Both these sub-contracts were overseen by Duncan Lawson in his roles as Director of the MSOR Network and Director of **sigma**. The MSOR Network employed a Higher Education Curriculum Innovation Officer (Peter Rowlett) and **sigma** employed an Assistant Director (Moira Petrie and then Dagmar Waller) to deliver the activities set out in the sub-contracts. There was good continuity with the work of the More Maths Grads project as Makhan Singh, Hazel Lewis and Duncan Lawson had all played significant roles in the delivery of that project. In addition to the IMA managed work, there was also a significant number of regionally funded maths focused projects which are contained in an appendix at the end of this report.

There were therefore four sources of mathematics work within the National HE STEM Programme - work from the IMA, MSOR Network, **sigma** and projects funded regionally. Total project funding was £21 million for the whole National HE STEM Programme, with the mathematics strand receiving £1.5 million.

Regional Partners of the National HE STEM Programme

North East and Yorkshire – University of Bradford
North West – Manchester Metropolitan University
Midlands and East Anglia – University of Birmingham
South West – University of Bath
South East and London – University of Southampton
Wales – WIMCS

Professional Body Partners of the National HE STEM Programme

Mathematics – IMA
(on behalf of the other mathematical organisations)
Chemistry – RSC
Physics – IOP
Engineering – RAEng

Pilot project dissemination

The National HE STEM Programme was the direct successor to the HEFCE funded pilot projects including the More Maths Grads project. The first task of the maths strand team was to share the work of More Maths Grads with the HE mathematics community, ensuring that resources and expertise were maintained.

At the end of More Maths Grads in January 2010, all the physical outreach & widening participation resources were packaged into a box called 'Maths in a Box'. A copy of this box was sent to each maintained secondary school in England and Wales, as well as a HEI version being sent to each HEI mathematics department.

For HEI maths departments and teachers who had not fully explored 'Maths in a Box', the mathematics strand team embarked on a national tour of eight regional workshops sharing the learning from More Maths Grads and giving training on the resources in Maths in a Box. The workshop was titled 'Opening the Box!' and was held at eight locations including the University of York; Manchester Metropolitan University; University of Birmingham; University of Bath; University of Plymouth; University of Portsmouth; Cardiff University and Queen Mary University of London.

There was also an offer to all HEIs for training on using the resources in 'Maths in a Box' and sessions have been conducted all over the country and in different settings such as with PGCE students at the University of York and with student ambassadors and staff at the University of Manchester. Furthermore, a "Good Ideas Guide" has been produced which gives suggestions for how to use the resources with young people.

An important part of More Maths Grads was a research theme carried out by a team at Sheffield Hallam University. This looked at every aspect of the undergraduate mathematics student experience including what motivated students to choose a maths degree and their experiences once they had commenced such a programme. Alongside two other pieces of More Maths Grads funded research, these findings were packaged into booklets and the authors filmed talking about their findings. These resources were then made available to the mathematics community using the support of the National HE STEM Programme.

Menu of activities

Two calls were launched early in the National HE STEM Programme under the title 'Proven disciplinary interventions and approaches'. HEI departments were offered a menu of successful outreach activities from which they could choose an activity and apply for small amounts of funding. All the activities had taken place during the pilot projects and had therefore been evaluated as to their impact. There have been some very positive outcomes from this funding call – for example all the HEIs who ran a 'maths challenge competition' have run the activity again in the second year using funding from their own institution.

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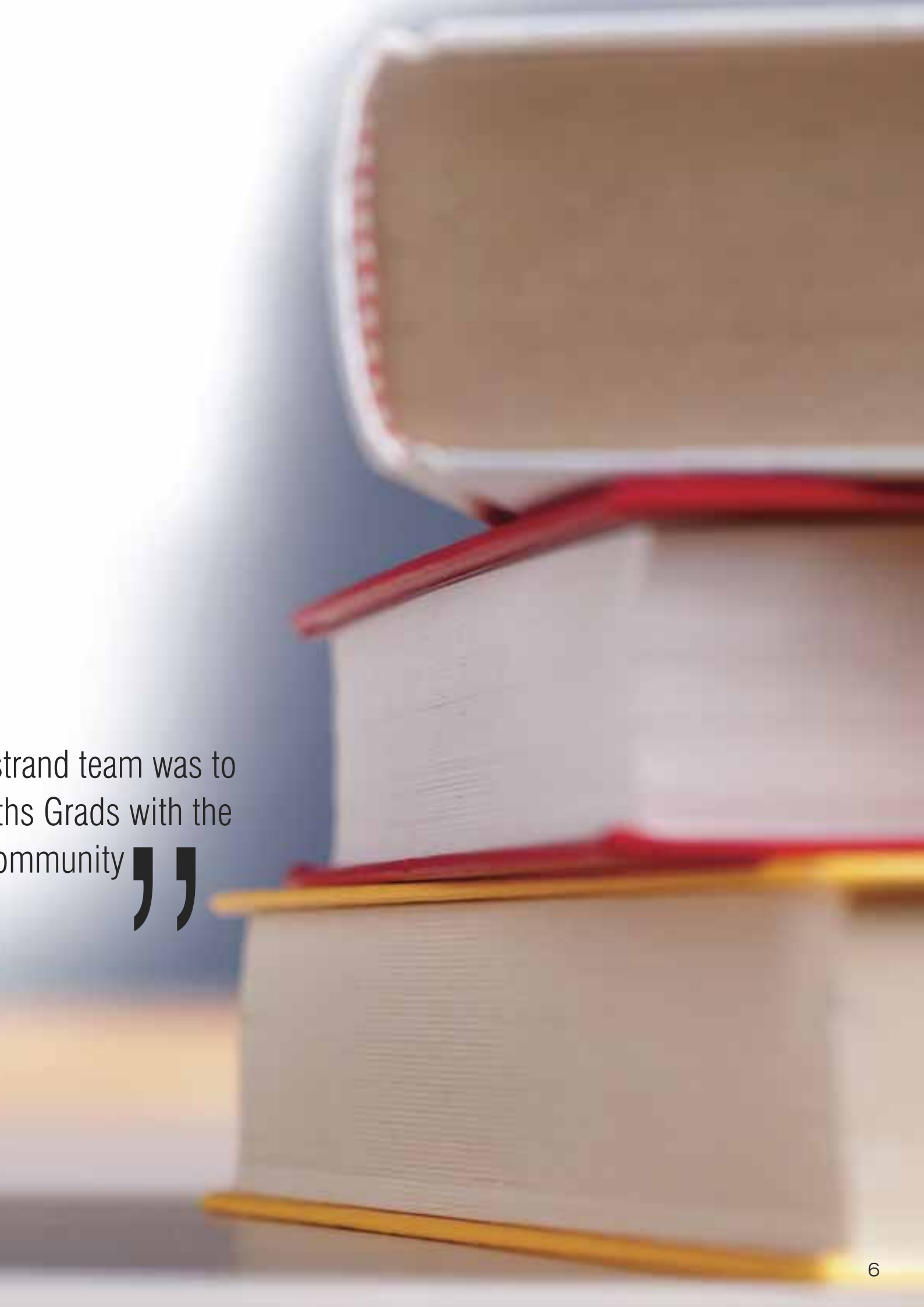

