

## REVIEW ARTICLE

# Mathematics Support – past, present and, most importantly, future

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## Abstract

This article briefly reviews the development of mathematics support in higher education over the last 25 years, highlighting in particular the work of **sigma**, centre for excellence in university-wide mathematics and statistics support as a Centre for Excellence in Teaching and Learning and subsequently as part of the National HE STEM Programme. A description of **sigma**'s current HEFCE-funded programme of activities is included, giving particular attention to the development of the **sigma** network. The article closes by focusing on the legacy of **sigma**'s current work and the future sustainability of the **sigma** network.

**Keywords:** Mathematics support, centre for excellence, sustainability

## 1. Introduction

Mathematics support has been defined by Lawson et al. (2003, p.9) as “a facility offered to students (not necessarily of mathematics) which is in addition to their regular programme of teaching, lectures, tutorials, seminars, problems classes, personal tutorials, etc.” The case for mathematics support has been made extensively elsewhere and is not rehearsed here beyond giving three key quotations from important national reports:

*“Higher education has little option but to accommodate to the students emerging from the current GCE process”* from *Making Mathematics Count*, the report of the Smith Inquiry into post-14 mathematics education (Smith, 2004, p.95);

*“Many students require some additional academic support, especially in the mathematical skills required in science, mathematics, engineering and technology”* from the National Audit Office report, *Staying the course: The retention of students in higher education* (NAO, 2007, p.33);

*“We estimate that of those entering higher education in any year, some 330,000 would benefit from recent experience of studying some mathematics (including statistics) at a level beyond GCSE, but fewer than 125,000 have done so”* from the Advisory Committee on Mathematics Education (ACME) report *Mathematical Needs: Mathematics in the workplace and in Higher Education* (ACME, 2011, p.1).

The way in which many universities have chosen ‘to accommodate to’ the needs of the students that they recruit has often been through the introduction of some kind of mathematics support provision. The most common model that is used is a ‘drop-in’ centre which offers one-to-one support to students who drop-in at a time of their choosing during the centre’s opening hours. In addition to the personal support from a tutor, most support centres also offer a range of resources, both paper-based and on-line.

## 2. Mathematics support – the past

In September 2015, the Mathematics Support Centre at Coventry University will begin its 25<sup>th</sup> year of operation. This centre began in 1991 as the BP Mathematics Centre, having received start-up funding from the BP (British Petroleum) Engineering Education Fund, covering the capital cost of equipping a dedicated room (complete with green chairs and yellow cushions) and the revenue cost of a full-time centre manager for two years. The Coventry Centre drew visitors from many higher education institutions from across the UK, some of which established their own centres along similar lines. Loughborough University was one of these institutions, setting up its Mathematics Learning Support Centre in 1996.

The early days of mathematics support have been described by Kyle (2010, p.103) as “*a form of cottage industry practised by a few well meaning, possibly eccentric individuals*”. However, despite these humble beginnings, mathematics support gradually gathered momentum. In a survey of UK universities carried out in 2000, 46 out of 95 responding institutions indicated that they had some kind of mathematics support provision (Lawson et al., 2001). A similar survey carried out in 2004 indicated that the number had increased to 66 out of 101 responding institutions (Perkin and Croft, 2004). It should however be noted that, notwithstanding the well-developed centres at places like Coventry and Loughborough, much of this provision could probably still be fairly described as a cottage industry provided by enthusiastic individuals. In the 2000 survey, one third of those providing mathematics support did so for less than 5 hours per week and, similarly, a third (quite possibly the same institutions) provided help to fewer than 10 students per week.

In 2005, a joint submission by the Mathematics Learning Support Centre at Loughborough University and the Mathematics Support Centre at Coventry University to HEFCE’s Centres for Excellence in Teaching and Learning (CETL) scheme was successful. The resulting centre was named **sigma**, Centre for Excellence in University-wide Mathematics and Statistics Support. The recognition, and the funding, that came with being a CETL enabled mathematics support to become much more firmly established across the higher education landscape.

