The Mathematics HE Summit took place at the University of Birmingham on 12 January 2011, organised by the Maths, Stats and OR (MSOR) Network as part of the Mathematical Sciences HE Curriculum Innovation Project within the National HE STEM Programme. This brought together: Heads of Mathematics or their representatives from 26 universities offering mathematics degrees (about half of those in England and Wales); Education representatives from the Institute of Mathematics and its Applications, the Royal Statistical Society, the Operational Research Society and the Council for the Mathematical Sciences; members of the National HE STEM Programme, sigma and the MSOR Network; and several individuals.

The day was chaired by Prof. Duncan Lawson and opened with a debate, in which Prof. Alexandre Borovik of University of Manchester proposed and Jon McLoone of Wolfram Research opposed the motion: ‘We believe that memory, subject knowledge and technical fluency remain vital for undergraduate mathematicians in the digital age.’ Following this, breakout groups discussed the topics: ‘We can’t let them graduate unless...’; ‘If maths students can’t communicate in writing or speak in public – is that my problem?’; and ‘If most maths graduates “aren’t confident” in handling unfamiliar problems – should we care?’ After lunch the Summit received feedback from the morning discussions and an update on employer engagement activity from the Mathematical Sciences Strand by David Youdan. The Summit heard and discussed presentations from Prof. Jeremy Levesley on ‘Taking control of the assessment agenda’ and Dr. Neil Challis on ‘What do the students think about their Maths degrees?’ A final set of breakout sessions considered the topic: ‘Imagine there is £100k–£150k in total available to support curriculum development across the sector, how best should this be targeted and what are the priority areas?’ These final discussion groups produced a list of recommendations for prioritising curriculum development.

Reports of the debate and discussion sessions as well as reports by Levesley and Challis on their presentations are available in a report via the MSOR website [1]. The recommendations from the Summit were taken into project briefs in our third call for funding from the Mathematical Sciences HE Curriculum Innovation Fund. The focus of this section of Connections is on the recommendations made in the final discussion sessions and the work taking place this academic year, supported by the HE Curriculum Innovation Fund as part of the National HE STEM Programme Mathematical Sciences Strand, to address these priorities.
References


**Project in brief: Problem Solving**

**Summit recommendations:**

**Project 1: Problem Solving**

Project partners: Trevor Hawkes, Coventry University and Chris Sangwin, University of Birmingham (£36k)

The project’s aims are to:
1. champion the value that problem-solving contributes to students’ development as mathematicians, to their enjoyment of mathematics, and to success in their courses.
2. make it easier for lecturers to incorporate problem-solving meaningfully in their teaching and assessment.
3. find out what other HE mathematicians are doing successfully in this area, to build on their experience, and to disseminate examples of good practice.

We will: consult widely in HE; carry out case studies; write a good practice guide; create problem banks with solutions and examine the role of mathematical software in problem-solving.

**Project 2: Problem Solving**

Project partners: Sue Pope, Liverpool Hope University and Lynne McClure, NRICH, University of Cambridge (£20k)

LHU and NRICH will work together to design and develop a cohesive problem solving package which supports HE colleagues in embedding problem solving into their courses, through:

a) a guide to the various pedagogies of problem solving and its assessment, in collaboration with the other Problem Solving project;

b) a virtual problem solving environment which hosts problems suitable for a range of undergraduate mathematics courses, ideally hosted by NRICH;

c) case studies generated through the development and trialling process, in collaboration with the other Problem Solving project.

**Industrial Problems for the HE Curriculum**

**Project in brief: Development of a bank of industry-based problems, suitable for undergraduate students, developed in consultation with industry partners and vetted.**

**Project 1: Industrial Problems for the HE Curriculum (maths)**

Project leader: Martin Homer, University of Bristol (£29k)

This project aims to create a diverse online repository of industrial case study problems, suitable for use throughout mathematics undergraduate programmes. It will build on the unique and proven track record of the Department of Engineering Mathematics at the University of Bristol for collaborative research between mathematicians, engineers and applied scientists. This will be an evolving resource: as well as problems, relevant data, and suggested solution techniques, there will be an online discussion area, to encourage collaborative input and feedback from users. Existing problems can be adapted in light of experience from across the community, and new problems continually added.

**Project 2: Industrial Problems for the HE Curriculum (stats)**

Project partners: Neville Davies, RSS Centre for Statistical Education, University of Plymouth and Shirley Coleman, Industrial Statistics Research Unit, Newcastle University (£10.5k)

The project will engage with an industrial/business partner to identify real problems solvable using data interrogation, graphical and statistical modelling methods. With advice from university colleagues, these will be synthesised into formats for teaching at three levels. At level one the problems will be posed so that solutions can be obtained by using individualised samples. At level two students may need to do research and collect secondary data that will help them solve the problems. At level three students will collect primary data, possibly interacting with the organisation that provided the problem. In their solutions students will provide written discussions/reports.
Developing Graduate Skills uptake projects

Summit recommendations:
Building on the case studies collected by the mini-project ‘Developing Graduate Skills in HE Mathematics Programmes’ (reported on pages 16-19).

Three mini-projects are being supported to spread good practice identified in that collection of case studies.

Project 1: Maths Careers: Greenwich graduates where are they now?