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Outreach and widening participation

Maths outreach report

Widening participation and outreach was a major theme of the National HE STEM Programme and the mathematics strand began by investigating the landscape of maths outreach work going on in England and Wales. This was done through a survey of all mathematics departments, with the view that the results would help build links and enable the sharing of good practice between institutions. The resulting report is now available to download from the IMA website www.ima.org.uk. The analysis showed that there is excellent outreach work going on, with some really innovative and interesting activities. In particular the report showed that the majority of maths departments now have some form of student ambassador programme.

Public Engagement Project

Early on in the Programme, a call was put out to the mathematics community to produce resources which increased public awareness of the key role of mathematics underpinning STEM disciplines. The successful bid came from Coventry University and resulted in a video being produced which explained to the public the maths behind internet banking. Titled 'Bob's misadventures in Maths', this video can be viewed at www.mathscareers.org.uk.

www.mathscareers.org.uk

The IMA manages a website called www.mathscareers.org.uk which is the foremost website on mathematical careers for young people. The mathematics strand allocated funding to increase the resources on the website so that there is more material for those aged 16-19 and for mathematics undergraduates. Visits to mathscareers.org.uk have been increasing rapidly and as a result, there are now on average 15,000 visitors per month. This site is an excellent complement to outreach activity by HEI maths departments as it provides a source of extra information to which young people can refer.

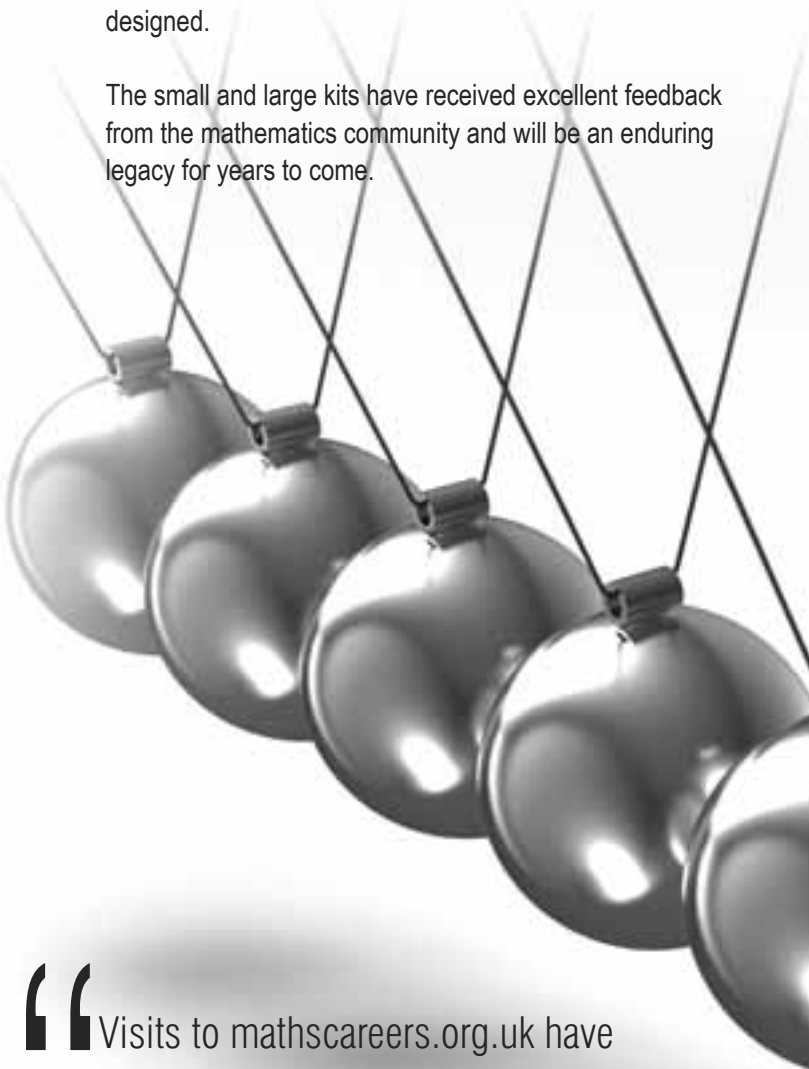
Seeing Where Maths Can Take You - Engineering in Action

The National HE STEM Programme was a STEM wide project and as such it was important to utilise the opportunity to work between disciplines. A project was established with the RAEng which highlighted engineering as a career by showing the specific mathematics that engineers use on a daily basis. These resources were aimed at A-level students as well as mathematics and engineering undergraduates who are considering which career to follow. The resources produced included a booklet where young engineers talk about the mathematics they use and what it is like to follow their career. This booklet is accompanied by a DVD which showcases a series of videos highlighting (engineering) maths in action.

Maths outreach and careers kits (Small and Large)

It is becoming increasingly common for maths departments to be asked to provide hands on activities at science fairs, careers fairs or open days. Many staff find it difficult to allocate the time and resources to produce such activities, even if they have the expertise and knowledge to do so. This is why the mathematics strand aimed to resolve this by producing two kits. One was a small briefcase of activities, many of which were toys with interesting and surprising mathematics behind them. At large science fairs such as Big Bang, the science and engineering activities available for students to participate in are often very impressive. The large outreach and careers kit aimed to produce grander equipment to enable mathematics not to be overshadowed by the activities available in other disciplines. As a consequence, a series of seven large activities, including a Galton Board, a Double Pendulum and an aerofoil were designed.