From the outset, **sigma** determined to be outward looking. It had been written into the CETL proposal that, using the University of Leeds as a test-bed, **sigma** would develop a ‘blue print’ for the establishment of a mathematics support centre in a university that did not have such a provision. After successfully initiating mathematics support with the Skills@Library student support at the University of Leeds, **sigma** then offered two years of funding (which had to be matched by the bidding institution) through a competitive bidding process for two universities wishing to set up mathematics support. The universities of Bath and Sheffield were successful in securing this funding and both chose to call their support provision MASH (Mathematics and Statistics Help). These three mathematics support centres have flourished in the years since they received **sigma** funding and today receive far greater funding from their own institutions than they received during the **sigma** pump-priming days.

In addition to distributing funds to initiate mathematics support in other institutions, some CETL funds were used to establish a research programme to provide a rigorous scholarly underpinning to mathematics support. Three **sigma**-funded PhD’s were completed exploring different aspects of mathematics support.

In 2009, HEFCE and HEFCW initiated the National HE STEM Programme ([www.hestem.ac.uk](http://www.hestem.ac.uk)). This programme had a number of different aims; one was to enhance the student experience in STEM disciplines in higher education. The Programme identified that across STEM, mathematics is a barrier to success for many students. It therefore commissioned **sigma** to continue its work of

assisting institutions to establish mathematics support provision. During the lifetime of the National HE STEM Programme, **sigma** assisted the establishment of 22 new support centres and provided funding to six institutions for enhancement projects to improve already existing mathematics support provision.

A key new initiative that **sigma** introduced during the National HE STEM Programme (2009-2012) was the creation of six regional hubs covering the whole of England and Wales. The idea behind regional hubs was to address the sense of isolation that many involved in the provision of mathematics support felt. In newly emerging mathematics support provision (and, indeed, in more established but small provision) the individual providing mathematics support was often on his/her own either as the only mathematician in a wider student support unit or as a student support-focused tutor in a mathematics department dominated by research. Each **sigma** regional hub had the role of providing local opportunities for mathematics support providers to meet to share good practice, exchange ideas and offer each other mutual support.

The impetus given to mathematics support during the period from 2005 to 2012 established it as an important element of wider student academic support across the whole of the higher education sector. Kyle ended his previously cited article with the conclusion that, notwithstanding his early reservations, "*Mathematics support came of age in the first decade of the 21<sup>st</sup> century*" (Kyle, 2010, p.104). There was further national recognition in 2011 when **sigma** won the Times Higher award for *Outstanding Support for Students* and the then Minister of State for Universities and Science, David Willetts, championed the work of **sigma** in a number of speeches and in his booklet *Robbins Revisited* (Willetts, 2013, p. 51).

With the ending of the National HE STEM Programme in 2012, external funding for national co-ordination of mathematics support activities ended. During the academic year 2012-13, the activities of **sigma** were maintained primarily through the regional hubs and the annual conference. Each hub continued to offer at least two meetings during the year at which mathematics support practitioners could engage in professional development and also have a forum for exchange of practice.

### 3. Mathematics support – the present

During 2012-13, the **sigma** Directors had been in discussion with HEFCE about the importance of mathematics support and, in particular, of firmly establishing the embryonic **sigma** network. In October 2013, HEFCE announced funding for **sigma** to undertake a three year programme of activities to further embed mathematics support across the sector and to establish a sustainable community of mathematics support practitioners.

There are several strands to **sigma**'s work within the current HEFCE programme. The competitive allocation of pump-priming funds (to be matched by the institution) has continued. Funding has been allocated to ten institutions to set up mathematics support. The institutions are: University of the Arts, London; Bournemouth University; University of East London; University of Greenwich; Halesowen College; Kings College, London; Lancaster University; University of Leicester; Royal Holloway, University of London; and Vision West Nottinghamshire College. These institutions include two FE colleges (Halesowen and West Nottinghamshire) who are developing mathematics support for their HE in FE students. This is a new avenue of work for **sigma**. The University of the Arts is the first specialist art college to engage with **sigma** and they have produced some innovative support resources, particularly in relation to geometry, that are of especial relevance to art students.