Project leader: Noel-Ann Bradshaw, University of Greenwich (£1k)

Inspired primarily by Case Study 1, the University of Greenwich’s Maths Careers afternoon will enable current maths students to hear first-hand from recent graduates how and when to apply for jobs and what different careers entail. Representatives from several industries including banking, insurance, teaching, transport, analytics and mathematical modelling will be invited to give presentations and answer questions on their careers. Most presenters will be early career mathematicians who will be able to understand the needs of our students. An Employability Skills Guide will be prepared showing students how to develop their skills and explaining the link between final year options and career choices.

Project 2: Progress Files – Greenwich Implementation

Project leader: Tony Mann, University of Greenwich (£1k)

Progress files were used in Case Study 7 by SHU to enhance employability by promoting self-reflection. The results of the case study are encouraging and suggest a better way of achieving the reflective activities which have been introduced, with partial success for final year students, at Greenwich. The project will implement the SHU system at Greenwich to enhance our existing procedures. If the pilot is successful it is envisaged that the system will be extended and more fully integrated with the Greenwich Virtual Learning Environment (VLE).

Project 3: Mathematical Presentation and Communication Skills within the Core Curriculum

Project leader: Andrew Neate, Swansea University (£1k)

Mathematics students are expected to absorb how to present mathematics in a precise and succinct manner from the books they read and by observing their lecturers. However, students often do not see this as important and often fail to engage in developing such transferable skills. The importance of focusing on these study skills was highlighted in Case Studies 12 and 14. We hope to raise the importance that students place on these aspects of their education from the very beginning of their time at university. This will be done through a short series of workshops covering transferable skills as part of their normal lecture programme and reinforced through feedback on assignments and general tutorial support.

Assessment

Summit recommendation:
Research project to provide a review of existing theory of assessment schemes for mathematics and collect examples of good practice on use of different assessment methods for mathematics. Explore exemplars of innovative approaches to assessment. Develop a repository of assessment teaching resources. Develop a package of question design support for new lecturers.

Project: MU-MAP – Mapping University Mathematics Assessment Practices

Project partners: Paola Iannone, University of East Anglia and Adrian Simpson, Durham University (£50k)

This project will survey assessment practices across university mathematics and develop resources to share good practice. It will also focus on the costs and effects of the change required to implement good practice in new contexts so that lecturers can both see what others are doing and understand the practical issues involved if they wish to adapt those methods to their own practice. Outputs will consist of the MU-MAP website (including databases of literature and electronic versions of all outputs), the MU-MAP Good Practice Book with sections covering different forms of assessment practice, dissemination workshops and professional and research articles.

Track the progress of all these projects through the Mathematical Sciences HE Curriculum Innovation Project website: www.mathstore.ac.uk/hestem
**Being a professional mathematician**

**Summit recommendation:**
Develop a collection of teaching resources on the development of mathematics - stories from history and more recent development of the discipline. These should aim to counter a view of mathematics as a static, completed body of knowledge and instead encourage awareness of the process of doing mathematics. They should develop students' awareness of the culture of mathematics.

Project partners: Tony Mann, University of Greenwich and Chris Good, University of Birmingham (£10k)

This project will produce a set of case studies on “being a mathematician”. Some will be historical, some based on interviews with present-day mathematicians, statisticians and OR practitioners in academia and industry. Teaching materials will include documents of these case studies (on paper or in MP3 format), worksheets and possible seminar questions looking at topics including employment opportunities, mathematics research and its impact, gender and race issues, the role of professional bodies, and how these different mathematical practitioners see themselves as mathematicians. A workshop will discuss how this body of material might fit into the undergraduate curriculum.

**Models of industrial placements**

**Summit recommendation:**
Pilot of undergraduate students gaining experience of working in industry through short term placements (e.g. 2 hours per week).

Project leader: Tony Mann, University of Greenwich (£2k)

As well as a traditional year-long sandwich placement, the University of Greenwich has a new ‘Mathematics Industry Placement’ 30-credit module taken during the final year. This involves short-term placements of the kind recommended by the Summit so, rather than initiating a new pilot scheme, a mini-project exploring the Greenwich pilot has been commissioned.

This project will contribute a report on the experience of running this scheme in order to capture information that could help other departments considering such schemes. This project will also run a workshop at Greenwich to allow discussion of placements for mathematics students and sharing of experience from elsewhere.

**Views of graduates on the HE curriculum**

**Summit recommendation:**
Research to collect the feedback of graduates in employment on the mathematics HE curriculum.

Project leaders: Matthew Inglis and Tony Croft, Loughborough University (£5k)

This project seeks to understand graduates’ perspectives on the undergraduate mathematics curriculum. Specific foci will be on understanding:

i. the mathematics that graduates use in their day-to-day work;

ii. graduates’ perceptions of generic skills developed by studying undergraduate mathematics;

iii. specific components of the undergraduate mathematics curriculum which graduates believed helped develop these skills;

iv. specific skills which were not developed during degree courses which participants believe could and should be;

v. how, and how well, graduates believe their curriculum was delivered and whether with hindsight different delivery mechanisms may have left them better prepared for the workplace.

**HEA Workshop and Seminar Discipline Series - Open Call**

The HEA is providing UK subscribing institutions delivering Higher Education, the opportunity to promote research and evidence that has informed departmental and institutional policy and/or practice through an institutionally hosted workshop and seminar series.

Through the discipline series, institutions are invited to host and deliver a workshop or seminar on teaching and learning in a discipline context. Workshops and seminars will be held throughout the 2011-12 academic year. This is an open call with no closing date for proposals.

For more information and proposal forms go to www.heacademy.ac.uk/funding