The small and large kits have received excellent feedback from the mathematics community and will be an enduring legacy for years to come.



"Visits to mathscareers.org.uk have been increasing rapidly and as a result, there are now on average 15,000 visitors per month"

A group of experienced maths outreach practitioners from a number of institutions were consulted for their ideas and advice on both kits. This meant that the items in both kits were tried and tested ideas which have been in use for many years and have proved their value to mathematics outreach.

Region	Regional Custodian(s)
South West	University of Plymouth
South East and London	University of Hertfordshire Brunel University University of Portsmouth University of Greenwich
Midlands and East Anglia	Coventry University
North East and Yorkshire	University of Leeds University of Sheffield University of Durham
North West	Manchester Metropolitan University plus four further kits held in a consortium
Wales	Swansea University Aberystwyth University
Other	LMS and RSS

"The kits contain some really interesting objects which inspire you to go out and motivate young would-be mathematicians. It makes a major contribution to mathematical outreach."
Neil Challis, Head of Mathematics, Sheffield Hallam University.

"...we borrowed the harmonograph and this went down a storm with all ages." Jim Tabor, Head of Mathematics, Coventry University

Employer engagement

Employer engagement can be a challenge for HEI mathematics departments – graduates enter a huge variety of different careers so it is virtually impossible to find a single representative employer with whom to build a relationship over a number of years. It is however increasingly recognised that there are significant benefits to employer engagement in terms of the employability of graduates as well as fostering fruitful research collaborations.

Industrial Panel Project

The IMA was approached by Dr Pargat Singh Calay of London Metropolitan University who wanted to set up an industrial advisory panel to review the department's mathematics degree curriculum. The IMA filmed the whole process and supported Dr Calay to write a case study which has been published to share with other mathematics departments. The process has been so successful and so well received by London Metropolitan University, that further funding was made available via a central National HE STEM Programme funding call for other (mathematics) departments to set up a similar group. Four HEIs have since adopted the good practiced showcased by London Metropolitan; these are: University of York; University of Hertfordshire; Manchester University; and University of the West of England.

> "Four HEIs have since adopted the good practice showcased by London Metropolitan"

Maths at Work Days Project

As a result of the Menu of Activities funding call, the University of Salford ran its first ever Maths at Work day; an event where employers run workshops and give talks on the mathematics that they use in their career. It is both an outreach event and an employer engagement event, building strong links between universities and local employers. The University of Salford mathematics department received this event extremely positively and agreed for it to be filmed so that the experience could be shared with other departments. The mathematics strand additionally produced a written practical guide to running a Maths at Work day. The day was so popular in Salford, that they have committed to running it for a second year, this time using funding from within their own institution.

Student ambassadors and careers

During the pilot project More Maths Grads, it was recognised that student ambassadors are one of the most effective tools in widening participation and recruitment. Additionally, the process of being a student ambassador usually benefits undergraduates, leaving them more confident, better communicators and often more employable. For these reasons, the maths strand decided to invest in projects to help departments running various forms of student ambassador scheme.

> "student ambassadors are one of the most effective tools in widening participation and recruitment."

Student Ambassador Case Study Guide

A case study booklet was produced which featured nine diverse models of student ambassador scheme, including situations where the students receive academic credit, where they are paid for their time and where they do the work under an entirely voluntary basis.

Maths Ambassador Resource Kit (MARK)

In theory Maths Ambassadors have several key advantages when they are in the classroom working with secondary school pupils. Undergraduates are currently studying mathematics to a high level and are interacting with researchers on a daily basis. This means that undergraduate ambassadors have the chance to be in an excellent position to talk about modern applications of maths and bring into the classroom knowledge of the kinds of careers to which studying mathematics leads. Many teachers feel isolated from this kind of information and therefore ambassadors can bring real benefit to the classroom. Ambassadors do however sometimes need help with this kind of information and that is why the MARK was developed.

The Maths Ambassador Resource Kit (MARK) includes a wealth of easily accessible materials and is accompanied by a new ambassadors section on www.mathscareers.org.uk. Some highlights from the MARK include a video featuring maths graduates talking about their careers, and a series of clips showing where maths is used in real life, presented by Channel 4's Countdown presenter Rachel Riley.

What can I do with my maths degree?

The booklet with the title 'What can I do with my maths degree?' does exactly what the title says by giving undergraduates a guide to careers following on from their maths degree. As with all the items produced by the National HE STEM Programme, departments are free to reproduce, without charge, the materials under a creative commons license.

Where the maths you learn is used

Not many undergraduates know where the maths they learn is used in the real world. This booklet produced by Queen Mary University of London was designed to show the applications of common undergraduate topics, with an additional aim that it will motivate undergraduates to consider careers they had not previously considered. It has been very well received by maths departments and around 3,500 copies were distributed to over 20 HEIs.

Careers Pilot Project

The majority of careers professionals do not come from a STEM background and may lack confidence in giving advice on mathematical or scientific careers. As such a pilot professional development course was established, accredited at postgraduate level. It was developed using expertise from the IMA, Cardiff University, Sheffield Hallam University with Babcock International and the Welsh Spoke director Alison Braddock. University of Glamorgan validated the course for use at UHOVI (University Heads of the Valley Institute). It was a great success with excellent feedback from the participants and it is hoped that this course will continue for many years to come.

Maths LASTS! project

Sustainability and legacy is at the heart of the National HE STEM Programme and as such a key consideration has been enabling the work to continue beyond the life of the programme. The first step is that all materials produced by the IMA are held on www.mathscareers.org.uk, and that they are essentially copyright free, with only a simple creative commons license. The resources have also been gathered into a kit called Maths LASTS (Maths Legacy And Sustainability Toolkit Set). Maths LASTS will be made available to each HEI maths department along with a copy of the Small Maths Outreach and Careers Kit, and the MARK box for student ambassadors. Departments will have physical copies of all materials as well as access to electronic versions allowing them to print multiple copies of resources.

As part of the National HE STEM Programme, a project entitled 'Employer Engagement: Case studies for adoption in HEI Mathematical Sciences' was led by Edmund Chadwick at University of Salford and supported by Makhan Singh at the IMA. The project looked to collate and distribute established good practice with regards to how HEI Mathematics departments engage with employers. The aim was to produce a practical guide which showcases twelve good practice examples of employer engagement within HEI mathematics departments. This guide has been completed and is available in hard copy from Edmund Chadwick (electronic copy available from the IMA and Maths Careers website – www.mathscareers.org.uk).