The survey of the extent of mathematics support provision that took place in 2000 and again in 2004 (reported above) was repeated in 2012. This was before the 10 new centres above were established. The findings of the 2012 survey (Perkin et al., 2013) were that 88 out of 103 responding institutions offered some form of mathematics support. This means that the percentage of responding institutions offering mathematics support has grown from 48% in 2000, to 65% in 2004 to 85% in 2012 and, given the institutions that **sigma** has supported to establish mathematics support during the current HEFCE funded programme, the figure is likely now to be even higher.

In addition to providing funding to institutions to set up mathematics support, **sigma** has also provided each new centre with an experienced mentor who acts as a point of contact and source of advice to the new centres. Furthermore, **sigma** delivers annually a series of workshops (one in each regional hub area) to train tutors working in mathematics support to assist the new centres in providing students with a high quality service.

With a view to the future, **sigma** has used part of the HEFCE funding to further develop the open learning resources for students that are available through the **mathcentre** and **statstutor** websites ([www.mathcentre.ac.uk](http://www.mathcentre.ac.uk) and [www.statstutor.ac.uk](http://www.statstutor.ac.uk)). Resource development grants have been targeted on the development of resources in areas where these websites have gaps. In addition, the resources for mathematics support practitioners (such as the guides to setting up mathematics support provision, evaluating mathematics support provision and resources for training tutors available from the **sigma** network website, [www.sigma-network.ac.uk](http://www.sigma-network.ac.uk)) are being extended.

A significant piece of research, a 'sector needs analysis', has been commissioned. 23 senior staff (typically PVCs for Learning and Teaching) from across the sector have been interviewed to establish their views of the mathematical and statistical needs of students across their institutions and how these need are being met in a strategic (rather than piecemeal) manner. The findings of this work show a high level of awareness within university senior management of issues relating to mathematics and statistics. The researchers found that *"All of the HEIs questioned reported having students who are challenged by mathematics and statistics ... Furthermore, all the universities questioned recognised that unless they provide appropriate forms of learning support for mathematics and statistics, it is inevitable that there will be an adverse impact on their students' satisfaction, retention, achievement and employability"* (Tolley and MacKenzie, 2015, p.2).

#### 4. Mathematics Support – the future

Given the findings of the report of Tolley and MacKenzie (2015), referred to above, it is clear that the need for mathematics support is going to remain for the foreseeable future. The current HEFCE-funding for **sigma** runs until the end of the academic year 2015/16. A key element of this funding is to plan for sustainability beyond this time when it is likely no further funding will be available. Working towards sustainability has been integral to much of the work that **sigma** has undertaken since the start of the current grant in 2013. This has taken a number of forms.

Firstly, there has been a deliberate policy of establishing legacy materials. The importance of the **mathcentre** and **statstutor** websites as repositories of shared, high quality learning resources for students has been acknowledged. So-called 'community project' areas of the websites allow for the uploading of resources that members of the mathematics support community have developed. Anyone can upload learning resources to the repository – but, as a quality control mechanism to ensure the maintenance of the websites' reputation, the resources must be peer-reviewed by someone from another institution before they are openly shared with the wider community. Other legacy resources are aimed at mathematics support providers rather than students. So, for example, the materials used during tutor training workshops have been made available via the

**sigma** network website to assist in local delivery of such workshops in the future when there is no funding for central 'trainers' to tour the country running workshops in each hub region.