Mathematical Sciences HE Curriculum Innovation Project

The aims of the National HE STEM Programme included delivery of "Higher Education curriculum developments focusing upon course delivery and design, to enhance student knowledge, progression and skills". In mathematics this was addressed by the HE Curriculum Innovation sub-contract which was held by the MSOR Network.

Under this sub-contract over £250k of funding was distributed to 33 projects involving work from more than 120 people at 41 UK HEIs. There is much to share from these projects – good practice advice, evaluated innovative approaches, problem banks and other curriculum resources ready for immediate use and much more. In addition the HE Curriculum Innovation sub-contract ran or took part in nearly fifty workshops and other events directed to its aim.

An overview summary of this work is included on these pages. It is not possible to describe all this activity in detail in this short report – further information about all the projects and the resources can be found at www.mathstore.ac.uk/hestem.

Funding priorities

A high-level event in January 2011, the HE Mathematics Curriculum Summit brought together Heads of Department (or their representatives) from around half of the universities in England and Wales that offer a BSc (Hons) Mathematics degree, with representatives of the professional bodies and others for a day of debate and discussion leading to a series of recommendations for curriculum development priorities of the community. Around 70% of the funding allocated by this sub-contract was directed to the priorities identified by the Summit.

In order to allow for interesting innovation which could not be predicted, calls for funding always included an open call for projects fitting the National HE STEM Programme aims. Around 30% of the funding allocated by this sub-contract was for new innovations discovered this way.

Thumbnail sketches of some of the larger pieces of work funded by the HE Curriculum Innovation sub-contract are outlined below.

Developing graduate skills

A booklet was published collecting case studies of successful methods to improve graduate skills development within a mathematical context. Three mini-projects were commissioned based on these case studies and proved that much of this practice was suitable for transfer elsewhere. In addition, mathematics-specific resources and teaching practice on speaking and writing skills was developed and shared

Employer engagement

A number of projects working with employers, employees or professional bodies were funded; these focused on either delivery of a curriculum approach or providing input to develop good practice advice or curriculum resources that can be used in a range of HEIs. Major projects included the development of undergraduate problems based on real world industrial scenarios in both mathematics and statistics, resources giving an idea of what it is like to work as a mathematician and a survey of graduates' views of the HE mathematics curriculum.

Assessment

A major project conducted research to answer questions about what alternative methods of assessment can offer, evidence of validity and guidance on the process of changing your teaching to involve a new assessment type.

Problem solving

Two projects took place to identify and share good practice and develop curriculum resources on the teaching of problem solving. Many mathematics degree courses claim to develop problem solving skills but do not often explicitly focus on their development. These resources and the associated good practice guide show the value of problem solving and will enable course teams to incorporate problem solving more effectively into the curriculum.

Maths Arcade

This project produced an innovative approach, based around playing and analysing stategy games, to develop mathematical thinking, provide student support (particularly at the transition) and build a staff and student mathematical community. The Maths Arcade was developed at the University of Greenwich and has since been adopted by a further seven universities. A case study booklet gives details of its implementation.

Student-centred approaches

Under this theme funding was made available for a number of projects working to accommodate student needs or taking a student-centred view on improving the undergraduate experience, including methods for supporting students in different contexts, helping engineers better understand their mathematics or providing adjustments for students with disabilities.

All these reports and resources can be accessed via www.mathstore.ac.uk/hestem

Provision of Maths Support

The National HE STEM Programme identified mathematics as one of the key barriers to student success on STEM courses and proposed mathematics support as one of the "proven approaches" that the Programme would seek to embed across the sector. **sigma**, established by Duncan Lawson of Coventry University and Tony Croft of Loughborough University in 2005 as one of the Centres for Excellence in Teaching and Learning, was named as the partner to deliver this section of the maths strand activities managed by the IMA. The term maths support includes the provision of mathematical and statistical support offered to students, studying a range of subjects, which is in addition to their normal lectures, tutorial and problem solving classes.

There have been five main strands of activity:

- Establishing a mathematics support network, a free association of staff and institutions providing mathematics support who work together to share resources and experience.
- Assisting in the creation of new mathematics support provision in HEIs in England and Wales either through providing funding, matched by institutions, or by providing assistance, advice and training.
- Enabling the enhancement of existing mathematics support provision through the allocation of matched funding allied with expert advice.
- Disseminating good practice and sharing resources within the maths support community.
- Running a number of special projects of value to the wider maths support community

1. **sigma** Maths Support Network

This network is particularly important for staff in HEIs where mathematics support is located in a wider academic support unit, as often these individuals are quite isolated, having no mathematics colleagues in their own institution with whom to share ideas. It is also of great benefit to those setting up new maths support provision as it enables them to easily find expert advice and guidance.

Six regional hubs were established providing opportunities for informal meetings, sharing good practice and developmental workshops. Each is co-ordinated by an individual or individuals involved in providing maths support.
North East – Liz Meenan, University of Leeds and
Chetna Patel, University of Sheffield
North West and North Wales – Sarra Powell,
University of Liverpool
Midlands – Duncan Lawson, Coventry University and
Tony Croft, Loughborough University
South West and South Wales – Jane White,
University of Bath
South East – Martin Greenhow, Brunel University
Eastern England – David Bowers,
University Campus Suffolk

sigma-hub events have focused on a wide variety of topics from how to provide specialist statistical support, to maths support for nursing and midwifery students and have been very well attended by staff from over 70 different institutions.

Following a workshop entitled "Looking to the Future", the six regional hubs have committed themselves to continue to operate within their regions during 2012/13 and to work together to maintain the **sigma** network into the future.

2. Establishing New Maths Support Centres

sigma ran two open funding calls in order to establish new maths support provision within HEIs. As the result of the first of these calls, five centres were established in 2010 at the University of Kent, University of York, University of Central Lancashire, University of Lincoln and London Metropolitan University. As part of the selection process, institutions were required to provide match funding and give a commitment to continue provision beyond July 2012.

The majority of these centres have become very well established. The Centre at the University of York has been written into the University's OFFA Access Agreement and was singled out as a feature of good practice in the 2012 QAA institutional audit of the University. Sadly, due to unforeseen circumstances, provision at London Metropolitan University may not continue in 2012/13.

The Wales spoke of the National HE STEM Programme noticed the success of maths support and ran its own funding scheme which led to the setting up of eight new maths support centres at HEIs throughout Wales. **sigma** has supported this initiative through the development and delivery of a training package for postgraduate students who act as tutors in maths support centres and through providing expert advice at two workshops which brought the eight new centres together.

The success of the first new centres call led to **sigma** being allocated additional funding in 2012 to run a second call. This led to the establishment of a further nine centres at the University of Warwick, Keele University, University of Liverpool, University of Birmingham, Anglia Ruskin University, University of Wolverhampton, Liverpool John Moores University, University of Brighton and Cardiff Metropolitan University. In view of the short timescales to have these centres "up and running", **sigma** organised an induction workshop attended by representatives of all nine second round new centres and has provided advisors / mentors for each centre to act as sounding boards and critical friends.

All of these centres are progressing well and have already provided support to students while preparing for full scale activity in the 2012/13 academic year.

3. Enhancing Existing Maths Support Provision

Enhancing existing maths support was selected as one of the options for the HE STEM Adopters programme. Through this programme, **sigma** has supported the University of Bath, University of Lincoln, University of Leeds, Birmingham City University, Cardiff University and University of Exeter in introducing new elements to enhance their existing mathematics support provision. The enhancements have been designed to respond to local needs and include such things as the provision of specialist statistics support and the use of student ambassadors. As with the second round of new funded centres, **sigma** has assigned expert mentors to assist these universities in developing and implementing their enhancement.

4a. Dissemination of Good Practice

Working with the MSOR Network, **sigma** has organised an annual conference, the CETL-MSOR conference, during each year of the National HE STEM Programme. These have taken place at the University of Birmingham (2010), Coventry University (2011) and the University of Sheffield (2012). Each year the conference has been attended by over 100 delegates. At CETL-MSOR 2012, many of the presentations were given by colleagues who had delivered activities and projects funded by the National HE STEM Programme either as part of the HE Curriculum Innovation theme or as part of the maths support theme.

The **sigma** Network has agreed that the CETL-MSOR conference is a most important networking opportunity to share experiences and best practice in the teaching and learning of maths, statistics and OR and have committed to continuing the conference in 2013 (when it will return to Coventry) and beyond.

As part of the networking activity **sigma** produced regular e-newsletters for the community to share information about events and new resources. Annual **sigma** prizes for outstanding contribution to maths support and to a rising star have been awarded to individuals nominated by their colleagues.

The winners of these prizes have been:

2010 Outstanding contributor: Christie Marr
Rising Star: Ciarán Mac an Bhaird
2011 Outstanding contributor: Liz Meenan
Rising Star: Inna Namestnikova
2012 Outstanding contributor: Rob Wilson
Rising Star: Not awarded.

4b. Sharing Resources

As the maths support community has grown so have requests for support, advice and training. **sigma** provided training for post graduates working in maths support centres and published a guide to enable individual institutions to provide this in the future. Gathering feedback from students is an important way for maths support centres to demonstrate their effectiveness. As part of its activities, **sigma** has produced a comprehensive guide which has been distributed in hardcopy and is also available for download from the s**igma** Network website.

Two other booklets have also been produced – these are "How to set up a mathematics support centre" and "And the winner is …. Maths support". The second of these is a celebration of mathematics support based around **sigma's** success in the 2011 Times Higher Awards where it won the award for Outstanding Support for Students.

The above resources are directed to staff involved in providing maths support. In addition to these, **sigma** has contributed to the development of resources for students. These include a significant number of resources for the Statstutor website, the development of real datasets for use in statistics support and, in conjunction with the MSOR Network, a series of subject specific facts and formulae leaflets.

5. Special Projects

A number of special projects of benefit to the wider maths support community have been commissioned and overseen by **sigma**. These included a survey of all UK HEIs to determine the number offering some form of mathematics support - 88 were identified, representing 85% of the responding institutions. A second project was a thorough literature review of all publications relating to evaluating the effectiveness of mathematics support. Isolating the effect of maths support is a non-trivial problem and this summary of all the key publications will be of great benefit, particularly to the newly established centres as they seek to demonstrate their worth.

In recognition of the growing importance of statistics and also the shortage of specialist statisticians, **sigma** has supported a successful pilot project delivering statistics support at a distance using the internet conferencing package Elluminate.

Finally working with the Retention Practice Transfer Partnership (PTP), managed by the Midlands and East Anglia spoke of the National HE STEM Programme, **sigma** staff have authored a Good Practice guide on Mathematics Support as one of the set of eight guides produced by this PTP.

All resources are available on the **sigma** Network website **http://sigma-network.ac.uk** together with case studies of the funded centres.

Final Thoughts

In our view, the work of the mathematics strand in the National HE STEM Programme has been of huge benefit to the HE mathematics and wider STEM communities. From the start we aimed to produce sustainable outputs to support real changes in practice. In the event we have achieved far above and beyond the original remit given to us.

We have been supported in our work by very many members of the HE maths community who have given their time and ideas willingly. The support of the spokes has also been invaluable.

Our work has generated projects resulting directly in new practice which should be sustained long after the close of the project. Examples include the `Maths at Work Days' project at University of Salford and the Industrial Advisory Boards being run at London Metropolitan University and elsewhere.

The mathematics curriculum summit held in January 2011 generated many projects around the theme of curriculum innovation. These projects, essentially designed by the mathematics community, have produced an impressive array of good practice guides and learning resources. Given that the community itself requested this work to be undertaken, we are confident that the high quality outputs will be used extensively throughout the sector in the years to come.

Mathematics support existed before the National HE STEM Programme. But operating within the Programme, and with judicious use of its funds, **sigma** has been able to hugely increase the number of institutions providing some form of maths support (now standing at 85% of HEIs surveyed) and to establish a committed community of practitioners who will continue to operate as a network into the foreseeable future. The success of maths support has even reached the attention of the Minister for Universities and Science who has extolled its value in a number of public fora.

We have been conscious of the need to generate lasting physical materials to be used beyond the life of the project; the IMA has overseen the development of new careers and outreach resources for HEI mathematics departments including the Large Maths Outreach and Careers Kit, the Maths Ambassadors Resource Kit and the Maths LASTS! Box. All of these and other outputs created can be freely downloaded from the www.mathscareers.org.uk website. (Or in the case of the Large Maths Outreach and Careers Kit, can be borrowed from a regional custodian.)