Alongside legacy materials, **sigma** has focused on capacity building amongst the community of practitioners. There are a number of strands to capacity building but the annual CETL-MSOR conference, the regional hub meetings and the provision of experienced mentors are key elements. Respondents to a recent survey carried out by the External Evaluator of the current **sigma** programme highlighted ways in which this capacity building is being effective:

*"sigma staff have been very encouraging – without that support we would not have had the confidence to get started"*

*"Engagement with other practitioners at workshops, meetings and the conference ... is likely to translate into work with collaborators at other institutions which could not have occurred if the sigma network had not existed"*

*"I am the only maths support tutor at the University of ... - the support of sigma has been vital in helping me sustain and develop ideas for the maths support service we provide"*

Since its inception in 2006, the CETL-MSOR conference has grown into the leading UK conference for all aspects (not just mathematics support) of learning and teaching of mathematics, statistics and OR in higher education. There has never been any difficulty in identifying an institution to host the conference nor in finding people to take on conference committee roles, giving confidence that the conference can continue in the future. The conference has been subsidised by **sigma's** external funding which has enabled delegate rates to be set well below those of other conferences and in the future these rates will need to rise to ensure that the conference fully covers its costs. However, the conference is now held in such esteem that there is confidence that there will continue to be strong demand amongst practitioners to attend the conference.

The Tolley and MacKenzie report (2015) identified continuous professional development (CPD) as a key area of need. The PVCs in the survey expressed the view that provision from outside individual institutions would be welcome and ideally such training should be recognised formally or lead to some kind of professionally accredited status. Although **sigma**, through its conference and workshop provision, offers a range of CPD, it is beyond **sigma's** capacity, even with the current HEFCE funding, to operate a system of professional accreditation. However, **sigma** does seek to explicitly align much of the CPD it provides with the UK Professional Standards Framework (UKPSF, 2011) and this should assist individuals in seeking professional recognition through the different grades of fellowship of the Higher Education Academy.

The sustainability of mathematics support in individual institutions appears to largely be secure. Institutions recognise the value of mathematics support to their students (as indicated in Tolley and MacKenzie, 2015). Several institutions cite their mathematics support provision in their OFFA<sup>i</sup> access agreements and publicise the provision to potential students as an attractive marketing feature during the recruitment process.

What is more vulnerable is the wider community of practice and the sharing and mutual support that it offers. As one respondent to the evaluation survey, cited previously, put it *"It's great to have such a supportive network to tap into for advice and help. I find the support of the sigma network invaluable. It is like a big family."* In an attempt to maintain this supportive network, **sigma** is currently exploring the possibility of establishing an 'unincorporated association' whereby individuals and institutions will be able to become members of a formally constituted network with

individuals from across the community taking on roles within the network, such as Chair, Secretary and Treasurer, as part of their academic citizenship. This development is as yet in the early stages of planning, but it appears to be a promising avenue to explore and it is anticipated that further details will be available by the time the CETL-MSOR conference takes place in September 2015.

## 5. Conclusion

It is clear that the need for mathematics support in higher education is not going to disappear in the near future. It is also clear that over the last ten years much has been gained from the collaboration of mathematics support providers. The mathematics support community of practice that has developed during this time is, as has already been referenced, highly supportive and welcoming to new individuals and institutions. Despite governmental pressures towards the marketisation of higher education which have led to increased competition amongst universities, mathematics support has remained highly collaborative. This collaboration has not only been effective in enabling the expansion of the mathematics support community, it has also been efficient in that it has reduced the amount of duplicated work (for example, by promoting the sharing of resources across the sector rather than the reinventing of the wheel). The **sigma** Directors, the Chair of the **sigma** network and regional hub coordinators are committed to seeking to sustain the **sigma** network as a thriving community of practice into the future.

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<sup>i</sup> OFFA stands for the Office for Fair Access, the independent regulator of fair access to higher education in England. In order to be able to charge fees above the 'basic' level an institution must produce an Access Agreement outlining how it promotes fair access and have this Access Agreement approved by OFFA.