The sheer commitment of the mathematics team has produced so much high quality work and means that a legacy of the mathematics strand within the National HE STEM Programme will remain for many years to come across the STEM landscape.

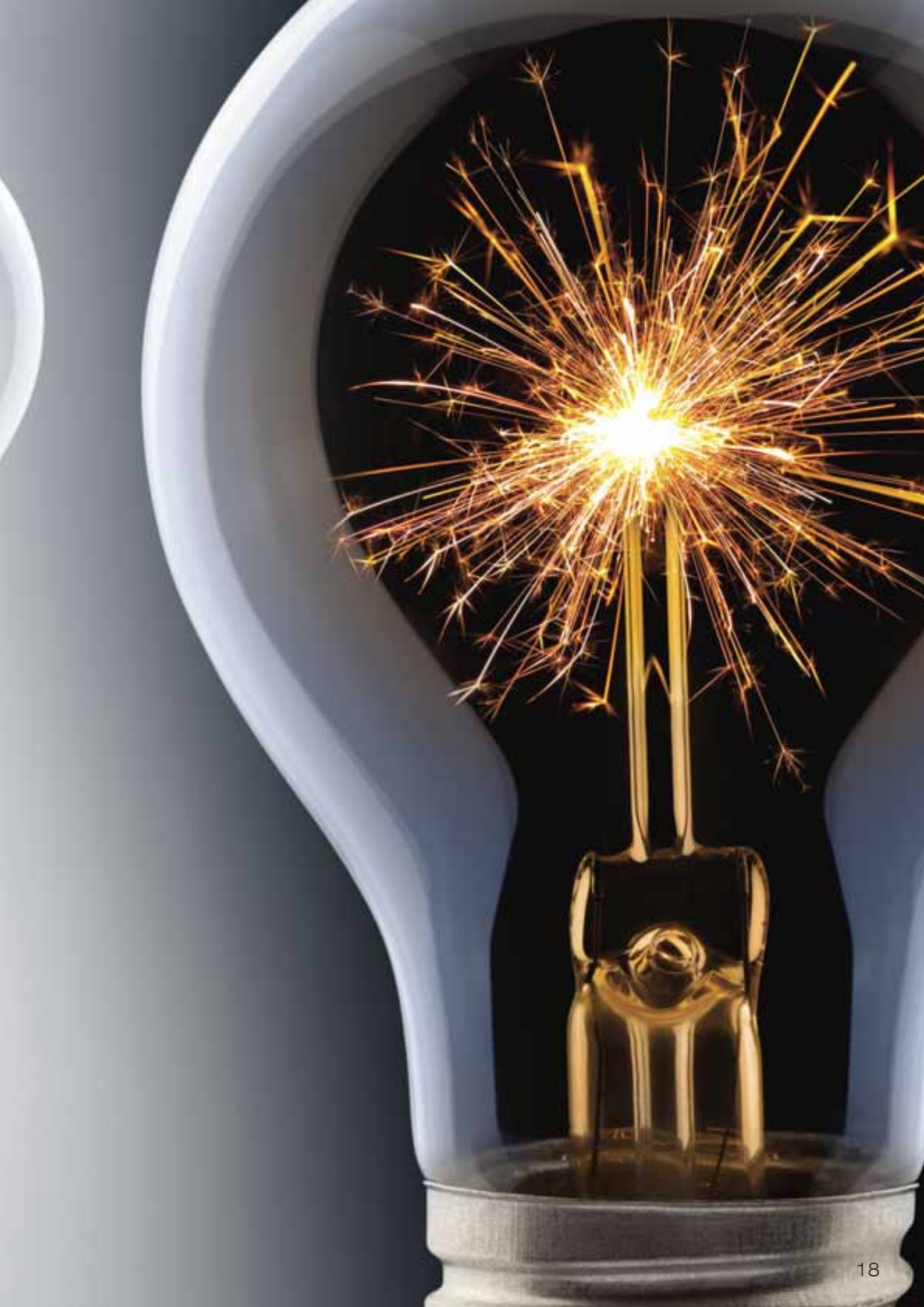
Our work for the Programme has, of course, benefited from the previous excellent work from **sigma**, the MSOR Network and the `More Maths Grads' project. The IMA is proud to have led our part of the Programme on behalf of the community.

The Programme itself closed on 31st July 2012 and we believe that all involved may take satisfaction from our achievements and reflect on a job well done. We will all watch developments keenly.

David Youdan,
Executive Director, IMA

Nigel Steele,
Honorary Secretary, IMA

Duncan Lawson
Director, **sigma** & Director MSOR Network



Appendix: Table of all mathematics projects in the National HE STEM Programme

To the best of our knowledge the below includes all mathematics projects in the National HE STEM Programme

2020 Vision: A curriculum for Mathematics graduates for the next decade	Chris Good	University of Birmingham	£20,950.00
A Pilot for a Shared On-Line Statistics Advisory Service	Alun Owen	Loughborough University	£5,000.00
A proactive intervention to facilitate transition to HE for engineering students with non-typical mathematical backgrounds	Stephen Hibberd	University of Nottingham	£9,900.00
A Statistical Awareness Curriculum for STEM Employees	Neville Davies	University of Plymouth	£10,000.00
An interactive, online numeracy resource for pre-registration student nurses and midwives	Sarah Green	University of the West of England	£10,000.00
Assessing student teams developing mathematical models in business and industrial mathematics	Edmund Chadwick	University of Salford	£5,000.00
Being a professional mathematician	Tony Mann	University of Greenwich	£11,000.00
Building on the Maths Arcade: supporting mathematics learning	Noel-Ann Bradshaw	University of Greenwich	£5,000.00
Career Mentoring Scheme for Maths Students	Jeff Waldock	Sheffield Hallam University	£15,000.00
Challenge competition	Phil Ansell	Newcastle University	£750.00
Challenge competition	Farzana Aslam	Coventry University	£1,000.00
Challenge competition	Debra Croft	Aberystwyth University	£1,500.00
Challenge competition	Ruth Edwards	University of Southampton	£1,500.00
Communicating Maths in Science	Andrew Hone	University of Kent	£15,000.00
Constructing a Coherent STEM Strategy with Schools	Alison Hooper	University of the West of England	£8,750.00
Curriculum Impact: making explicit links from the HE mathematics curriculum to applications in science, technology, business and industry	Vivien Easson	Queen Mary, University of London	£9,480.00
Development and integration of com puter- aided assessment of discrete mathematics	Martin Greenhow	Brunel University	£5,000.00

Appendix: Table of all mathematics projects in the National HE STEM Programme

Developing Graduate Skills in HE Mathematics Programmes	Jeff Waldock	Sheffield Hallam University	£6,500.00
E-learning and formative in-course assessment in mathematics and statistics for engineers	Bill Foster	Newcastle University	£10,000.00
Employer Engagement in Mathematics	Edmund Chadwick	University of Salford	£10,000.00
Engaging with employers coordination project	Jeff Waldock	Sheffield Hallam University	£2,250.00
Engineering Students Understanding Mathematics (ESUM)	Barbara Jaworski	Loughborough University	£2,500.00
Enhancing Employability by Engaging with Employers in Mathematics	Margit Messmer	University of Leeds	£30,400.00
Enhancing maths Support – Adopters programme	Jane White	University of Bath	£10,000.00
Enhancing maths Support – Adopters programme	Trevor Hodge	Birmingham City University	£10,000.00
Enhancing maths Support – Adopters programme	Robert Wilson	Cardiff University	£4,000.00
Enhancing maths Support – Adopters programme	Rachel Canter	University of Exeter	£4,500.00
Enhancing maths Support – Adopters programme	Liz Meenan	University of Leeds	£8,000.00
Enhancing maths Support – Adopters programme	Michael Gallimore	University of Lincoln	£9,800.00
Enhancing Statistical Literacy in the Workplace PTA	Paul Hewson	Plymouth University	£2,000.00
Enhancing the communication and speaking skills of mathematics undergraduates	James Groves	Lancaster University	£5,300.00
Enhancing the second year experience for undergraduate mathematicians	Tony Croft	Loughborough University	£29,587.00
Enhancing workplace statistical literacy by work-based learning	Paul Hewson	University of Plymouth	£10,000.00
Exploring the transition from school mathematics to university for STEM undergraduates across the SW	Garrod Musto	Kingswood School, Bath	£3,810.00

Appendix: Table of all mathematics projects in the National HE STEM Programme

Good Practice on Inclusive Curricula in the Mathematical Sciences	Emma Cliffe	University of Bath	£2,200.00
Group Work Working Group	Noel-Ann Bradshaw	University of Greenwich	£1,300.00
Hands on Maths Workshop	David Bedford	Keele University	£1,700.00
Hands on Maths Workshop	Chris Marchant	University of Liverpool	£1,700.00
Hands on Maths Workshops	Ruth Edwards	University of Southampton	£1,700.00
Hands on Maths Workshops	Emily Danvers	Brunel University	£1,700.00
Hands on Maths Workshops	Bryan Fryer	University of Wolverhampton	£1,630.00
Hands on Maths Workshops	Debra Croft	Aberystwyth University	£989.00
History of Mathematics in the Higher Education Curriculum Working Group	Tony Mann	University of Greenwich	£2,250.00
Identifying skill gaps of employers and Mathematics undergraduates	Jeremy Levesley	University of Leicester	£25,520.00
Increasing Public Awareness of the key role of mathematics underpinning STEM disciplines	Trevor Hawkes	Coventry University	£8,000.00
Industrial panel mathematics degree review	Pargat Singh-Calay	London Metropolitan University	£4,369.00
Industrial Problem Solving for Higher Education Mathematics	Martin Homer	University of Bristol	£29,000.00
Industrial Problems for the HE Curriculum (Stats)	Neville Davies	University of Plymouth	£10,606.00
Integrating formative and summative e-assessment into mathematics teaching and learning for first and second year students.	Jeremy Levesley	University of Leicester	£48,000.00
Large Maths Outreach and Careers Kit	Makhan Singh	Institute of Mathematics and its Applications	£7,604.00
Level 3 maths problem solving	Sue Pester	Wales Institute of Mathematical and Computational Sciences	£12,000.00
Live on-line distance support	Paul Rice	University of Northampton	£3,025.00

Appendix: Table of all mathematics projects in the National HE STEM Programme

Making Maths Graduates more employable	Noel-Ann Bradshaw	University of Greenwich	£10,000.00
Mathematical Presentation and Communication Skills within the Core Curriculum	Andrew Neate	Swansea University	£1,000.00
Mathematics Industrial Advisory Board	Makhan Singh	Institute of Mathematics and its Applications	£20,600.00
Mathematics Support in the National Health Service	Lynda Gatecliffe	University of Bradford	£63,900.00
Maths Ambassador Resource Kit (MARK)	Makhan Singh	Institute of Mathematics and its Applications	£45,711.00
Maths Arcade uptake Programme	Noel-Ann Bradshaw	University of Greenwich	£11,000.00
Maths at Work Day	Edmund Chadwick	University of Salford	£2,000.00
Maths at Work Day	Chris Marchant	University of Liverpool	£2,000.00
Maths at work day	Kerie Green	University of Wales, Newport	£2,476.00
Maths at Work Day	Debra Croft	Aberystwyth University	£1,876.00
Maths at Work Day	Joe Walters	University of Portsmouth	£2,000.00
Maths at Work Day	Ruth Edwards	University of Southampton	£2,000.00
Maths at Work Day	Malcolm Eyre	Staffordshire University	£2,000.00
Maths Busking	Ruth Holland	University of Leeds	£2,635.00
Maths Busking; engaging the general public and school groups through the powerful medium of street entertainment!	David Abrahams	University of Manchester	£9,985.00
Maths Graduates: where are they now?	Noel-Ann Bradshaw	University of Greenwich	£1,000.00
Maths Magic	Stella Cottrell	University of Leeds	£18,775.00
Maths Support for STEM Undergraduates	Rebecca Griffiths	Wales Institute of Mathematical and Computational Sciences	£90,000.00
METAL: Media Enhanced Teaching and Learning	Joel Feinstein	University of Nottingham	£2,100.00
Methods to produce flexible and accessible learning resources in mathematics	Emma Cliffe	University of Bath	£8,500.00
Models of industrial placements	Tony Mann	University of Greenwich	£2,000.00

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MU-MAP – Mapping University Mathematics Assessment Practices	Paola Iannone	University of East Anglia	£49,956.00
New Maths Support Centre- Anglia Ruskin University	Toby Carter	Anglia Ruskin University	£10,000.00
New Maths Support Centre- Cardiff Metropolitan University	Tom Crick	Cardiff Metropolitan University	£9,728.85
New Maths Support Centre- Keele University	Ian Ronald	Keele University	£10,000.00
New Maths Support Centre- Liverpool John Moores University	Andrew Fox	Liverpool John Moores University	£8,010.00
New Maths Support Centre- London Metropolitan University	Pargat Singh Calay	London Metropolitan University	£15,000.00
New Maths Support Centre- University of Birmingham	Peter Byers	University of Birmingham	£10,000.00
New Maths Support Centre- University of Brighton	Catharine McConnell	University of Brighton	£10,000.00
New Maths Support Centre- University of Canterbury	Allia Wilson	University of Canterbury, Kent	£6,000.00
New Maths Support Centre- University of Central Lancashire	Claire Worthington	University of Central Lancashire	£15,000.00
New Maths Support Centre- University of Lincoln	Ian Snowley	University of Lincoln	£15,000.00
New Maths Support Centre- University of Liverpool	Damian Clancy	University of Liverpool	£10,000.00
New Maths Support Centre- University of Warwick	Andrew Mead	University of Warwick	£10,000.00
New Maths Support Centre- University of Wolverhampton	David Wilkinson	University of Wolverhampton	£10,000.00
New Maths Support Centre- University of York	Ant Edwards	University of York	£15,000.00
New Maths Support Centre (Wales)- Aberystwyth University	Balazs Pinter	Aberystwyth University	£5,000.00
New Maths Support Centre (Wales)-Bangor University	Alan Shore	Bangor University	£5,000.00
New Maths Support Centre (Wales)- University of Glamorgan	Paul Roche/Fraser Lewis	University of Glamorgan	£5,000.00

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New Maths Support Centre (Wales)- Glyndwr University	Cedric Belloc	Glyndwr University	£5,000.00
New Maths Support Centre (Wales)- University of Wales Newport	David Baxter	University of Wales Newport	£5,000.00
New Maths Support Centre (Wales)-Swansea Metropolitan University	Arnaud Marotin	Swansea Metropolitan University	£5,000.00
New Maths Support Centre (Wales)-Swansea University (College of Engineering)	Paul Ledger	Swansea University	£5,000.00
New Maths Support Centre (Wales)-Swansea University (College of Science)	Warren Perkins	Swansea University	£5,000.00
Opening the MMG Box	Louise Walker	University of Manchester	£4,750.00
Outreach Training	Alison Braddock	Wales Institute of Mathematical and Computational Sciences	£2,237.00
Pop Maths Quiz	Paul Dale	University of Derby	£600.00
Pop Maths Quiz	Fiona Maddock	Keele University	£600.00
Pop Maths Quiz	Nicolette Rattenbury	Manchester Metropolitan University	£600.00
Pop Maths Quiz	Phil Ansell	Newcastle University	£600.00
Pop Maths Quiz	Bryan Fryer	University of Wolverhampton	£596.00
Pre university online maths course for STEM undergraduates	Stephen Lee	Wales Institute of Mathematical and Computational Sciences	£5,200.00
MAPS: Mathematical Problem Solving Project	Trevor Hawkes	Coventry University	£36,500.00
PSUM: Problem Solving in Undergraduate Mathematics	Sue Pope	Liverpool Hope University	£20,000.00
Progress Files – Greenwich Implementation	Tony Mann	University of Greenwich	£1,000.00
Regional Hub – Eastern England	David Bowers	University Campus Suffolk	£9,000.00
Regional Hub – North East	Liz Meenan	University of Leeds	£4,500.00
Regional Hub – North East	Chetna Patel	University of Sheffield	£4,500.00
Regional Hub – North West and North Wales	Sarra Powell	University of Liverpool	£9,000.00

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Regional Hub – South East	Martin Greenhow	Brunel University	£9,000.00
Regional Hub – South West and South Wales	Jane White	University of Bath	£9,000.00
sigma management plus Regional Hub – Midlands	Tony Croft	Loughborough University	£18,000.00
Small Maths Outreach and Careers Kit	Makhan Singh	Institute of Mathematics and its Applications	£15,404.00
SMART: Supporting MATLAB Automated assessment to Reinforce Teaching	Alan Irving	University of Liverpool	£9,800.00
Stimulating Techniques in Entry-level Mathematics (STEM) with the STACK computer aided assessment system	Chris Sangwin	University of Birmingham	£9,064.05
Student-centred approaches coordination project	Carol Robinson	Loughborough University	£2,250.00
Support for integration of NW Sigma and HE STEM Programmes	Conway Mothobi	Manchester Metropolitan University	£5,000.00
Supporting progression in mathematics education	James Hind	Nottingham Trent University	£1,500.00
Supporting Undergraduate Engagement and Achievement in STEM Disciplines	Alexandra Shukie	University Centre at Blackburn College	£5,000.00
Survey of Current Maths Support	Glynis Perkin	Loughborough University	£2,586.66
Teacher Fellows in Mathematics	Rebecca Griffiths	Wales Institute of Mathematical and Computational Sciences	£30,000.00
Teaching Students to Write Mathematics	Kevin Houston	University of Leeds	£1,100.00
The Effectiveness of Maths Support	Tony Croft	Loughborough University	£5,000.00
The Internet Librarian and Curator for Mathematics Videos	Trevor Hawkes	Coventry University	£4,953.00
Transferring the Magic to STEM	Peter McOwan	Queen Mary, University of London	£9,970.00
Using Statistics Effectively in Mathematics Education Research Working Group	John Marriott	University of Plymouth	£1,000.00
Views of graduates on the HE curriculum	Matthew Inglis	Loughborough University	£6,200.00
Work-related Learning Working Group	Edmund Chadwick	University of Salford	£300.00
Workforce Mathematics Course	James Hind	Nottingham Trent University	£21,000.00
www.mathscareers.org.uk - HE STEM Resources	Susan Bolton	Institute of Mathematics and its Applications	£56,500.00
X & Y Factor	Katie Chicot	Open University	£500.00
Sheffield Teacher Fellow	Alistair Warren	University of Sheffield	£16,100.00

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